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AFFORDANCES OF ARBITRARINESS IN TRANSMODAL SEMIOSIS

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Arbitrariness is a linguistic principle proposed by Ferdinand de Saussure through his synchronic structuralist analysis of language. He delineates the structure of signs and establishes the absence of a necessary relationship between the signifier and the signified. Any such putative relationship is arbitrary. Whereas his theory discusses the arbitrariness in linguistic perception, this paper argues that there is significant arbitrariness between sensory modalities in object identification which affords experiments on sensory substitution projects.

Keywords: affordance, arbitrariness, haptisigns, vidisigns, semiotics, neurosemiotics, transmodality

The dilemma of arbitrariness was penned by Shakespeare romantically in the soliloquy of Romeo, "What is in a name? That which we call a rose by any other name would smell as sweet" (Shakespeare, 2003, Act 2, Scene 3). If changing names does not affect the objects they refer to, are the words intrinsically connected to them? Ferdinand de Saussure addressed this dilemma in language by the principle of arbitrariness (Saussure, 2011). Though Saussure did not invent this concept, he brought a systematic discussion on the topic and proposed it as a foundational principle of language (Lifschitz, 2012).

Saussure dealt with only one modality of sensation with two properties, hearing and speech. This paper enquires arbitrariness across sensory modalities. A more inclusive semiotic theory of Charles Sanders Peirce is also surveyed, and significant terminological and structural concepts of signs are borrowed from him. This paper refers to each faculty of sensation as

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a modality. Transmodality refers to the cross-wiring of sensory modalities. Arbitrariness in sensory modalities refers to a discretionary relationship between sensory modalities and object identification.

Saussuarian Antecedents

Saussure begins by accepting the principle that all words are signs. There is a long philosophical trail of theorizing words as signs. Signs are internal representations of external realities or other internal signs (O'Brien & Opie, 2004). Umberto Eco has scouted through the extensive literature on signs and the historical antecedents of the discipline of semiotics (Eco & Marmo, 1989). Charles Morris traces the theory of words as signs (Bronstein, 1947). Jia and Merleau-Ponty make a historical survey of linguistic signs (Jia, 2019; Merleau-Ponty, 1964). Over the centuries, philosophers of semiotics have either redefined or made nuanced understandings of what signs are. One of the earliest definitions could be of Augustine of Hippo, who defined sign as "something that shows itself to the senses and something other than itself to the mind. (*Signum est quod se ipsum sensui et praeter se aliquid animo ostendit*)" (as cited in Meier-Oeser, 2011). In principle, all philosophers on the topic agree that every word is a sign. Keller (1998) expresses it succinctly; every word in a dictionary stands for an object outside or inside the mind and therefore is a kind of sign. There is no meaningful word that does not stand for another thing or concept. In that sense, all language is but a metaphor.

Saussure dissects signs into a signifier (the sound image) and a signified (the concept). As in the diagram below, the signifier is the sound image of an arbor, and the signified is the mental concept of the arbor itself (Saussure, 2011). Therefore, arbitrariness consists of the possibility of changing the signifier without changing the signified.

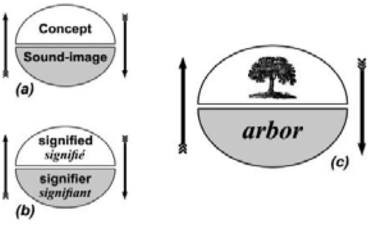

Figure 1. Signifier-Signified Dyad (Dylan, 2012)

The sound image of saying *tree* in English, *arbor* in Latin or *ped* in Hindi can still evoke the same concept of the tree in mind. Later, semioticians named the actual object (tree) a referent (Dietrich et al., 2007). The phenomenon of interchangeability of the signifiers is what Saussure calls the principle of arbitrariness. Arbitrariness can be represented in the following diagram.

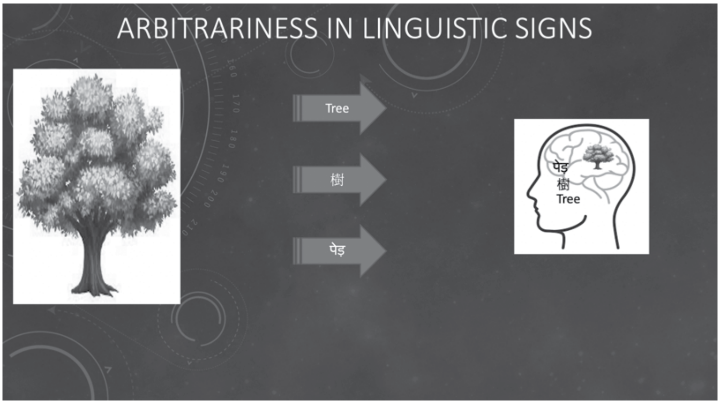

Figure 2. Multilingual Arbitrariness

In the diagram, speakers of English, Chinese, and Hindi use different words to evoke the exact meaning of the tree from the same referent. When these words are spoken or heard, a specific sound image or sensation is imprinted in the primary auditory system, which later evokes the percept of the tree in the listener's mind. Irrespective of the language used, if the listener knows the language listened to, a similar image of the tree is created in the listener's mind. The interchangeability of these sound images is at the root of the diversity of languages, according to Saussure. There is no necessary relationship between the external tree (the referent) with the name they are called by. A necessary relationship lies between the referent outside and the object image created in the brain to create meaning successfully.

Figure 3. Semiotic Process of Words

Arbitrariness in linguistics has been explored extensively (Dingemanse et al., 2015; Holdcroft, 1991; Lifschitz, 2012). Linguists and neuroscientists have taken three positions in general: (a) Those who deny arbitrariness. For example, Ramachandran argues that visual components and onomatopoeic substructures determine the choice of words (Anderson, 1998; Ramachandran et al., 2020); (b) Those who embrace arbitrariness (Jakobson & Hrushovski, 1980); (c) Those who concede arbitrariness in some cases (Burling, n.d.). The differences of opinions based on diachronics by those who deny arbitrariness do not dent the argument of Saussure who made a synchronic approach to linguistics.

Peircean Triads

According to Peircean morphology of signs, a sign consists of three components (a) sign vehicle (representamen), (b) an object, and (c) interpretant (Mertz, 1979; Peirce, 1992). Accordingly, the representamen carries a crucial signifying element by color, shape, texture, or another symbol if it is an internal representation that can evoke the meaning of the referent or the mental image of the referent. Peirce calls it the object. The understanding or perception about the connection between the representamen and the object, he calls an interpretant (Atkin, 2013).

Peirce proposes three ways a sign vehicle (representamen) can represent its object: iconic, indexical, and symbolic (Burks, 1949; Mertz, 1979; Peirce et al., 1994). By similarity, it is iconic; by causation, indexical; and by convention, symbolic. Considering the Peircean point of view, the symbolic category of signs is arbitrary and held by conventions, which would suffice to build this inquiry. So, this paper considers arbitrariness as foundational.

There is a categorization of the representamen, viz., qualisigns (Atkin, 2013; Peirce, 1992; Peirce et al., 1994). Qualisigns signify a referent by virtue of its qualia, like the color or shape. Thus, a representamen can appeal to an organism's visual, auditory, or tactile modality according to its qualities appealing to their respective modes of sensation. Accordingly, a diagram of a semiosis, according to Peirce, will look as follows.

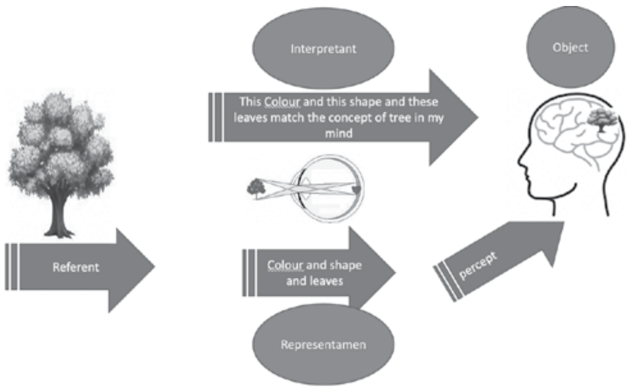

Figure 4. Visual Semiosis

The semiotic process of non-linguistic signs can be reconstructed as follows (see the diagram above). First, the tree appeals to the observer's eyes by its color, shape of the foliage, and trunk, which leave an inverted image, the signifier in the eye's retina. Then, this inverted image is broken down into electrochemical codes of the neurons as color intensities, lines, brightness, and shape, and travels to the visual cortex where it is identified as matching to the image of the tree in the mind.

The theory of Saussure was purely linguistics or semiotics of the auditory sensation (Saussure, 2011), whereas Charles Sanders Peirce deals with signs in general and naturally comprises all modes of perception. Combining Peirce and Saussure liberates the investigation from the linguistic constraints of Saussure to all modalities of sensations while experimenting with the principle of arbitrariness of Saussure. In the combinatorial mode, Peirce's representamen becomes the signifier and the object, the signified.

Figure 6. General Sensory Semiotic Process

Peirce has worked out an extensive taxonomy of signs. However, he leaves open-ended categories which need to be developed further. One such category is the aforementioned qualisigns. Qualisigns did not get the required attention in his later writings. This study has developed a glossary to engage with the representamen (hereafter signifiers) of different sensory modalities.

The qualia of an object, such as its color, shape, smell, sound, surface texture, and taste, appeal to different sensory organs. Color and shape appeal to the eyes, sound appeals to the ears, and taste to the tongue. The qualisigns are divided into six depending on what sensory organ picks up the quality of the signifiers.

1. Vidisign: a signifier appealing to the eyes of the interpreter is defined as a vidisign.
2. Audisign: a signifier appealing to the ears of the interpreter.
3. Tactisign: a signifier appealing to the tactile sensation of the interpreter.
4. Odisign: a signifier appealing to the nose of the interpreter.
5. Delisign: a signifier appealing to the taste on the tongue of the interpreter.
6. Haptisign: is a combinatorial signifier that involves a mixture of tactile and kinesthetic sensations.

More of these signs could be identified and named. But for this study, these primary sensory categories would suffice.

Arbitrariness is conceded to linguistic symbols. But the possibility of arbitrariness is not explored in other modes of perception. Can arbitrariness be attributed to haptisigns? Can two types of tactisigns end up creating the same mental image of the object, what could be called a tactile synonym? This question was humorously placed in an Indian story of five blind people getting to know an elephant. Each blind man touches one part of the elephant and creates a mental image of the elephant. On asking to explain the shape of the elephant, the one who felt the tail claimed that the elephant was like a broom, while the one who touched the leg said that the elephant was like a pillar ('Blind Men and an Elephant', 2021). The parable explains the dilemma of arbitrariness in other modes of perception. However, this intramodal arbitrariness is not explored in this study. Instead, the paper inquires if there is arbitrariness between different sensory modalities and what principles govern such trans modality.

Transmodality and Arbitrariness

Transmodality may be provisionally defined as the switching over of sensory modalities to arrive at the recognition of an object. There are different transmodal experiences, such as grapheme color synesthesia or number distance synesthesia (Ramachandran et al., 2020). Transmodality is slightly different from synesthesia. Synesthesia involves adding one more quality to the conventional sensory perception. For example, color or depth is added to the original percept of a number or the audisign of music. Transmodality, instead, refers to the perception of music through touch or sight with a total absence of the original auditory sensation. The transmodality question explored here is, "Can haptisigns, audisigns, or tactisigns create or refer to the same mental image or object in the mind?" For example, can a person who interprets the qualisigns of a tree's color, foliage, and shape identify the tree through any other modality of sensation?

A phenomenological observation of how the visually impaired navigate the world by enhanced capacities of other sensory organs or read Braille script invites an enquiry into the possibility of communication or compensation between the sensory organs.

By sensory arbitrariness, this paper refers to the possibility of producing or evoking a mental image created naturally by one sense organ by the efficiency of another, thereby achieving object identification. For example, audisigns create the mental image of the music. However, vidisigns of music notation also can create a mental image of the same music with some learning. Beethoven, Boyce, two deaf musicians could feel the music just by looking at the notations (Stokoe, 1972). Thus, sensory arbitrariness refers to the ability of the brain to functionally attain a perception naturally connected with one sensory modality with another (Sebeok, 1968). An arbitrariness may exist when spoken words are written, and the reader can produce the same mental images of the object created by the auditory sensation.

Unity of Object

A problem of transmodality raised by philosophers is on the unity of consciousness. The dilemma of the unity of consciousness comprises five large topics: subjective unity, neurophysiological unity, phenomenal unity, content unity, objectual unity (Brook & Raymont, 2021). What falls under this discussion is objectual unity in inter-modal object experience. Objectual unity can be simply rephrased thus: How does a person who sees a bird and hears its chirping recognize that they are both coming from the same object? There are two positions of the philosophers on the question. Following the psychological atomistic theory, all sensations are considered parallel, and there is no objectual unity to the experience (O'Brien & Opie, 1998). The other position claims that there is clear representational unity among the modes of sensation (Bayne, 2009). The question was paused differently to John Locke by W. Molyneux. Would someone born blind identify cubes and shapes with tactile familiarity on gaining sight by vision alone? Locke answered it in the negative; so did Berkeley ('Molyneux's Problem,' 2020).

Vidisigns cannot have a natural common perception with audisigns. For example, light and color against a piece of music. Light and color are sensed not by the brain but by the special receptor cells of light in the eyes and a bit of music by the listening apparatus of the ear that picks up airwaves. The object will have the properties proper to the qualisigns that evoke them. Object identification will occur by other sensory modalities but identified with the specific properties proper to the modality. A transmodal understanding of the referent with properties proper to another sensory modality will be a learned behavior, just like alphabet reading. There is a possibility for complete tactile or haptic transmodal experience of a referent if microsimulation of neurochemical frequencies of colors and light with their hues transmitted by the eyes is achieved. It requires more advancement in cognitive semiotics and neuroscience than is available presently. Hence, there is a temporary limit to the translation of the concept of arbitrariness. What can be substituted is an alternative understanding of the object in a modality proper to each sense organ.

A Cognitive Semiotic Approach to Arbitrariness

Molyneux's question boils down to transmodal arbitrariness. An answer to the question should come from interdisciplinary spaces since a philosophical enquiry cannot produce hard empirical proofs. The multidisciplinary space of cognitive science and neuroscience offers a comfortable positioning to enquire transmodality since precedence is set in combining these two disciplines with semiotics.

Since the 'cognitive turn' of enquiries in the 1950s (Thagard, 2020), semiotic philosophy has had a tradition of partnering with psychology (Smythe & Jorna, 1998), neuroscience (Deacon, 1997; Roepstorff, 2004), and biology (Sebeok, 1968). The emergence of cognitive semiotics as a discipline has encouraged productive enquiries into the neural foundations of all modalities of perceptions. Newer interdisciplinary enquiries combining semiotics and neuroscience keep producing newer specializations such as neurosemiotics (Bouissac, 1986), semiotics and microbiology called cellular semiotics (Galantucci et al., 2012; Roepstorff, 2004). So, this enquiry is typical and not novel.

The human experience is often multimodal. While a sound is heard, one also sees something connected to the sound. A bird chirps, and one turns the head in the direction and finds a cuckoo. Does the mind intrinsically connect the vidisign and audisign of the cuckoo, or are they learned behaviors from observing coincidental patterns? This problem of multimodality is also related to Molyneux's problem.

An experimental proof occurred accidentally, solving Molyneux's problem. After a corneal replacement surgery, a congenitally blind child was asked to identify visually the objects that it used to identify tactilely (Otrovsky, 2006). The child could not identify the objects at all. This discovery challenges transmodal arbitrariness fundamentally. What could be hypothesized about this inability to identify visually an object previously known with haptic familiarity? The mind picks up information about objects by qualisigns. The eyes, by the colors, brightness, and depth, while tactilely the qualia perceived are shape, contours, and temperature of the object. However, on gaining sight, the child learned to unify the tactisigns and vidisigns quite quickly (Held et al., 2011). What could be hypothesized about this transmodal problem, and how could it be overcome?

An object (referent) identification does not mean that the observer understands all the qualia of the referent. An observer understands only the modality-specific qualia of the referent. In multimodal experiences, additional qualia get added to the referent gained from the qualisigns of additional sensory modalities (Zangenehpour & Zatorre, 2010). So, multiple signifieds of the same referent can be added up to form a single signified. Once such patterns are created, it is difficult to unlearn such combinatorial perceptions or signifieds. Additional qualia of a referent are not recognized at the first instance of occurring without coincidental associations. To conclude the discussion on multimodal experiences, it is safe to say that there is a transmodal arbitrariness in referent identification. However, since the object in the memory is identified with the qualia connected with the available sensory modalities, transmodal arbitrariness is limited to those qualia.

What is the affordance that the arbitrariness of the sensory modalities offering in this situation? An object has multiple sensory appeals, which allows it to evoke multiple signifieds in the mind. Therefore, a functional understanding of the object can be achieved by alternative sensory modalities and alternative signifieds.

Bridging Semiotics with Cognitive Sciences

Bridging semiotics with cognitive science requires a biological retelling of the semiotic processes because part of all semiotic processes is biological, neurological, and physiological. From the time a referent interacts with a subject (the experiencing person), a signifier corresponding to the sensory organ is created, which is transferred through an electrochemical signal to the brain, a completely biological process. These signifiers are named as stimuli in cognitive sciences.

Stimuli are divided into the distal stimuli and proximal stimuli (Goldstein, 2009). In semiotics, distal stimuli are equivalent to referents, and proximal stimuli are equivalent to signifiers. When an observer is able to connect the signifier to the object or a signified, a percept, which Peirce calls the interpretant, is established. For example, the proximal stimuli with the mental image create a sign in Saussuarian semiotics. However, Pierce includes an interpretant to the signifier-signified dyad of Saussure and creates the Peircean sign, which is equivalent to perception.

The process of creating a mental image begins with the qualities of the distal stimuli, its color, shape, taste, smell, or temperature. Next, they reach lights of different wavelengths to the eyes, which are interpreted as colors in the eye, or as chemical properties that incite the body's taste or smell or heat receptors, which are interpreted to arrive at object recognition or identification of the referents. Distal stimuli identified as such by their qualities are the aforementioned qualisigns (Atkin, 2013).

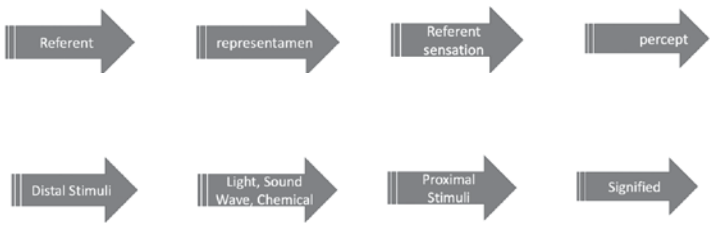

Figure 7. Peircean Semiotic Process in Comparison to Cognitive Science Narrative

The sensory organs comprise a group of interrelated specific receptor cells transducing the referent image into electrochemical codes. Among other animals, we find receptor cells for ultraviolet rays, magnetic receptors, or thermal image receptors (Smith, 2008). Electrochemical signs transduced from external stimuli are processed through the eyes, ears, tongue, nose, and skin, primarily lead to referent recognition. These signs represent the world outside for the brain to understand and make sense of them for the organism's survival in very complicated ways. In every semiotic process happens a cellular level semiotics (Roepstorff, 2004).

The senses are connected to specific cortices of the brain where the electrochemical codes are deciphered, and referent recognition happens. Thus, researches in language have reached localizations of the linguistic processes. Broca's and Wernicke's Areas have been long identified as primary semantic and syntactic regions of the brain. They have magnetized neurolinguistic investigations, not only from neuroscientists like Ramachandran (Ramachandran et al., 2020) but also from linguists like Chomsky (Berwick et al., 2013; Chomsky, 2000; Ramachandran et al., 2020). The interdisciplinary approaches began to ground the language processing in the brain rather than in the mind. That pattern of localizing mental functions in the brain revolutionized many philosophical investigations, though objections to this approach are not uncommon (Rieber & Wollock, 1997).

In the case of tactile semiosis, electrochemical codes carrying the contours and texture of the surface of an object are carried to the postcentral gyrus of the parietal cortex (Deibert et al., 1999; Lederman & Klatzky, 2009). The signals are deciphered there, and the referent is identified. In addition, there is a neural pathway lying between the sensorimotor cortex to the visual cortex (Reed et al., 2004; Sathian, 2016). Such cross-wiring between sensory cortices helps in adding up the qualia and lays the foundation for arbitrariness between sensory modalities.

In a scenario of visual sensory input deprivation, a blind person feels a pen. The signifier falls under tactisigns. The blind person perceives that the referent is a pen. Thus, what could have been a visual perception is achieved through tactisigns. However, the signified of the pen in a blind person will be different from the signified of a person who can see. As mentioned earlier, a referent can be perceived through different modalities. The Braille script is successful for blind people because of this possibility. So, the transmodal arbitrariness allows a functional signified in the perceiver through different sets of signifiers.

Transmodal perception is used extensively by technology. For example, a pilot knows the temperature of the aircraft engine by a dial in the cockpit. The natural sensory modality of heat is the thermoception of the skin. It is converted into a dial in the cockpit as a transmodal vidisign. Transmodality of sensation is often referred to as sensory substitution. In sensory substitution, the characteristics of one modality of sensation are substituted by signifiers of other modalities. For example, in a visual to auditory substitution, a machine can speak out a visual element such as the color of an object. Sensory substitution experiments were started as early as the 1960ies by Bach Y Rita (Bach-Y-Rita et al., 1969). The latest advanced experiments in this line are done by David Eagleman (2014). These sensory substitution experiments are founded on the plasticity of the brain. The ability of the brain to adapt to new experiences is called neural plasticity or brain plasticity (Fuchs & Flügge, 2014). The brain gets modified structurally or functionally with each learning experience or injury (von Bernhardi et al., 2017).

Studies in the neurostructural changes of persons with sensory deprivation shed further light on the transmodal arbitrariness argument. Though sensory systems are more or less independently wired, experiments on neural systems have proved that there are neural pathways between the somatosensory cortex and auditory cortex to the visual cortex (Deibert et al., 1999; Ramachandran et al., 2020). But, beyond establishing neural pathways to the visual cortex or the language-processing areas of the brain, in scenarios of sensory loss or congenital blindness, whole cortical regions have been found recruited for augmenting the function of the functional sensory modalities (Tomasello et al., 2019; Zangenehpour & Zatorre, 2010). Thus, for example, the underutilized visual cortex in a blind person has been found recruited (Müller et al., 2019; Tomasello et al., 2019) for sorting audisigns or tactisigns. This explains the heightened compensatory sensitivity (Chinnery & Thompson, 2015; Macdougall & Rabinovitch, 1971) of the other sensory modalities in a blind person.

Neural plasticity and cortical recruitment for augmenting functional sensory modalities indicate the interchangeability of signifiers or transmodal arbitrariness to identify the same referent. It explains how braille readers read accurately with tactisigns. However, tactisigns have a limitation in completely getting translated from vidisigns since they are limited to the reachability of the limbs. In this scenario, the referents appealing to the eyes should be converted into tactile signifiers. As an example, a cloud has no possible alternative qualisigns as signifiers. Converting vidisigns into tactisigns is required to create the signified of the cloud. It is possible to say 'cloud' simply. But it is difficult for the auditory system to be overwhelmed with continuous auditory cues while it is already being used for the regular auditory functions. Therefore, an alternative modality to audisigns is required. Haptisign is an alternative.

Conclusion

There is a neurological cross-wired infrastructure for transmodal arbitrariness in the brain. But there is a modality constraint in the arbitrariness, which can be overcome by advancement in experimental semiotics and neuroscience. The qualia of a referent proper to one sensory modality cannot be naturally processed by other modalities of sensation but can be acquired by training.

Specialized rods and cone cells of the eyes decipher colors, brightness, and other visual data. From the eyes run coded data about light, shape, lines, color, and spatial positioning through optical nerves to the visual cortex. Switching the neurochemical compositions and frequencies that represent light, shape, etc., in the visual neural system accurately into tactisigns require more advancement in neuroscience and bionics than currently available.

If cortical recruitment and reassignment of the visual cortex have already taken place in the case of congenital blindness, the visual cortex will not respond accurately and entirely to the later restoration of the ocular impediments. The phenomenon invites further experiments on transmodal vision substitution.

Further enquiries are required to establish if enhanced sensitivities of the functional sensory modalities are due to the availability of the recruited cortical areas of the dysfunctional sensory modalities for refining the functional modalities or if the cortical regions of the dysfunctional modalities use their specialized neural structures to augment the functional modalities with unconscious perception.

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