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FROM NEUROSCIENCE TO ETYMOLOGY, AND BACK: RECONSTRUCTING 'PROTOSYNAESTHESIA' FROM LANGUAGE

Simona Georgescu

Abstract

I focus on the relationship between sensory perceptions, as it is reflected in language. I provide a comprehensive theoretical framework, which includes an overview of the latest neuroscientific research on the connection between the two main sensorial modalities (in humans), sight and hearing. I then offer a crosslinguistic perspective on the verbalization of this relationship, both in synchrony and diachrony. By showing that many words that denote a visual impression stem from lexical roots expressing an acoustic sensation, we propose a closer evaluation of several Indo-European etymological families related to the semantic field of 'brightness'. I observe that many lexical roots that have been artificially separated into two or more homonymic stems because of an apparent semantic incompatibility actually go back to a common origin, namely the verbalization of a sound, and have followed recurrent patterns in their semantic evolution towards the designation of a luminous phenomenon. This approach could provide new insights in the role played by synaesthesia in language evolution.

Keywords: Historical linguistics, neuroscience, etymology, synaesthesia, Indo-European languages.

1. Introduction: aims and methods

In the *Eudemian Ethics* (1245b, 24), Aristotle speaks of συναίσθησις as a 'shared sensation or perception' between friends, the capacity of 'feeling together', in line with what we call today 'empathy'. This meaning was to remain the main acceptation of the term συναίσθησις throughout Classical and Late Antiquity. Nonetheless, in *Historia animalium* (534b, 18) Aristotle uses the same word to refer to the ability of cephalopods, crustaceans and insects to perceive simultaneously by sight, smell and

taste. It is this meaning that was to make a career in modern languages, albeit with various specialisations, depending on the cultural and scientific perspective.

The concept of 'synaesthesia' has been explored in literature (cf. Engstrom, 1946; Skard, 1946; Lynne Duffy, 2013), studied from a psychological perspective (Simner & Hubbard, 2013), probed in its relation to language (Ullmann, 1957; Miller, 1976), and only recently observed by neuroscientists and increasingly prospected as an innate mammal feature (cf. Gazzaniga *et al.*, 2015: 215-223). Thus, in recent years it has been possible to demonstrate, through empirical research, that perceptions are fluctuating, intertwined in different areas of the brain, and that this biological structure influences our understanding of the world.

The hypothesis put forward here is that this reciprocal influence between perceptions manifests itself in language from the earliest documentation of Indo-European languages, and that it can be reconstructed for Proto-Indo-European, allowing us to outline the notion of 'protosynaesthesia'.[1] In order to circumscribe the subject, allowing for an in-depth analysis, I shall focus on the interference between sight and hearing – the two main modalities in the human hierarchy of senses (cf. Viberg, 1984) – and its reflection in words related to light phenomena ('shine', 'bright') in Indo-European languages.

The implications of such a research subject are twofold and bidirectional. On the one hand, by better understanding how the brain functions, it will be possible both to establish more precisely the genetic relationships between words and to trace back the pathway of a word whose origin is unknown. On the other hand, by establishing a sufficiently consistent inventory of words following a similar conceptual pattern underlain by the connection between brain modalities, we will perhaps be able to return the benefit to neuroscience: thus, while so far the brain's crossmodal features have been studied using invasive methods on animals in particular, plus a few one-off experiments on humans (see §2.3.), language – as the expression of thought, and therefore, to some extent, of the brain – has not been considered. I advocate the study of language as a tool for delving into cognitive functions, while linguistic evolution may parallel certain changes in the human perceptual paradigm.

Quoting an observation that seems self-evident today, 'language would not be this way were it not for the way our minds are' (Enfield, Kockelman & Sidnell, 2014: 11), it should be pointed out that the reciprocal also applies: our mind would not be the same if it had not been for language

to shape our cognition and refine our thinking. Therefore, the analysis of language and the survey of the mind can equally shed light on each other. In Evans and Green's terms (2006: 5), 'language offers a window into cognitive function, providing insights into the nature, structure and organization of thoughts.'

Evidence from neuroscience (Coulson, 2017), neurolinguistics (Bauer & Just, 2019; Brennan, 2022) and cogitive linguistics (Lakoff & Johnson, 1980a) highlights the degree to which our mind and, consequently, our language are conditioned by our bodily functions. The evidence we hold mostly relies on contemporaneous data, on scientific studies made on the brain during the last two decades, and – for cognitive linguistics – on synchronic uses of language. Nonetheless, the relationship between mind and language cannot be fully understood if we limit ourselves to a purely synchronic view.

However, a 'diachronical neuroscientific' perspective would be difficult to attain, given that the brain does not fossilize. Therefore, we have no archaeological information about what the inner structures and neuronal systems looked like in the human brain even two millennia ago, let alone two million years ago (cf. Martínez & Arsuaga, 2009; Balari *et al.*, 2013). We do not know how our ancestors' cognitive mechanisms worked. Thus, we can only rely on the one thing that becomes tangible and that preserves our thoughts, namely language. As a tool used without interruption[2] for communicating human life (both inner and external), it is the only immaterial element that can be reconstructed with fairly high scientific accuracy. Therefore, by analysing language, we can infer information about the prehistoric speakers' physical, social and spiritual environment[3], and equally, we can get a glimpse of how their cognitive mechanisms functioned and combined across time.[4] In other words, if we use linguistic expression as a mirror, we can explore not only how our ancestors saw the realities that surrounded them through their own 'glasses', but we can also prospect the 'glasses' themselves.

It is my understanding that an 'archaeology of thought' (as, perhaps, a subdomain of linguistic palaeontology[5] or linguistic anthropology[6]) needs its own tools. Our approach should thus stem from the methods used in historical linguistics, namely comparative grammar – reconstruction (Meillet, 1925). This method consists of inferring protoforms (reconstructed ancestral words, normally in non-attested languages) from their reflexes (related words in attested cognate languages), based on the assumption of regular sound change. Further, from protowords one can derive significant

information about the protoconcepts that underlie these words. In the present study, I shall focus on the protoconcepts that are more likely to be closer to original human cognitive mechanisms because they are sensory-related. In other words, within what I call an 'archaeology of thought', I propose to distinguish an 'archaeology of sensory perceptions'. I thus try to use the same methodological principles used in protoword reconstruction in order to reconstruct the relationship between senses, mirrored by language. Therefore, this study can be considered a search for protosynaesthesia, just as it is encapsulated in etymology.

The structure of the article is designed to take a methodical approach to the issue: in the first part I aim to set out briefly the theoretical foundations of the problem, bringing together perspectives from different fields – cognition, linguistics, neuroscience; thus, the aim is to understand and describe the cognitive mechanisms at work, on the one hand, in the process of understanding and interpreting reality, and, on the other hand, in translating this interpretation into language.

The critical data for evaluating the theories exposed are, nonetheless, linguistic data. Thus, in the second part of the study, the theorized concepts will be validated by a crosslinguistic sample of words reflecting the cognitive mechanisms under consideration. I shall focus more closely on the Indo-European etymological clusters that manifest the cognitive-perceptual phenomena of interest. Through this approach, I intend to corroborate the – still scarce – information from neuroscience, by observing how the connection between different brain areas emerges in language.

These two foundations – theoretical and empirical – will afterwards require a reanalysis of various Indo-European roots whose lexicographic interpretation does not meet the conceptual criteria identified. The new survey will lead to the proposition of a reorganized structure of certain etymological clusters. This third part will represent my concrete contribution to etymology.

Thus, my research is primarily oriented towards the delineation of a comprehensive theoretical framework, by confronting scientific fields that are not generally analysed together, but whose synchronization can highlight new and useful elements in each of them, opening the way to more in-depth analyses in one direction or another. Secondly, the application of validated theoretical notions to Indo-European languages will allow for substantial etymological advances.

From a focused linguistic point of view, relationships between perceptions become essential first and foremost to answer the question of whether language emerged as a great process of synaesthesia, as Ramachandran and Hubbard (2001) propose. According to Nobile and Lombardi Vallauri (2016: 13), 'l'intera questione dell'origine del linguaggio può essere pensata nelle sue prime fasi come un grande fenomeno di sinestesia o transmodalità, incentrato sulla possibilità di "tradurre" diverse forme di motorietà e sensorialità in termini fonoarticulatori e uditivi'. I do not pretend to reach a conclusion about this difficult question by this single study, but I aim to bring a few more details that can be further used to better understand language in close relation to the mind.

2. Theoretical background

2.1. The brain in the body: the embodiment theory

Language expresses concepts just as they are shaped in the speaker's mind rather than as objective entities of the external world. Such concepts, as first shown by Lakoff and Johnson (1980b; 1999), emerge from the very nature of our brains, bodies, and bodily experience. The two linguists assess, against a long philosophical tradition, that reason is not 'a transcendent feature of the universe or of disembodied mind'; on the contrary, it is 'shaped crucially by the peculiarities of our human bodies, by the remarkable details of the neural structure of our brains, and by the specifics of our everyday functioning in the world' (Lakoff & Johnson, 1999: 15).

Biological research on the brain (Feldman, 2006; Coulson, 2017) renders indisputable the fact that reason has developed merely from human sensory and motor systems and that it uses the same mechanisms and circuits as its functional basis. As Johnson (1987) puts it, 'our thinking systems are typically based on our sensory, motor, affective, and interpersonal experiences and cognitive capacities, all of which involve our embodiment.' In other words, it is common sensations, usual movements, and purely physical contact with the environment that shape our perspective on reality. According to Lakoff and Johnson (1999: 15), 'to understand reason we must understand the details of our visual system, our motor system, and the general mechanisms of neural binding,' because our reasoning, be it basic or abstract, 'requires mechanisms of

neural computation used for other purposes and adapted to thought and language' (Feldman, 2006: 8).[7]

A plain example of how our mind interprets the world in an embodied manner is the way in which language resorts to comparisons with human body parts to give names to non-human elements: we speak of the 'foot of the mountain', the 'shoulder of the hill', the 'arms' or 'mouth of the river', etc. A more abstract level of embodiment can be found in expressions such as 'arms of the galaxy', 'eye of the storm', or 'heart of the engine'. Furthermore, our tendency of projecting the basic movements and actions of our bodies onto mental processes underlies our understanding of intellectual or abstract activities in general: e.g., 'we embrace a theory', 'steal someone's idea', or 'step on someone's pride'. These expressions are synchronically transparent, but the same cognitive processes uphold diachronic semantic conversions, which have lost their transparency: e.g. the Romance verbs meaning 'to understand', Fr. *comprendre*, Sp. *comprender*, originate in Lat. *comprehendere* 'to embrace'; Sp. *entender*, derived from Lat. *intendere*, is also based on an embodiment-grounded comparison between a hand reaching out to grasp an object and the mind reaching out to grasp an idea. Even mental processes that imply a high level of abstract thinking stem from the simple motor functions of our body: understanding consecutive numbers as a string of objects, moving from one number to another as in a spatial displacement, perceiving historical events in a determined spatial order, or, in general, perceiving time as a horizontal axis along which our past and future unfold as we 'advance' in life, are all examples of reasoning anchored in embodiment. Yet, we are so accustomed to this way of interpreting abstract, non-spatial concepts in terms of purely spatial movement, that we do not even realize that our mind uses its motor functions to order abstract categories.

These observations that form the basis of the embodiment theory are strengthened today by the findings of neuroscience, where neuroimaging research reveals the involvement of perceptual and motor systems in conceptual tasks (Coulson, 2017; Bauer & Just, 2019). It is this fusion between empirical neuroscientific research and theoretical linguistic studies that led to the following statement (Lakoff & Johnson, 1999: 44):

> The embodied-mind hypothesis therefore radically undercuts the *per*ception/*con*ception distinction. In an embodied mind, it is conceivable that the same neural system engaged in *per*ception (or in bodily movement) plays a central role in *con*ception. That is, it is possible that

> the very mechanisms responsible for perception, movements, and object manipulation could be responsible for conceptualization and reasoning.

This assumption is essential to my investigation. The act of perceiving external reality through the senses is closely – indeed, physically – linked to a 'higher' instance, that of conceptualisation. The two acts cannot be separated, but occur at the same time. It must be borne in mind that there is an intimate relationship between physical perception (in our case, sight and hearing), the transposition of that sensation into a concept, and the mental association that can generate a set of meanings.

2.2. Synaesthesia

The embodiment theory leads to a re-evaluation of the notion of 'synaesthesia'. I use the term *synaesthesia* here in its basic etymological meaning, as 'association between senses'[8]. As indicated, concepts are shaped in our minds through senses, which allow for the translation of the external world in internal terms. In what follows, I shall make some observations on synaesthesia in its relation to language, more specifically, on how the association between senses is reflected at the surface level of linguistic expression. In the next section we shall delve into the field of neuroscience to see how this coactivation of different sensory perceptions can be scientifically explained.

The most obvious implication of synaesthesia for language is the tendency to express one sensation in terms of another: e.g. *sharp sound* (tactile + acoustic), *sweet voice* (gustatory + acoustic), *loud colours* (acoustic + visual) or *sharp smell* (tactile + olfaction). This has led to its interpretation as a type of metaphor. In broad terms, it is indeed a metaphor in the etymological and primary sense of the word (Gk. μεταφορά, lit. 'transposition'), because it does represent a transfer between two conceptual domains, namely the description of one concept in terms of another. It was only with the book *Metaphors we live by* (Lakoff & Johnson, 1980a) that linguists stopped analysing metaphor as a figure of speech, intended and used solely for stylistic embellishment, and started to interpret it as an unconscious recourse, more precisely, a method of expression resorted to out of necessity, not out of a purely expressive intention. In the case of the expression of synaesthesia in language, the bodily basis is even more clear. The perceptual modalities are so interrelated that the transfer between them is natural, anatomically explainable, as we shall see (§2.3).

Interesting cases from a linguistic point of view are those in which the source modality has lost its prominence and the word has come to refer exclusively to the target modality, leading to a semantic change: e.g. Lat. *nitidu-* 'shiny' (involving the sense of sight) > Rom. *neted* 'smooth' (perceptible by the tactile sense); Lat. *acru-* 'sharp' > Rom. *acru* 'sour', etc. The fact that we tend to express the characteristics of one sensation in terms of another actually reflects this network of permanent neural connections, a strong biological binding that will be explained in the following paragraphs.

2.3. Synaesthesia in neuroscience

Let us start with a basic example. When we hear a sound, we are able to imagine what provoked it – our brain instantly recreates the event and evokes the properties of the object implied; we do not just analyse the sounds separately from their cause, but we actually recreate the context: this ability translates our brain's capacity of creating images starting from sounds. If, for instance, we hear a *bang*, we can instantly tell from the quality of the sound that there were probably two cars crashing, rather than a peal of thunder or a gun-shot. When we hear a sound like *plump*, we can automatically infer the features of the falling object – its dimensions, its weight –, and those of the material receiving it.

Thus, from the characteristics of auditory perception we instinctively determine many non-auditory characteristics of the events and objects involved. Actually, the ability to distinguish events from the sounds they make is part of the evolutionary adaptation of (at least) all vertebrates. When language emerged in humans, the one thing we know is that there was a very basic form of synaesthetic 'device' at work, the one that makes the connection between acoustic forms and visual forms: this must have been the primary form of synaesthesia – in our terms, protosynaesthesia – and still is the most prominent sensorial association[9] (Allott, 2001).

In what follows, we shall take a look into the biological basis of the coactivation of the visual and auditory modalities, through the survey of the most recent studies in the field of neuroscience concerning this interplay between perceptions.

It has long been considered that each brain area responds to only one kind of perception, being modality-specific, and that these areas are strictly delimited from each other. However, in the last two decades there has been 'something of a revolution in multisensory research' (Driver

& Noesselt, 2008), due to the observation, supported by an increasing number of studies, that there is a strong connection between different senses, detectable in various brain regions. The existence of numerous multisensory convergence zones in the brain (that is, brain regions where neurons receive afferent inputs from multiple senses) was previously known (Driver & Noesselt, 2008), but more recent studies show that the interplay between different senses also affects brain regions that were traditionally considered to be sensory specific (*i.e.* concerning only vision or only hearing or only touch, *etc.*), while also influencing neural responses and perceptual judgments.

The past few years have seen an increasing research interest in the cross-modal capacity of the human brain, although in order to reach concrete results a significant part of the experiments were conducted on non-human subjects. For instance, experiments on ferrets showed that multiple visual cortical fields innervate the auditory cortex (Atilgan *et al.*, 2018), which means that visual stimuli influence the way sounds are perceived, by enhancing the sound that corresponds to a specific visual stimulus from an amalgam of sounds. By analysing multimodal stimulation in prairie voles, Campi *et al.* (2010) observed the outstanding predominance of auditory responses when the visual area was stimulated, which, corroborated with studies in other mammals, seems to indicate that multisensory inputs are integrated at a basic level of cortical processing, and this basic integration 'may be a general feature of organization shared by all mammals' (Campi *et al.*, 2010). Moreover, both monkey and human studies have shown that primary cortices also respond to stimuli from other modalities (Driver & Noesselt, 2008), mainly revealing direct anatomical connections between the auditory and visual areas of the brain (Beer *et al.*, 2011).

Moving forward, experiments on human subjects were initially focused on blind and deaf people, and the results are essential for us, because they attest to parallel crossmodal responses: in blind people, auditory stimuli elicit consistent activity in the visual cortex, creating visual images in the brain (Klinge *et al.*, 2010). Just as there has been reported a 'widespread auditory network toward visual areas in the blind' (*ibid.*), studies on deaf subjects point out the processing of visual stimuli in the auditory cortex, translated into the creation of virtual sounds from purely visual stimuli (Finney *et al.*, 2002). The evidence for crossmodal plasticity in deaf and blind subjects attests to the strong connection between these two cortical areas as an inherent characteristic of the brain.

Further imagistic studies on non-impaired subjects have revealed 'the existence of direct white matter connections between auditory and visual cortex' (Beer *et al.*, 2011), which constitutes strong evidence for direct structural connection between the two brain areas.

Additional research on humans exposed to light stimuli simultaneous with auditory stimuli has registered the bidirectional influence of the stimuli addressed to one modality on the cortical area responsible for the other modality: concretely, it has been observed that auditory stimuli can reset or evoke oscillatory responses in visual brain areas (Naue *et al.*, 2011), while visual stimulation can definitely change the auditory interpretation of an acoustic stimulus (see the already classic McGurk effect, cf. Gazzaniga *et al.*, 2015: 215). This supports the idea – essential for our further reasoning – that stimulation of sight triggers an auditory response: this means that our brain not only creates a virtual visual image from the interpretation of a sound, but also creates a virtual auditory scene to match the visual scene.

It has, furthermore, been observed that visual oscillatory activity and auditory stimulation are reciprocally influenced by each other, mostly because an oscillatory light phenomenon is perceived as a movement (Naue *et al.*, 2011). It is primarily movements that are interpreted in terms of sounds (see below, §4), as a result of our mind being accustomed to hearing a sound when it sees a movement. We must bear in mind, for the subsequent demonstration, that oscillatory light is interpreted by our brain as motion.

Together these data provide a biological explanation for the recurrent correspondence between lexical meanings referred to these two modalities. It is also important to notice that, according to most of the studies cited above, it is most probable that the sensory binding between sight and hearing normally occurs within the auditory cortex. This piece of information leads to the conjecture that visual data are being interpreted and processed by the brain area responsible for the acoustic sense, which triggers the conclusion that, for instance, oscillatory light phenomena are automatically transformed into sounds.

It is worth mentioning that studies both on animals and humans have registered a relation between sound intensity and luminance.[10] The association between brightness and loudness was observed and explored by Marks (1974), whose results 'mimic those of synaesthesia and suggest that most subjects may match auditory to visual brightness,' leading him to assert the existence of 'psychological correspondences between light

and sound.' The more recent study by Atilgan *et al*. (2018) leads to the already outlined conclusion that there are similar instances to measure the two different modalities discussed, and the intensity of one sensorial impression triggers an equivalent intensity in the perception of the other stimulus.

Although these observations may seem significant enough to draw certified conclusions concerning synaesthesia, studies in this field are still in their infancy and many unknowns remain.[11] It is, thus, reasonable to assume that a perspective from another field may provide new information either supporting or refuting certain conjectures, while shedding additional light on certain issues and opening new pathways of research.

In §3 we shall see how the relationship between the auditory and visual senses is reflected in different languages. Before that, a few clarifications are necessary regarding semantic change from a cognitive point of view.

2.4. Meaning change as a mirror of cognitive shifts

Since mental processes are mirrored, as previously mentioned, in language, so should most changes in our cognitive structure be.[12] These changes are interpreted in linguistics in terms of semantic shifts, which in the last three decades have begun to be thoroughly explored, precisely in the attempt to understand how the human mind works (Blank, 1999; 2000; Blank & Koch, 1999; Koch, 2000, *etc*.).

Until the cognitive perspective on language emerged, by the end of the twentieth century, it was generally believed that, unlike the apparent regularity of phonetic change, semantic evolution lacked any rules. Given this bias, many of the etymological analyses that rigorously pay attention to the phonetic criterion fail precisely because they place semantic aspects in a marginal position (cf. Georgescu, 2021b: 15-19). It is true that ever since the early twentieth century, it has been noted that meanings do not change in a completely random, chaotic way, but that similarities can be identified either in the semantic evolution of words designating the same concept crosslinguistically, or in the denomination strategies used regardless of time and space. From Lakoff and Johnson (1980a) to Traugott and Dasher (2002), it was emphasized that the laws governing language are ontologically linked to the categorial system of the human mind.

If we interpret in linguistic terms the above-mentioned example of Lat. *comprehendere* 'to grab from all sides, to embrace', we would say that it has changed its meaning in Fr. (*comprendre*) and Sp. (*comprender*) to

'understand'. Precisely because it is a change that stems from the fact that our brain is embodied (see above, §2.1), we should not be surprised to find the same change in the evolution of other verbs, such as: Lat. *capere* 'to grab' > It. *capire* 'to understand', Gk. καταλαμβάνω > M.Gk. καταλαβαίνω 'to understand', Germ. *begreifen*, *fassen*, Eng. *grab*, *grasp* (an idea), *etc.* (*cf.* Georgescu, 2020)[13].

Such examples suggest that semantic evolutions are not plain accidents, but actually follow certain patterns, recurrent in most cases, because 'ultimately rooted in our shared human cognitive make-up' (Evans & Wilkins, 2000: 547).

We should also bear in mind that the evolution of meaning follows a unidirectional trajectory, in the sense that the better-known concept is the one that encompasses the lesser-known concept and gives it its name: it is more likely that the concrete meaning of 'grasp, embrace' would acquire the abstract meaning of 'understand', than vice versa. This direction is typologically recurrent, given that it stems from universal human experiences, which implies that 'there must be some overarching principles' of semantic change (Traugott & Dasher, 2002).

3. Lexical interferences between 'sight' and 'hearing'

On the basis of his survey of more than fifty languages from different families, Viberg (1984) showed that there is a strong typological tendency for verbs expressing a modality higher in hierarchy to extend their semantic area towards other modalities, lower in hierarchy, thus in the following order: sight > hearing > touch > smell/taste. As stated in his analysis, verbs expressing visual perception will be able, crosslinguistically, to cover also auditory perception (and sometimes touch): for example, in Swahili, the verb *onekana*, derived from *ona* 'see', can be used for sight, hearing, and touch; in indigenous languages both in Australia and in the Caucasus, the verbs for 'hear' are formed on the basis of a verb meaning 'to see'; moreover, the passive form of 'to see' is used to refer both to sight and hearing in Korean and Luo (Viberg, 1984: 140-141).

Several other cases of colexification[14] of these sensory perceptions, mostly in Australian languages, are discussed by Evans and Wilkins (2000): *e.g.* in Yir Yoront, the verb *karr* covers the two modalities discussed, as does the lexeme *nhaamaa* in Guugu Yimidhirr, *etc.*

My own independent crosslinguistic survey of verbs expressing the concepts of 'see' or 'hear' shows, in not a few cases, a clear colexification of the two sensory perceptions. According to the data stored in Lexibank (https://lexibank.clld.org/)[15], there are nine languages from different families – indigenous languages from Australia, South America, Africa and Papua New Guinea – that reflect this direct sensorial association: *e.g.* in Kuku Yalanji (North-East Australia), the verb *nyajil* means both 'to see' and 'to hear'; in the Central African language Kimgunga, the verbal root *ku* is also glossed with both meanings, *etc.*

Focusing on the Indo-European family, we find significant semantic evolutions from Proto-Indo-European to the Indo-European languages that transparently reflect the strong link between the visual and the auditory perceptions: PIE **(s)keuh-*, whose meaning has been reconstructed as 'to see', engendered both English verbs *show* and *hear*, along with Gk. ἀκούω 'to hear'. Beyond the multisensory binding discussed above, there is a concrete case where the functional interplay between these modalities becomes clear, namely in the Latin descendant from the same root, *custos* 'watchman' – who must equally use his auditory and visual senses. Another example is that of the stem **au- / auei-*, with the reconstructed meaning of 'perceive, understand' (although, typologically speaking, it is unlikely that the original meaning was abstract and general: normally the direction of evolution is from concrete to abstract): its descendants either verbalize a meaning referring to sight (Hittite *aušzi* 'sees', Avestic *aviš* 'apparent, obvious', Persian *aškar* 'clear, bright), or express the concept of 'hearing' (Lat. *audio*, Gr. αΐω, 'hear').

These preliminary linguistic data help to strengthen the hypothesis that our neural structure involves a direct communication channel between the two brain areas responsible for sight and hearing. The cases of colexification of the two concepts are merely a consequence of our mind's embodiment.

4. The relation between 'movement', 'light', and 'sound: crosslinguistic evidence

As I have argued above (§ 2.3), our brain interprets visual aspects, like oscillatory light phenomena, in terms of motion and recreates the corresponding virtual sounds. As early as 1923, Jespersen observed that 'because a sound is always produced by a movement and is nothing

else than the impression left by that movement on the human ear, this movement that causes the sound can be expressed in turn by the word used for the sound (e.g. *bubble*, *splash*, *crack* etc.).' He adds: 'even when the movement does not cause a loud sound, the sound is used to describe the movement, e.g. *flutter, flow, slip, glide*.'

These observations, mainly based on Hilmer's works (1914; 1918), are in no need of demonstration. On the one hand, we are perfectly aware that there is a natural tendency to give linguistic expression to a natural sound, by making use of the phonetic system that each language has. It is what we understand by *onomatopoeia* ('a word that imitates natural sounds'), including here not only words like *cuckoo* or *cock-a-doodle-doo*, but also lexemes that reproduce the sound made by a blow such as *bang*, *bump* or *dump*. On the other hand, there is an equally universal tendency (attested crosslinguistically and diachronically by Georgescu, 2021b) to refer to the movement that produced the sound by using the very onomatopoeia created to render the sound. To give just a few examples from English, *pat*, originally an onomatopoeia expressing 'a sound produced by a light stroke', results in the verb *to pat* 'hit or strike' (OED_2). The same evolution as taken place in the cases of *tap* 'to strike lightly', *plump*, *huck*, *knack*, *knock, crack*, *etc*. (for more examples, see Hilmer, 1914; Georgescu, 2021b).

As previously shown, light phenomena are perceived as movements and are therefore also interpreted and processed in the auditory area of the brain. In other words, the auditory cortex reacts as if it has received an acoustic stimulus from the gleaming or glittering light. Therefore, in order to describe this kind of phenomena, speakers will instinctively use words that originally expressed sounds produced by movements. In what follows, I shall offer a crosslinguistic perspective on the lexical correspondence between light and sound. This cognitive relationship can be identified in language either synchronically, as colexification, or, more often, diachronically, one meaning having evolved from the other.

It has been noticed that words expressing visual phenomena are expressed by onomatopoeias in various languages (*cf*. Focșeneanu, 2006). For example, the Dravidian language Kota describes the 'visual sensation caused by flames burning brightly' by the onomatopoeic word *dagdagn*, while in the same language, *bagbagn* means 'to burn with great flames' (Emeneau, 1969, *ap*. Focșeseanu, 2006); the Malayo-Polynesian language Kambera expresses the concept of 'glimmering' by the transparent onomatopoeia *jila*, and 'to glow' by *bila* (Klamer, 2000,

ap. Focșeneanu, 2006). Japanese provides a consistent list of words of transparent onomatopoeic origin referring to different types of visual impressions produced by light and its reflection on various surfaces: e.g. *giragira* 'to shine' verbalises the sunlight reflected in the water, mostly of the setting sun, while *kirakira*, whose translation in English would also be 'to shine', and which also renders the glow of light reflected in water, is rather used for bright morning light; a word like *pikato* expressing a 'glimmer' is used in contexts where its onomatopoeic origin becomes clear (the glimmering goes *pikato*); *chirachira* means 'to flicker' (e.g. 'the starlight goes *chirachira*'), *kuraku hikaru* expresses the light / dark contrast; onomatopoeias like *kiratto, pikatto, pikapika* suggest reflection of light on solid, smooth surfaces, referring to a flashing, momentary light; further on, words like *pikapika, munemune, tsuyatsuya* are associated with objects that reflect light (*e.g.* metal weapons), while *pikapika* also designates 'lightning'; a parallel formation, *chikachika*, verbalizes a strong glow (*cf.* Focșeneanu, 2006). These examples leave no doubt concerning the binding between different sensorimotor perceptions and its direct reflection in language.

If we take a look at the linguistic expression for the concept of 'bright' in different languages, we notice that it is sometimes colexified with the notion of 'loud' (cf. Lexibank): in the Nakh-Daghestanian language Aghul, *iaii* covers both meanings of 'loud' and 'bright'; the same colexification is registered in the Catuquinan word *isi*, from the Pano-Tacanan family.

Within the Indo-European linguistic family, Lexibank provides the examples of Lat. *clarus* 'loud' and 'bright', and Middle High German *hel*, verbalizing the same pair of concepts (related to the verb *hallen* 'to echo, to resound').

We may add here Lat. *micare*, attesting both meanings of 'to move rapidly to and fro, vibrate, flicker' and 'to shine, glitter, sparkle'. Even the English verb *bright* was, in Old English, an ambivalent verb, meaning both 'luminous' and 'clear (of a sound)' (OED_2). The same connection is visible in Fr. *éclat*, designating at the same time a 'violent sound and movement' and 'light intensity' (TLFi).

Beside the examples cited above, reflecting a synchronic association between the concepts of 'light' and 'sound', we find significantly numerous instances of the same connection in diachrony: many words originally referring to a certain sound acquire a meaning related to luminous phenomena. It is not insignificant that the direction of evolution goes from auditory to visual perception, not vice-versa, which supports the

observation that visual stimuli are also processed in the auditory cortex, which converts them into virtual sounds corresponding, from the point of view of intensity and duration, to the oscillatory light phenomena.

In what follows, I shall bring some examples of diachronic variation from 'sound' to 'light' in various Indo-European languages. The English verb *to glance* originally meant 'to move rapidly', while its modern meaning is 'to cause a flash of light by rapid movement', 'to shine' (OED_2). The same semantic evolution is registered for Eng. *sparkle*, originally 'to fly or spring' (since *ca*. 1200), today meaning 'to emit sparks' (OED_2). Returning to the example cited above of M. H. Germ. *hel* 'loud, sonorous' and 'bright', it's worth mentioning that its modern meaning has become narrowed to the concept of 'bright' (cf. Kluge-Mitzka, 1960). The same semantic change can be identified in the case of a basic Romance verb for the concept of 'shining', It. *brillare* 'shine'/ Fr. *briller* / Sp. *brillar*, derived from the root **birl- / bril- / pirl- / pril-* 'to fidget, move' (LEI).[16] Another significant stem giving origin to verbs meaning 'to shine' is the Germanic prototype **brand-* meaning both 'to sparkle' and 'to hit' (FEW 15/1, 242b-252b): it is interesting to notice that it engendered, on the one hand, the verb O.Fr. *brander* 'to shine' (of the dawn, a ray of light), and, on the other hand, M. Fr., Fr. *brandir* 'to throw', 'to shake (the sword)'. These cases attest to the strong mental connection between the two different sensory-motor impressions, reinforcing the findings in neuroscience.

We return now to the above-mentioned example of Lat. *clarus*, for a deeper insight into its etymological family, in order to better understand the semantic networks that may be developed inside an etymological family originated in a root verbalizing an auditory impression. Lat. *clarus* is attested with two meanings: on the one hand 'loud, clear (of a sound)', on the other hand 'clear, bright, gleaming'. It stems from the same lexical root as the Latin verbs *calo* 'call', *clamo* 'cry out' and *clango* 'to make *a noise*'. The etymological dictionaries (Ernout & Meillet, 1932; Vaan, 2008) establish a genetic relationship between these Latin lexemes and Gk. κλέος 'noise, glory', κλαίω 'cry' and κλαγγή 'penetrating sound', all of which express different types of auditory impressions. If we go further in our quest for the etymological network, we find that all of these words are related to Gk. κλάω 'break', which confirms the conceptual contiguity between a sound and the movement that may produce that sound. Consequently, we may infer that the name for the movement originates in the onomatopoeia created to reproduce the sound. Given the neuronal

perception of oscillatory light as movement, we can recreate the following conceptual scheme:

Sound → cry, shout
→ movement → break
→ light

As we shall see further, this pattern can also be observed in other evolutions of Indo-European roots, which attests to the cognitive grounding of this associative network. By observing and acknowledging this recurrent scheme in the semantic evolution of words originally verbalising a sound impression, we can take steps forward in two directions: on the one hand, we will be able to overlap lemmas that, on grounds of the lack of a semantic integrative perspective, were treated as homonymic by the benchmark etymological Indo-European dictionary, Pokorny's *Indogermanisches Etymologisches Worterbuch* (IEW); on the other hand, the systematization thus obtained will bring to light genealogical relations between words that were previously treated as stemming from different roots, or simply as lexemes of unknown origin.

5. 'Shining' in Proto-Indo-European

The significant weight of the concept of 'shining' or 'bright' in the Indo-European vocabulary becomes patent when we look at its large number of verbalizations, as found in Pokorny's IEW. The quantitative aspect of the data is important here: I have counted 42 roots with the meaning 'to shine', which is the highest number of verbalizations of a concept in Proto-Indo-European, as reconstructed in the IEW. In comparison, the second best represented concepts are 'to hit' and 'to cut / break', each with 34 verbalizations, followed in third place by 'to swell / boil' with 28 lexical representations. The notion of 'to move' also has a high weight in the vocabulary, but, even if we put it together with the concept of 'shake' or with various types of spatial movement – from which it is quite hard to separate it –, we still do not exceed 35 lexicalizations. We can therefore establish without doubt a fact that seems to me essential for the present study, namely the immense need to express the notion of 'shining' or 'bright', which indicates the importance of the concept in the life of prehistoric speakers, in their way of relating to the environment.

I provide below the list of roots for which the meaning 'to shine' (or a related one) has been reconstructed. It should be noted, however, that modern European languages no longer make precise distinctions between types of 'shining' or of 'brightness' (as, for instance, Japanese does), given that the variety of light types has lost its importance in our mental and perceptual world; therefore, for the vast majority of protoforms, the reconstructed meaning is the plain generic, prototypical, significate 'to shine'.

**aues-* 'to shine; gold, dawn, aurora'
**bha-* 'to shine'
**bheig^{w}-* 'to shine'
**bhel-* 'shining, white'
**bheleg-* 'to shine'
**bher-* 'shining, brown'
**bherək-, bhrek-* 'to shine'
**bherə̂g, bhrēĝ* - 'to shine, white, ash wood'
**bhleiq-* 'to shine'
**bhles-* 'to shine'
**bhlĕiĝ-, bhlīĝ* - 'to shine'
**bhlĕi-1 bhləi-, bhlī-* ' to shine'
**bhlēu-1 bhləu- : bhlū-* 'to shine'
**dei-1, de̯iə-, dī-, d̯iā-* 'to shine; day; sun; god'
**dhel-2* 'light, shining'
**dheu-3* shining, to shine
**erk^{w}-* 'to shine'
**ĝel-, ĝelə-, ĝlē-* 'light, to shine; to be joyful'
**ĝhel-1* 'to shine; green, gold, *sun'
**ĝher-3* 'to shine, shimmer'
**ĝhu̯oig^{w}-* 'to shine, star'
**ĝhu̯ōk^{w}-, ĝhu̯ək^{w}-* 'to shine, shimmer'
**(g^{w}hēi-) g^{w}həi-, g^{w}həid-* 'bright, shining'
**kai-lo-* 'bright, healthy'
**kand-, skand-, *(s)kend-* 'to glow; bright, *moon'
**k̂ad-2* 'to shine, to flaunt'
**k̂euk-* 'shine, glow'
**k̂eu-2* 'to shine, bright'
**k̂uei-3, kuei-d-, kuei-s-, kuei-t-* 'shining, white'

**lā[i]p-, ləip-, ləp-* 'burn, be bright'
**leuk- (*leuĝh-)* 'bright, to shine; to see'
**meigh-, meik-* 'glimmer, twinkle'
**meis-* 'twinkling, glimmering'
**mer-2* 'to shimmer, shine'
**nei-2, neiə-, nī-* 'move vividly, shine'
**(s)p(h)el-2* 'to shine, shimmer'
**sk̂āi-, sk̂əi-* 'to glimmer (of wet things); shadow'
**sp(h)eng-* 'to shine'
**stilp-, stilb-* 'to shine; to show'
**su̯eid-1* 'to shine'
**tu̯ei-2, tu̯ei-s-* 'to excite, shake, move around; to shimmer'
**u̯lek-, u̯l̥k- (*su̯lek-)* 'to shine, fiery'

Not a few of these reconstructed roots have a very similar form, sometimes differentiated only by the vowel length. These differences could simply be due to the internal variation of the PIE language, thus going back to a single prototype. Nonetheless, there still remain a substantial number of formally different stems meaning 'to shine', which can only indicate the importance of the concept and its many facets. It is improbable that all of these roots designated the exact same type of brightness: it is well known that it is counterproductive for a language to hold series of synonyms that cover the same meaning; if there are more words referring to the same concept, they either involve different nuances, or reflect a diatopic variation.

At the same time, it has been observed that in primitive languages, the physical descriptions of objects give primacy to the qualities of 'bright' or 'dark', even prior to characteristics like 'big' or 'small', 'round' or 'flat' (cf. Allott, 2001).[17] The Japanese model allows us to understand, on the one hand, how many types of brightness humans can perceive (although it no longer seems important for us to name them); on the other hand, the typological overview leads us to the hypothesis that these kinds of luminous effects, being associated with movements, could have been named using onomatopoeia. Going back to the observation concerning the similarities between some of the established roots, it is not improbable that the phonetic variation is the result of the interplay of an expressive variance in pronunciation, in a time period when their linguistic motivation was still perceived.

In what follows, I shall try to show that the connection between 'shining' and 'movement' can be detected within etymological families, or even within the semantic area of a single word.

6. The etymological relationship between 'light' and 'movement' in Indo-European clusters

In what follows, I shall explore the Indo-European etymological families that mirror the crossmodal interference between 'oscillatory light' (like sparkling, glimmering, shining) and 'movement'. I shall start from the stems that were reconstructed by Pokorny either with both meanings (e.g. 'shine' and 'move'), or with a meaning related to one of the concepts, but among the descendants of which we find words expressing the other concept.

The stem **ar(e)-ĝ-* is reconstructed with three meanings: 'glittering', 'white', and 'fast'. This triple semantic diagram must have been created by Pokorny starting from the Greek word ἀργός which encapsulates the meanings of 'white' and 'fast'. At first sight, these two concepts do not share a common ground, but actually their point of contiguity is represented precisely by the notion of 'glittering': as previously shown, it is plausible from a typological point of view that this notion is neuronally processed in the same terms as the visual impression of 'fast (moving)' and it is equally likely that it has engendered the concept of 'brightness', often perceived and lexicalized as 'white'.[18] To the same etymological family belongs Lat. *argūtus*, whose ambivalent meaning mirrors the same perceptual connection: on the one hand, it encapsulates a meaning that addresses the visual sense, 'lively, clear', and, on the other hand, it has an acceptation involving the auditory sense, 'piercing (for the ear), shrill, noisy, talkative'. Its basic meaning in Latin seems to have been related to sound production and perception, Lat. *arguo* 'to declare', 'to accuse, blame', so the root could have been a mere onomatopoeic lexicalization of speech. As we can infer from other examples as well (see above *clarus* and below **bha-*), the semantic pattern could be synthesized as:

Sound → speech
→ (fast) movement → glitter → white

For the stem **nei-/nī-*, Pokorny establishes both meanings of 'to move vividly' and 'to shine', starting from the two semantic pathways that it

followed: it engendered both Lat. *niteō, -ēre* 'gleam' (*nitor* 'radiance') and Old Eng. *nīð* m. 'fight'.

Parallelly, **tu̯ei-* is reconstructed with the meaning 'to excite, shake, move around', but also 'to shimmer'. Among its descendants we can highlight Gk. σείω 'shake, swing' and σείριος 'ardent', hence the name of the star Sirius; the same twofold evolution can be observed in Avestic, *ϑwaeso* 'trembling, shaking' and *ϑwisra-* 'luminous'.

In the same vein, **sp(h)e(n)d-*, semantically reconstructed as 'to shiver, to shake', gave origin to several words meaning 'to gleam, shine, bright': *e.g.* Lithuanian *spįstu* 'gleam, glisten', *spìndžiu, spindéti* '*id.*', Latvian *atspîst* 'shine intermittently', *spîdêt* 'gleam, shine', *spuôžs* 'gleaming, bright, luminous', etc.

The PIE root **aig-* with the reconstructed meaning of 'move swiftly, swing, vibrate' gives origin, on the one hand, to Old Church Slavic *vъzigrati* 'hop, jump', and, on the other hand, to Gk. αἴγλη 'gleam, radiance'; this word verbalizes the vibration of light, and although Chantraine (s.v. αἴγλη) expresses doubts about a possible relationship with Sanskrit *éjati* 'to move, tremble', and Beekes (2010) firmly rejects this conjecture, the neural contiguity between oscillatory light and movement holds up the hypothesis of a common origin for these words.

Another case significant for the present study is **bhlaĝ-* 'to hit'. Among its descendants we find, on the one hand, words designating a hard blow, like Old Icelandic *blak* 'blow, knock', but on the other hand, the same language registers the word *blakra* 'blink, glitter, flash'; the same pattern can be observed in Norwegian *blakra* which comprises the meanings of 'fan' and 'shine'.

The cases discussed so far provide lexical proofs of sensorimotor binding, for which we find consistent evidence in neuroscience. These linguistic samples foreground the scientific finding that the perception of oscillatory light phenomena is germane with the perception of movement, interpreted and processed in the same terms by the auditory cortex and turned into virtual sounds.

In the following section, I shall present some situations where the cognitive basis is the same, but has not been identified as such. Starting from the observations drawn so far, I shall try to reshape the etymological families according to the semantic criteria exposed.

7. Semantic reconstruction: reshaping etymological clusters

Most of the existing etymological dictionaries – not only those common to all Indo-European languages, but also the lexicographic tools dedicated to individual languages – lack an integrated semantic perspective. The little attention given to historical semantics at the time when the great etymological dictionaries were created is reflected in the types of solutions adopted: the rigorous phono-morphological reconstruction of a protoform is not coordinated with an equally valid semantic reconstruction, so that, not infrequently, obviously related Indo-European words are attributed to etyma considered homonymic (or with an artificial phonemic differentiation) precisely because they do not seem to be semantically concordant.

In the Indo-European family, obviously to a higher degree than within the history of an individual language, semantic relations remain hidden in plain sight. This is understandable, because the considerably larger spatial and temporal platform occasioned by the successive waves of separation of the Indo-European languages gave rise to increased divergences, to semantic (and formal) camouflages that cannot be easily detected. In order to reconstruct genetic relationships between words, linguistic surveys must be coupled with a deep understanding of the concepts behind the words, and therefore of the cognitive mechanisms that govern our linguistic expression.

Therefore, a reconsideration of the semantic criteria (which lacked a unitary and systematic perspective in Pokorny's approach) can lead to a deeper analysis and, consequently in certain cases, to a reorganization of the etymological families. It is of no use to strictly apply the phonetic criteria, if the semantic aspect is neglected. When meanings that stem from the same core are seen as unrelated, the reconstruction will not result in a single root, but in two, three, even five lemmas, identical or almost identical from a phonetic point of view, but separate because of the meanings reconstructed independently from one another.

In what follows, I shall rediscuss the lemmatization proposed by Pokorny for certain etymological clusters related to the concept of 'oscillatory light', in accordance with the cognitive relationship with movement and with auditory perception that I have theorized.

7.1. *bherə$\hat{k}$-

For the stem *bherə$\hat{k}$-, bhrē$\hat{k}$-, Pokorny reconstructs the meaning 'to shine'. Yet, among its established descendants, we find some whose semantic area refer clearly to physical movement: O. Ice. *bregða*, (preterit) *brü* 'quick, fast move, swing', O. Eng. *bregdan, brēdan* 'quick, fast move, swing' (→ Eng. *braid* 'flax, wattle, braid'), M. H. Germ. *bretten* 'pull, tear, twitch, weave'. Although the association between oscillatory light and movement is proven from a biological-cognitive point of view, we should bear in mind that the binding between concepts follows a systematic causal or consecutive order, which also translates in the unidirectionality of semantic change (see above §2.4): intermittent light is perceived as an iterative movement, but movement is not interpreted, reciprocally, in terms of oscillatory light, therefore it is only possible for a word with the more common meaning of 'move' to evolve towards the more specialized meaning of 'shine'. This pathway is actually shown by the roots cited above whose meaning could only be reconstructed as related to 'movement', and whose descendants acquire a significate related to light phenomena, but not vice versa. Following these arguments, we must presume that in the case of the root *bherə$\hat{k}$- too we should establish as an original meaning that of 'move' rather than 'shine'.

7.2. *bher-

Another arguable case that I shall focus on here is that of *bher-. Under this phonetic form, Pokorny places no less than five different roots. Leaving aside *bher- 'to carry', which I shall not include in the present discussion, we remain with *bher-2 'to boil, swell', *bher-3 'to scrape, cut', *bher-4 'roar, buzz, onomatopoeic words' (in Pokorny's own terms), and *bher-5 'shining'.

The words that Pokorny establishes as descendants for each of these roots, in not a few cases, overlap semantically: for instance, under *bher-2 'to boil, to swell', Pokorny places Middle Eng. *brim* 'blaze, glow', Nor. dial. *brīsa* 'blaze, flare, shine; set on fire', *brīs* 'fire, flame', O. Ice. *brimi* 'fire'. According to his semantic distribution, he should have placed these words directly under *bher-5 'shining'.

Moreover, he does not establish any relation between *bher-4 'roar, buzz, onomatopoeic words' and *bher-3 'to cut', where he includes, for instance, Lat. *feriō, -īre* 'to strike, knock, hit', and other verbs with the same

meaning of 'to hit'. Yet, it is acknowledged that such verbs expressing a sudden blow originate, in their vast majority, in an onomatopoeic root (cf. Hilmer, 1914; 1918; Majid *et al.*, 2007; Georgescu, 2021b). Therefore, since he admits that the phonetic sequence **bher-* is onomatopoeic, he could have accepted that the words that he places under another lemma of identical form must actually be part of the same family with the ones placed under the onomatopoeic root. Following this rationale, **bher-*3 'to cut' and **bher-*4 'onomatopoeic words' could be easily reduced to a unique core.

Furthermore, I have shown elsewhere (Georgescu, 2021a; 2021b) that the concept of 'swelling' and 'boiling' are also perceived as a movement and thus expressed by means of an onomatopoeia – reinforced by the sound made by a boiling liquid (cf. Ibarretxe, 2017: 201; 2023). 'To swell' is probably perceived as an aspect of 'boiling', hence designated by the same – most probably onomatopoeic – root. By extension, it can verbalize, for instance, a pustule, interpreted in terms of a bubble, the shoot of a plant, or, by metaphoric transfer, even a molehill (cf. Georgescu, 2021a). In the case of **bher-*2 with the reconstructed meaning of 'boil', 'swell', Pokorny places under this lemma verbs like Old Indian *bhuráti* (*bh̥r̄-é-ti) 'moves, shrugs, jerks, flounces, flounders', O.Ind. *bhramati*, *bhrümyati* 'wanders around, turns round', as well as the adjective Nor. dial. *brisk* 'agile, lively, alert' – an obvious conceptual extension of 'movement'.

Following these considerations, there is no justification for splitting the root **bher-* into four different lemmas (leaving aside, as mentioned, **bher-*1 'to carry'): by putting together and comparing all the lexemes that have been classified under one of the four entries, we can clearly reconstruct a single root, with developments in three main directions, in turn branching off on subsequent pathways:

**bher-* onom. 'sound' → roar / buzz
→ boil
→ move → hit
→ shine

7.3.**k̂eu*

A parallel semantic relation appears between **k̂eu-*1 'to swell' and **k̂eu-*2 'to shine'. From **k̂eu-*1 'to swell', Pokorny derives O. Ind.

śávas- 'strength' (from the idea that the strong ones are bigger, *i.e.* swollen, *cf.* Georgescu, 2020), Gk. κῦμα 'wave', Lat. *cumulus* 'heap', Ltv. *šuka* 'haycock', *etc.* On the other hand, **k̂eu-2* 'to shine' gave origin, according to the same etymologist, to O. Ind. *śúmbhati* 'shines', Avestic *savah* 'morning', Armenian *šukh* 'radiance, splendour, fame'. Nonetheless, following, the above demonstration concerning the identity between **bher-* 'swell' and **bher-* 'shine', I consider that these two supposed homonymic stems, **k̂eu-* 'swell' and **k̂eu-* 'shine' are, genetically speaking, a single lexical core.

7.4. **deiə-*

Another case we should rediscuss here is that of **deiə-*, split by Pokorny into *deiə*-1 'to shine' and *deiə*-2 'to swing, move'. It is under *deiə*-1 'to shine' where words like Lat. *dies* 'day', *deus* 'god', Old Irish *die* 'day', Gk. Ζεῦς 'Zeus', as well as O. Ind. *dyut-* 'gleam, shine' are discussed. From *deiə*-2 'to swing, move' stem, in accordance with Pokorny's classification, lexemes such as O. Ind. *dī́yati* 'fly', Gk. δῖνος 'whirl', or O. Ir. *dían* 'quick, fast'. Given the recurrent cognitive pattern observed in neuroscience and proven by the already numerous lexical cases discussed, it should be patent that here, too, we are dealing with a single root, originally referring to 'movement' and expanding its semantic area towards 'oscillatory light'.

7.5. **dhel-*

The root **dhel*-3 is reconstructed with the meaning 'to tremble', separate from **dhel*-2 'shine'. We have already seen several cases where words meaning 'to tremble' and 'to shine' were acknowledged as stemming from the same root, cf. **tu̯ei-* 'shake, move around' and 'shimmer'; **sp(h)e(n)d-* 'to shiver, to shake' > Lith. *spístu* 'gleam, glisten', Ltv. *atspîst* 'shine intermittently', *spîdêt* 'gleam, shine', *spuôžs* 'gleaming, bright, luminous'. Considering the semantically overlapping descendants placed divergently under one lemma or another, and on the basis of the semantic criteria outlined above, I suggest that these two entries should also be reduced to a single one, with the original meaning 'to shiver', 'to tremble'.

7.6. **bha-*

A similar rationale must be considered in the case of **bha*-, treated under two different lemmas, **bha*-1 'shine' and **bha*-2 'speak', to which a third one could be added, **bha(t)*- 'hit': according to Walde (1869-1924), -*t*- is nothing but a phonetic extension which could be absent, while Pokorny only suggests that the root could simply be *bha*-.

The relation between 'shine' and 'hit', as two concepts derived from 'movement', has already been discussed. An apparent divergence might seem to be the meaning of 'speak', but if we bear in mind that both meanings 'to hit' and 'to shine' are, by their very nature, based on an onomatopoeia, the logical relationship between them becomes patent. Indeed, what could be more onomatopoeic than the verb 'to speak' itself?

A plausible explanation is that this root was originally an ideophone used to reproduce either the sound of speech, or the impression produced by a hard blow. Consequently, it could verbalize both the idea of expressing (articulate) sounds, thus 'speak', and that of 'making a movement': from here, it is not hard to recognize the recurrent patterns in the semantic evolution of such a lexical root, either towards the meaning 'to hit', or, referring to light phenomena, 'to sparkle, shine'[19].

In conclusion, it is likely that we are dealing with a single root, **bha*-, with the following semantic developments:

Sound → speak
→ movement → hit
→ shine

7.7. **mer-*

Our last example is that of **mer*-, divided in five lemmas: **mer*-1 'to plait, weave', **mer*-2 'shimmer, shine', **mer*-3 'dark', **mer*-4 'die', **mer*-5 'rub, wipe, grab, rob'. For now, I shall not discuss **mer*-4 'die', but I shall focus on the other four lemmas.

Firstly, regarding the meaning 'plait, weave', we can highlight its conceptual relationship with 'movement' as seen in the case of **bherə́k̂*-: in the above-mentioned etymological family (§6.1), the descendance is clear, being developed even within the same language, e.g. O. Eng. *bregdan* 'fast move' > Eng. *braid*, in correspondence with Germ. *bretten* 'pull, tear, twitch, weave'. As we have shown, the action of braiding is

basically perceived as a rapid and repetitive movement, so the name must have been created as a specialisation of the meaning 'fast move'. At the same time, as discussed at length above, the perception of instant or oscillatory light as fast movement entails applying to it the same name used for motion. In the absence of phonetic counters, therefore, there is no impediment to joining under a single lemma **mer-* 'move' the concepts of 'plait' and 'shimmer'.

In immediate relation to these meanings is **mer-*5 (following Pokorny's lemmatization), with the reconstructed meanings of 'rub, wipe; grab, rob'. The latter two meanings are not justified, since they are found only in Sanskrit, and only as secondary meanings – hence probably derived on Sanskrit ground. The other two, 'rub' and 'wipe', are in fact subsumed to the idea of movement, fast, uniform and constant, being just one of the possible directions of specialization. I therefore consider that it is not justified to reconstruct these meanings as the original semantic core. Constant and rapid movement includes the idea of 'hitting' and 'violence', and it is probably from here that were developed such verbs as O. Ice *merja* 'hit', Middle Low German *morken* 'crush', and, a step forward conceptually, Arm. *mart* 'fight, struggle'.[20] We can thus attach to the concept of 'movement' also the idea of 'rubbing', 'wiping', and therefore I believe that **mer-*5 can easily be merged with the family of **mer-* 'move'.

We still have a few semantic pathways to clarify. Gk. μάρναμαι 'to fight' is classified by Pokorny under the lemma *mer-*5 'rub', a semantic relation accepted by Chantraine (1968) and Beekes (2010), also on the basis of Frisk's (1960) supposition that μάρναμαι should have initially meant 'crush, smash'. Yet, a significative clue about its original meaning can be found in the recurrent Homeric formula (*Iliad*) μάρναντο δέμας πυρός 'they fought like fire', where δέμας 'like' actually has a very concrete meaning, of 'body'; therefore, we have almost a material image of the fight taking the 'bodily' shape of fire. This syntagm could not be explained by the meaning of 'crush'. Haudry (2009: 321) sees here a representation of 'the fiery nature of the hero', in accordance with his own theory of the human being seen as fire. The picture is, however, much more concrete here, while the proposed metaphor seems a little too far-fetched. I think that the relationship between fight and fire can be interpreted in two ways: the comparison is based either on the lively, agile movement of fire, which actually attracts its categorization as a being in many cultures[21], or, more concretely, on the glow of armour and weapons in the sunlight, a feature so prominent in weapons that it constantly appears in their epic description.

Therefore, it is possible that the verb μάρναμαι is etymologically related to μαρμαίρω 'to gleam, glitter, shine', a concept derived, in its turn, from movement. I do not exclude the possibility that the same verb actually derives directly from the idea of movement, without the intermediary of 'shining'. In any case, all the words grouped by Pokorny under **mer*-5 'rub', 'wipe' can be included without difficulty under a broad sense of 'to move'.

Another word we should reanalyse from a semantic and etymological point of view is Gk. μάρμαρος 'marble'. Frisk (1960) suspects a relationship with μάρναμαι, from the idea of 'smashing' – a hypothesis explained by Pokorny as follows: just as Lat. *rupes* 'stone' comes from *rumpo* 'break' (in fact an uncertain relationship), so must be the case of μάρμαρος, coming from **mer*- 'crush'. Frisk believes that the meaning of 'marble' resulted from the folk-etymological connection with μαρμαίρω. On the other hand, Liddell, Scott and Jones' (1843) definition for μάρμαρος, 'a crystalline rock which sparkles', implies a more plausible etymological hypothesis, a name that stems from the visual characteristic of this type of stone. According to Beekes (2010), the genetic relation between μάρμαρος and μαρμαίρω 'to glow, to sparkle, to shine' is certain, which would place μάρμαρος in the conceptual field of 'shine', not 'smash'.

The last issue I shall touch upon is the perceptual relationship between light and darkness. As shown above, the meaning established for the third lemma created by Pokorny for the protoform **mer*- is 'dark'. Perhaps a good place to start is the verb Gk. μαραίνω (of the fire) 'to go out', (of flowers) 'to fade'. Its etymological relationship with μαρμαίρω 'shine' cannot be denied (both being built on the lexical root μαρ-), which brings up a significant issue for our discussion. The fact that both 'shimmering' fire and fire 'going out' are named by the same lexical root suggests that this stem might have been originally applied to intermittent light, encompassing in its conceptual area both the moment of luminosity and that of absence of light: it is actually their rapid succession that makes them perceptible, thus these two momentary states make up the concept of oscillatory light.

If we step out of this etymological family, we find several parallel examples. For instance, among the descendants of the root **bhleg*- 'to shine', we find both the Germanic protoform **blank*- 'white' (*cf.* Eng. *blank* 'clear', 'transparent' and Eng. *black*). The hypothesis we can propose for these two opposite directions of evolution is a lexicalization of the two hypostases of flashing light: as we already suggested, for the glitter to be perceived, there needs to be a moment of darkness followed by an

instance of light, which actually entails its interpretation as movement. In the case of other roots, the two senses are reconstructed together as the original semantic core of the root, precisely because of the impossibility of separating its obviously cognate descendants covering both meanings: e.g. **kel-* / **kal-* 'dark or light spot'. There are also cases where a lexical root referred to either 'light' or 'darkness' evolved towards the opposite meaning: e.g. **(ha)mer(gw-)* 'dark' gave origin to both Rom. *amurg* 'dusk' and Germ. *Morgen* 'dawn'; **ghel-* is the basis for Eng. *glitter*, *gleam*, etc., but also for *gloom* 'darkness'.

In fact, Pokorny classifies under **mer-*2 'shine' words obviously referred to 'darkness', which overlap perfectly from a semantic point of view with those grouped under **mer-*3:

- **mer-*2 'glow, brightness' > O.C.S. *mrakъ* 'darkness', *smerk* 'twilight", Rus. *mórok* 'darkness, mist, clouds';
- **mer-3* / **mor-* 'darkness' > Arm. *mṙayl* 'darkness, mist, clouds'.

In the light of these observations, we can conclude that the separation made by Pokorny between **mer-*2 'shimmer' and **mer-*3 'dark' is artificial, the two aspects being sides of the same coin and perceived together. Either of the two successive momentary states (light / darkness) can be prototypically lexicalized starting from this originally undifferentiated perception, just as it could happen that the common core splits into two, providing a name for both states, eventually with a slight phonetic differentiation (cf. Eng. *black* vs *blank* – with nasal infix).

In summary, four lemmas (out of five[22]) with the protoform **mer-* should, in my opinion, be reduced to a single one, with the meaning of 'repeated movement'.

8. Conclusions and future research

The main aim of my approach has been to outline the theoretical and empirical foundations of what we may call 'protosynaesthesia'. From a methodological point of view, I started from the idea formulated by Casanto (2017), who emphasizes the relationship that needs to be constantly considered between cognition and language. Thus, he points out, we can build 'cognitively informed theories of language', in which case 'discoveries about brain and mind serve as sources of hypothesis and potential constrains, but the data that are critical for evaluating these

theories are, for the most part, linguistic data.' On the other hand, when we build 'linguistically informed theories of cognition, discoveries about language serve as sources of hypotheses and potential constraints, but the data that are critical for evaluating these theories are, for the most part, nonlinguistic data (e.g. studies of how people think, perceive, act, feel, decide, remember or imagine).' In my endeavour, I had to use both approaches, while trying to propose both a 'cognitively informed theory of language' and a 'linguistically informed theory of cognition': the two perspectives underpin each other, and the data provided as support for each become the basis for the other theoretical frame.

Based on neuroscientific data, I first show that there is a close relationship between sensory perceptions, especially between sight and hearing (the two most developed modalities in humans), and that light phenomena are generally perceived as motion. As a result, they will be denoted by the same words expressing motion, themselves generally originating in onomatopoeias reproducing the (virtual) sound of the movement. Thus, what was considered to be merely a formal coincidence between words referring to light phenomena and those expressing sounds or sudden movements, can be now interpreted as a genetic relationship: the supposed homonymy, as treated in lexicography, is nothing but a colexification. I have supported these findings with a considerable number of linguistic examples, both from non-Indo-European and Indo-European languages. I have then tried to illustrate their applicability to concrete vocabulary analysis, and my proposed task was to reexamine Indo-European etymological clusters that either originated in a root referring to a light phenomenon, or included words that touch on this meaning. The semantic reinterpretation allowed me to rebuild large etymological families that were previously separated in lexicography by artificial criteria.

The theoretical and empirical foundations proposed here can be thought of as an opportunity to reanalyse cases of unknown, uncertain or erroneous etymologies. Modern lexicography still encounters many difficulties in establishing the origin of words with meanings related to light phenomena, whether they belong to classical languages or to modern European, often Romance, languages.[23] The principles presented here will serve as a platform for future etymological studies. At the same time, I hope that the linguistic data provided will open new pathways for interpreting the perceptual mechanisms that govern human – embodied – cognition.

Endnotes

1 I shall use here the term *protosynaesthesia* not in its general acceptation of 'supposed innate form of synaesthesia', as it is approached in psychology (Fassnidge, 2018), but with a coined meaning exploiting the value with which the prefixoid *proto-* is used in linguistics – in compounds like *protoword* and *protolanguage* –, namely the specialized, technical sense of 'reconstructed', or the wider meaning of 'original, primary': I thus use the term 'protosynaesthesia' to mean a 'reconstructed connection between sensory perceptions', or a 'primary form of synaesthesia', as it can be detected in a reconstructed language.

2 Although we do not have infallible clues about the period when it appeared, the most recent opinion places the origin of language no further than about 90,000-75,000 years ago (Balari *et al.*, 2013), but our possibility of concretely exploring language does not go beyond 8,000-7,000 years, the period for which we can reconstruct Proto-Indo-European (Heggarty *et al.*, 2023).

3 One of the best representatives of this approach is Emile Benveniste (1969), who reconstructs the whole Indo-European conceptual field of social, economic, and religious institutions on the basis of reconstructed words.

4 Here may be mentioned the ground-breaking work of Sweetser (1990), showing that there is a recurrent pattern in the semantic evolution of Indo-European verbs from 'sight' to 'knowledge', in different periods and various geographical spaces. Besides this study, there have, to the best of my knowledge, been no significant attempts to test linguistically whether the same kind of interpretations of the world, grounded on the association between body and mind, can be identified in prehistoric or ancient thinking.

5 The concept of 'linguistic paleontology' was coined by Adolphe Pictet (1859-1863) to refer to the reconstruction of social and material life through linguistic reconstruction.

6 For an overview of what linguistic anthropology should be (and unfortunately is not yet), see Stasch (2014). For the (desirable) relation between archaeology and language, see Blench (2014).

7 In Roher's terms (2007: 38), 'What is crucial to the argument of the embodiment hypothesis is that the *same* neural mechanisms which are responsible for "lower-level" activities like perception and movement are taken to be *essential* to "higher-level" cognitive abilities, namely to our reasoning and conceptualization".

8 There is also a narrow use of the term, describing a specific neuronal condition that has been named 'genuine perceptual synaesthesia', defined as a condition in which stimulation in one sensory modality systematically and automatically leads to experiences in a different modality. The grapheme-colour synaesthesia is by far the most common form, in which, for example,

a specific letter or number reliably and involuntarily triggers a specific colour response (Fingerhut, 2011: 11; Simner & Hubbard, 2013).

9 Seeing and hearing are the most active senses in the human being (*cf.* Miller & Johnson-Laird, 1976: 18): first, because, unlike taste and touch, they do not need direct contact, but only air and light; they differ from the sense of smell, conditioned by a more reduced spatial limit and diminished also through the millennia, compared to the animals' homologous sense.

10 For a psychological approach to intensity, both in vision (= brightness) and in audition (= loudness), see Miller & Johnson-Laird (1976).

11 *E.g.* 'the pathways transmitting nonvisual information to visual cortex are currently unclear' (Klinge *et al.*, 2010); 'the neural pathways that mediate these crossmodal effects of sounds on visual processing are still disputed' (Beer *et al.*, 2011); 'how auditory and visual information are integrated to form a coherent perceptual object is unknown' (Atilgan *et al.*, 2018); 'the contribution that visual activity in auditory cortex makes to auditory function remains unclear' (*ibid.*), *etc.*

12 'Il mutamento di significato e di fatto considerato come uno specchio che permette di intravvedere gli elementi della struttura mentale del linguaggio e la sua interfaccia con il pensiero e con la cultura' (Steiner, 2016: 4).

13 Recurrent patterns in semantic change may also be observed in cases such as 'to see' > 'to know' (Sweetser, 1990), 'to swell' / 'boil' > 'to rage' (Kövecses, 2000; Gevaert, 2005), 'hard blow' > 'fragment' / 'prominence' / 'cavity' (Georgescu, 2021b), etc. We may also recall Tagliavini's seminal work on the names of the 'pupil (of the eye)' in fifty languages of various families, where he observes that the strategies for designating this body part are actually limited to three basic concepts, regardless of space and time. To test the assumption about the existence of cognitive universals and as a continuation of the work initiated by Tagliavini, a project on the strategies used in naming the body parts in Romance languages has been proposed, but not (yet) carried out (Gévaudan & Koch, 2011).

14 I understand by 'colexification' the expression of two or more concepts by the same word.

15 Lexibank is a databank that contains 2029 languages and 3033 concepts, allowing complex types of crosslinguistic search (List *et al.*, 2022; List *et al.*, 2023).

16 Actually, TLFi establishes two homonyms in French, *briller* 1 'to fidget, move here and there, wiggle' and *briller* 2 'shine', although the former is considered to have derived from the latter. According to the argument presented here, the direction of evolution would have been the opposite.

17 As shown by Kay *et al.* (2009), the primordial colour system in languages is binary, bright *vs* dark, and it is only as languages evolve that they add other colour names, following almost the same stages.

[18] See the parallel examples of PIE **kand-, skand-,* 'to glow; bright' > Lat. *candidus* 'bright, white', PIE **leuk-* 'bright, shine' > Gk. λευκός 'white', PIE **bher-* 'shining; brown' > Russ. dial. *bryněťъ* 'white, gray', R.C.S. *bronъ* 'white; varicolored (of horses)', *etc.*

[19] See above (§5) the parallel semantic network developed from **ar(e)-ĝ-*, whose Greek descendant evokes the meaning of 'shining', while the Latin one denotes the act of 'speaking'.

[20] This meaning is also attested in Greek, but I do not think that it followed this pathway; I develop my hypothesis below.

[21] See, for instance, the "living fire" in several European communities (Frazer, 1966).

[22] Whether 'to die' is related to the idea of extinction (verbalized by Gk. μαραίνω) or to that of darkness will be left out of the discussion for now, in the absence of a detailed onomasiological study of the concept of 'death' in Indo-European.

[23] I may mention here the numerous lexical entries with a meaning referred to 'light' or 'darkness' grouped by Wartburg (FEW 23, 183b-184b) in a volume dedicated to words of uncertain origin in French (and, in general, Gallo-Romance languages or dialects).

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