LINGUAGEM EM FOCO
Revista do Programa de Pós-Graduação em Linguística Aplicada da UECE
V. 10, N. 2, ano 2018

MULTIMODALITY IN METAPHOR MEANING: A COGNITIVE ANALYSIS OF SCIENTIFIC TEXTS

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ABSTRACT

In order to be multimodal, a communication medium needs to combine different modes of expression. In this paper, we claim that even though metaphors are communicated in the verbal mode in scientific texts, the construction of some of them involves multiple perception processes. Our data comprise a set of conventionalized metaphors that are used in scientific papers as pedagogical tools for explaining technical concepts. To access the multimodality of the metaphorical process in the scientific domain, we use the following conceptual constructs: *metaphorical mappings* (LAKOFF; JOHNSON, 1980), *conceptual blending* (FAUCONNIER; TURNER, 2002), *image-schemas* (JOHNSON, 1987; HAMPE, 2005), *blended classic joint attention* (THOMAS; TURNER, 2011) and *narrative thinking* (TURNER, 1996). We analyze the scientific metaphors "cognitive filter" and "perceptual filter" that are used to construe the concepts of "cognitive transformation" and "schemata" in the field of cognitive psychology. Specifically, we show how the knowledge network associated with filters and the filtering process (i.e., the image-schematic structure of a filter and the entities and relations involved in the filtering process) helps to frame and construe the scientific concepts. Our results reveal that linguistic resources configured through analogical processes, such as metaphors and narratives, are essentially multimodal. The intended contribution is to think of the metaphor in the scientific text as a trigger to see an abstract scientific construction via image schemas.

Keywords: Metaphor; Multimodality; Scientific Text.

RESUMO

Para ser multimodal, um meio de comunicação precisa combinar diferentes modos de expressão. Neste artigo, defendemos a ideia de que, embora as metáforas sejam comunicadas verbalmente em textos científicos, a construção de algumas delas envolve múltiplos processos perceptuais. Nossos dados compreendem um conjunto de metáforas convencionais usadas em artigos científicos como ferramentas pedagógicas para explicar conceitos técnicos. Para acessar a multimodalidade do processo metafórico no domínio científico, utilizamos os seguintes constructos conceituais: mapeamentos metafóricos (LAKOFF; JOHNSON, 1980), integração conceptual ou mesclagem (FAUCONNIER; TURNER, 2002), esquemas de imagens (JOHNSON, 1987; HAMPE, 2005), *blended classic joint attention* (THOMAS; TURNER, 2011) e *narrative thinking* (TURNER, 1996). Analisamos as metáforas científicas "filtro cognitivo" e "filtro perceptivo" que são usadas para interpretar os conceitos de "transformação cognitiva" e "*schemata*" no campo da psicologia cognitiva. Especificamente, mostramos como a rede de conhecimento associada aos filtros e ao processo de filtragem (ou seja, a estrutura esquemática da imagem de um filtro e as entidades e relações envolvidas no processo de filtragem) ajudam a enquadrar e interpretar os conceitos científicos. Nossos resultados de análise revelam que os recursos linguísticos configurados através de processos analógicos, como metáforas e narrativas, são essencialmente multimodais. A contribuição pretendida é a de pensar a metáfora no texto científico como um gatilho para se ver uma construção científica abstrata via canais imagéticos.

Palavras-chave: Metáfora; Multimodalidade; Texto Científico.

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INTRODUCTION

Can verbal language be multimodal? The classical notion of multimodality assumes the existence of different modalities in the same communicative situation: when we combine sound and gesture, text and image, etc. to produce meaningful messages. Each medium communicates via one or more signaling systems and each signaling system (e.g., written signs, spoken signs, pictorial signs, gestures, etc.) is interpretable because of a specific perception process (FORCEVILLE, 2009). How we integrate different processes into coherent wholes is a crucial issue.

In the cognitive studies on metaphor, the multimodal integration is analyzed among source and target domains. In contrast to monomodal metaphors, whose target and source domains are exclusively or predominantly communicated in one mode, multimodal metaphors are those whose target and source domains are each represented exclusively or predominantly in different modes (FORCEVILLE, 2006, 2009; MÜLLER, CIENKI, 2009).

Although metaphors are communicated in the verbal mode in scientific texts, the construction of some verbal metaphors involves multiple perception processes. This is the hypothesis underlying this paper. We are particularly interested in the multimodality of metaphorical processes: the integration of specific modes (verbal, visual, sensory-motor, etc.) required for metaphor construction/comprehension.

Our study is based on the cognitive research on metaphor and our data comprise a set of conventionalized metaphors that are used in scientific texts as pedagogical tools for explaining technical concepts. For instance, cognitive psychologists use terms such as “cognitive filter” to explain a cognitive process or “perceptual filter” to explain a perceptual process.

To access the multimodality of the metaphorical process in the scientific domain, we use the following conceptual constructs: *metaphorical mappings* (LAKOFF; JOHNSON, 1980), *conceptual blending* (FAUCONNIER; TURNER, 2002), *image-schemas* (JOHNSON, 1987; HAMPE, 2005), *blended classic joint attention* (THOMAS; TURNER, 2011) and *narrative thinking* (TURNER, 1996). Specifically we show that meaning is a multilayered process that integrates not only linguistic signs but also visual and sensory-motor features.

In a nutshell, section 1 introduces the cognitive view of metaphor and describes the metaphorical process in terms of conceptual mappings, conceptual blending, and image-schemas and introduces the notions of (blended) classic joint attention; section 2 shows how these conceptual constructs help to shape the multimodality of the metaphorical process and also how narrative thinking contributes to it; section 3 presents the metaphorical data and analyzes the multimodal meaning-making of metaphors in scientific texts based on the constructs discussed in sections 1 and 2, followed by our final remarks.

1 ACCESSING THE METAPHORICAL PROCESS TO PROMOTE JOINT ATTENTION IN WRITING

This section discusses the cognitive notion of metaphor and the embodied view of meaning showing how linguistic meaning is conceptually grounded and perceptually constrained by our senses.

A basic assumption of Cognitive Linguistics is that language interfaces with mind and physical experience (LAKOFF, 1987a; JOHNSON, 1987). According to Lakoff and Johnson (1999), reason is shaped by the body. What this means is that we use our senses, what we can see, feel, hear, smell and taste (concrete concepts) to understand and reason about what we cannot perceive concretely (abstract concepts). The systematic comprehension of abstract concepts in terms of concrete concepts is the bulk of the Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980).

This theory describes metaphor as a conceptual process between two conceptual domains: the source domain, a concrete (perceptual) structure that is used to organize and understand a more abstract notion; and the target domain, which is the object of comprehension. We understand a target domain A in terms of a source domain B, when we build our knowledge of B based on our knowledge of A. The knowledge that is systematically mapped from B to A is structured in correspondences or *mappings*; it includes entities, properties, relations, structures, memory and inference patterns.

For instance, when we say "I'm a little *rusty* today", we are using knowledge from the source domain of machines (which includes the machine system, the machine functioning, because we know that machines are systems built to generate specific products, and that they operate in a series of sequential subroutines in a way that, if one of these subroutines cracks, it affects the entire system) as a background structure to understand and talk about the target domain of mind. We construct a corresponding structure in the mental domain: we understand mind as a machine, the mental functioning as the machine functioning. In this domain, mental operations involve a series of automated subroutines, the mind is configured to produce ideas (LAKOFF; JOHNSON, 1980; KOVECSES, 1990; FERNANDEZ-DUQUE; JOHNSON, 1999). These are "complex schema mappings" (LAKOFF, 1987a). In the example, the mappings include high-level abstract relations, such as causation.

Studies on the cognitive view of metaphor show that virtually all of our abstract conceptualization and reasoning is structured by metaphor (LAKOFF; JOHNSON, 1980). Besides high-level abstract relations, *image schemas* – "general topological and orientational structures that are kinesthetic in nature" (LAKOFF, 1987b, p. 194) also provide the concrete basis for abstract thought. These structures emerge from our everyday interaction in the world: they are based on bodily movements (front-back, up-down, path), object manipulation (contact, link, container, surface), and patterns of forces acting upon us and exerted by us (blockage, restraint, attraction, etc.) (JOHNSON, 1987; HAMPE, 2005).

We use the internal structure of image schemas to draw inferences. In the example, the image schema that helps to shape the meaning of "rusty" is PROCESS. This image schema, which is experientially grounded in the PATH schema, represents a sequence of actions that end up in some result. We use this schematic knowledge from the source domain of a processing device to build an inferential structure in the target domain of reasoning: in the target domain, the inability to produce ideas (product) is a result from malfunctioning thinking.

A more recent approach to the conceptual view of metaphor is the Blending theory (FAUCONNIER; TURNER, 2002). While the notion of conceptual metaphor is the one of a cross-domain mapping, the Blending theory describes the metaphorical comprehension of A in terms of

B as a blending process held among at least two input spaces: the conceptual structure of A (input 1) and the conceptual structure of B (input 2); a generic space, which represents the structure that is shared between the two input spaces; and a fourth space, the blended space, which emerges as a result from the combination of shared and unique properties from A and B. The blended space has an emergent conceptual structure; it is emergent because it accounts for properties that do not exist in either of the input spaces.

Unlike metaphorical mapping, conceptual blending is a cognitive operation that shapes the way we construct and process not only metaphors. It accounts for the role of language (literal, non-literal) in meaning construction, but it also anchors our understanding of non-linguistic events, such causation, agency, time and space.

In this study, we are interested in the knowledge network (imagery and inferential structure for causal relations, agency, spatial relations) that is mapped from the source domain of FILTER to multiple target domains used by scientists to mean SELECTION, REMOVAL, CHANGE, PURIFICATION etc. FILTER is a source domain, a conceptual domain which is concrete and thus used to structure and understand the target domain, which is the object of our understanding.

In our analysis, the "cognitive filter" and "perceptual filter" are used to construe the concepts of "cognitive transformation" and "schemata" in the field of cognitive psychology. This shows that meaning production and thinking are the two connected sides of semantics and metaphors are cross-domain blends that contain or produce meaning in contexts of communication.

When communicating via writing, this cross-domain between networks – which are usually familiar to the writer and non-familiar to the reader or vice-versa – brings, via blending, a common ground to the interaction. During interaction, readers make meaning by creating experiences that reflect the experiences that the writer intended to describe (BERGEN, 2012). This is what Thomas & Turner (2011) call *joint attention* – a common familiar scene experienced routinely. *Classic joint attention* happens when both the speaker and the listener share an environment they can refer to directly, in the same space and time.

Writing is not a scene of classic joint attention, but the writer will use the classic scene as an anchor so that, in the blend, writing becomes speaking, the indefinite audience that is not present becomes a single person who is right there, and the subject becomes something that can be perceived (THOMAS; TURNER, 2011). This is then *blended classic joint attention* and it is part of the writer's task to induce the reader to anchor her activity in the classic scene. In other words, if a mental network does not involve one of our experiential ideas, we blend it with one of those familiar ideas so that we can make a compact mental blend for the network that is based in manageable ideas (TURNER, 2014).

For instance, when we say that "Everything we download from the Internet is automatically filtered through our virus software[1]", in the blend, there is a filter between the information from the Internet and our devices, which are not even physical entities. And we are not deluded by thinking that the virus software is a person removing an object from a place, because this metaphorical construction gives us a way to grasp the entire network of ideas (TURNER, 2017).

1 <www.macmillandictionary.com>

The blend is a very useful conceptual tool. In blended classic joint attention, this is the role of metaphor: enabling us to see what we need to see. PERCEIVING IS SEEING. In the metaphorical viewpoint, the writer selects what s/he wants to focus on in their writing so that the reader´s viewpoint is modulated.

Another important point is the fact that we "filter" the world through our values, experiences and emotions. In this process of "filtering the world through our eyes", metaphors are revealed as one of the main forms to expand the communicative and expressive potential of a written text, exactly because production and understanding are not only constrained by linguistic elements but also by conceptual and perceptual elements. If perception means the ability to notice something by seeing, hearing, smelling, tasting and touching then these multiple paths to communication leads to multimodality.

2. THE MULTIMODALITY OF THE METAPHORICAL PROCESS

Multimodality refers to the various resources we use to create meaning when we communicate. It reminds us of the richness of all texts. In this section, we describe the multimodality of the metaphorical process and shed light on how narrative thinking can contribute to promote it.

We often hear from cognitive behavior therapists that "one has to understand how to *filter* their thoughts when conflicts begin to *boil*[2]". "Filter thoughts" and "boil" are metaphorical uses for meaning "process thoughts" and "feeling very angry". In this move of dealing with thoughts and feelings, the concept of filtration becomes the source domain to construe the meaning of separating reason (thoughts) from emotion (feelings) in the target domain.

Filtration is any of various mechanical, physical or biological operations that separate solids from fluids (liquids or gases) by adding a medium through which only the fluid can pass. The fluid that passes through is called the filtrate. In physical filters, oversize solids in the fluid are retained and, in biological filters, particulates are trapped and ingested and metabolites are retained and removed. In emotional filters, we extract reason from emotion and we should control our tempers by removing anger[3].

Examples of physical filters are water filter and coffee filter. In the frames of filtering both substances, the senses of taste, smell and hearing are in the cognitive scene. Filtering water brings up the concept of purification (i.e., clean by removing dirty or harmful substances) while filtering coffee raises the idea of production (i.e., create something new from a raw material). Our memory of having drunk water and coffee connects our perception to the positive or negative experiences related to these actions.

If a liquid boils, it becomes so hot that there are bubbles in it and it starts to become a gas. The conceptual metaphor that underlies "conflicts boil" is ANGER IS HEAT. In both cases – the filter

2 < https://www.psychologytoday.com/intl/blog/theory-knowledge/201202/understanding-how-we-filter-our-thoughts>.

3 < https://en.wikipedia.org/wiki/Filtration>

and the boiling – the image schemas of CONTAINER, PATH [PROCESS] and FORCE interact in order to promote transformation. As for narrative thinking, sentences are stories. In a construction, certain story structures go with certain grammatical structures as in "His **thinking** is moving in the wrong direction → His **truck** is moving in the wrong direction"; "grasp the **idea**→ grasp the **handle**" ; "accept the **explanation**→ accept the **gift**" (TURNER, 1996); "**conflict** boils → **water** boils" ; "**thought** filter → **water/coffee** filter". Coming from a SOURCE through a PATH towards a GOAL consists of a narrative course whose (abstract) network is anchored in (concrete) activity as in a classic scene. Thus narrative thinking contributes to promote blended classic joint attention.

Conceptualization, perception through our five senses, memory of our experiences, narrative thinking and our understanding of metaphors are all blended to play the essential role of making us attend to therapists when they say that you have to understand how to *filter* your thoughts when conflicts begin to *boil*. They would poorly mean the same by saying that you have to control your emotions by reasoning when you get very angry, but this would never be as resourceful in communication as bringing up the multimodality in the metaphors of the *filter* and the *boiling conflict*.

It may seem pyrotechnic to use such metaphors to communicate something that is by no means abstract and thus easy to understand, but

> using pyrotechnic examples makes it easier to introduce the blending and the multimodality of the constructions, but doing so runs the risk of suggesting that the blending is typically noticeable and unusual, which is false: blending is used constantly but in nearly all cases goes without notice (TURNER, 2017, p. 5).

Besides, we have explained here what the concrete process of physical filtration is like so that the readers of this paper could attend jointly to the idea of filtering emotions, which is abstract. According to Turner (2017), joint attention refers to the ability to teach, learn and cooperate. And linguistic constructions deployed in the scene of classic joint attention operate in a multimodal environment (STEEN; TURNER, 2013). "Blends are intelligible, even though it connects to conceptual elements in a network stretching over time, space causation, and agency, because it has some familiar, human-scale structure" (TURNER, 2017, p. 2).

In most written texts, where literal language predominates, the interaction between verbal and imagery generally adds illustrative and didactic value. However, we advocate for a multimodal concept of language *per se*. We speak and write from our sensory-motor experience, manifestly through metaphors.

3 MULTIMODAL MEANING-MAKING OF METAPHORS IN SCIENTIFIC TEXTS

According to Boyd (1993), there are two types of scientific metaphors: (i) pedagogical metaphors, i.e., metaphors that have an explanatory function (they are employed merely as a means of making a particular scientific concept clearer); and (ii) constitutive metaphors, i.e., metaphors that are part of the linguistic machinery of the scientific theory (they represent the language that is used to frame particular concepts).

In this paper, we analyze the first type, through the analysis of the scientific metaphors "cognitive filter" and "perceptual filter" that are used to construe the concepts of "cognitive transformation" and "schemata" in the scientific field of cognitive psychology. Specifically we show how the knowledge network associated with filters and the filtering process (i.e., the image-schematic structure of a filter and the entities and relations involved in the filtering process) helps to shape and understand distinct scientific concepts.

> **Example 1**: "In *Gender, Crime, and Desistance: Toward a Theory of Cognitive Transformation*, Giordano et al. argue that desistance is the result of a set of four cognitive transformations. […] The third cognitive transformation that an offender must pass through is […] the development of a[n appealing and conventional] "replacement self" [to supplant the marginal one]. [This] occurs when the offender begins to create a new self-identity defining the type of person the offender hopes to become. This new self-identity serves as a "**cognitive filter for decision-making**". No longer does the offender view himself as a criminal; rather, the offender begins to accept the self-view as a good worker, spouse, parent. The offender then, using this new prosocial identity, determines if certain behaviors, such as criminal behavior, are congruent with the responsibilities and expectations of the new roles he is assuming. Because antisocial behavior is not compatible with this new prosocial identity, the offender is likely to desist from crime" (CULLEN; WILCOX, 2009, Encyclopedia of Criminological Theory).

In this example, the cognitive transformation is conceptualized as a filtering process. This process is conceptually construed by blending three input spaces and a blended space:

(i) the input space of moral life, where we have ethical beings and good choices – in this space, the process of decision-making is based on boundaries, constraints and good selections (a moral self knows the limits that separates morality from immorality, good behavior from bad behavior, and always chooses the first);

(ii) the input space of immoral life, where we have unethical beings and bad choices – in this space, the process of decision-making is based on violations not on judgments, there are no boundaries or constrains (the marginal self does not separate good from bad choices and behavior);

(iii) the input space of filters, where the dynamic process of filtration takes place – this process is described as follows: raw ingredients are blended in a filter, the blended substance is processed, part of the substance is removed (not filtered), the other part is purified or results into a new product; and

(iv) the blended space, where the cognitive transformation, from marginal to ethical, is construed as a purification process – in this space, decision-making is conceptualized as a process of filtering (removing and selecting) bad from good. The idea of purification is emergent, it is in neither one of the input spaces, it is created through the blending between the old/marginal and the new/ethical self-identity against the background structure of a filter.

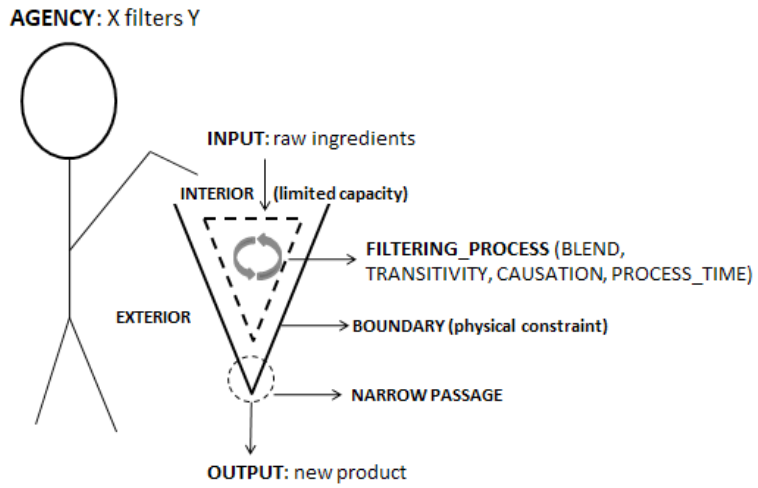
Notice that the filter (perceptible object) is in the classic scene, while the judgment is in the knowledge network of (i). We blend them, and in the blend, we treat the judgment as if it were a perceptible object: when the scientist uses the physical structure of filter to frame the abstract notion

of cognitive transformation, he anchors the abstract notion in the concrete scene. The abstract notion of cognitive transformation is framed as the concrete notion of filter and the knowledge associated with filters and the filtering process (inferences, imagery, causality, etc.) is blended in a new space, enhancing the knowledge of this space.

Figure 1 illustrates the knowledge network (structural, causal and inferential knowledge) underlying the classical scene of someone filtering a substance.

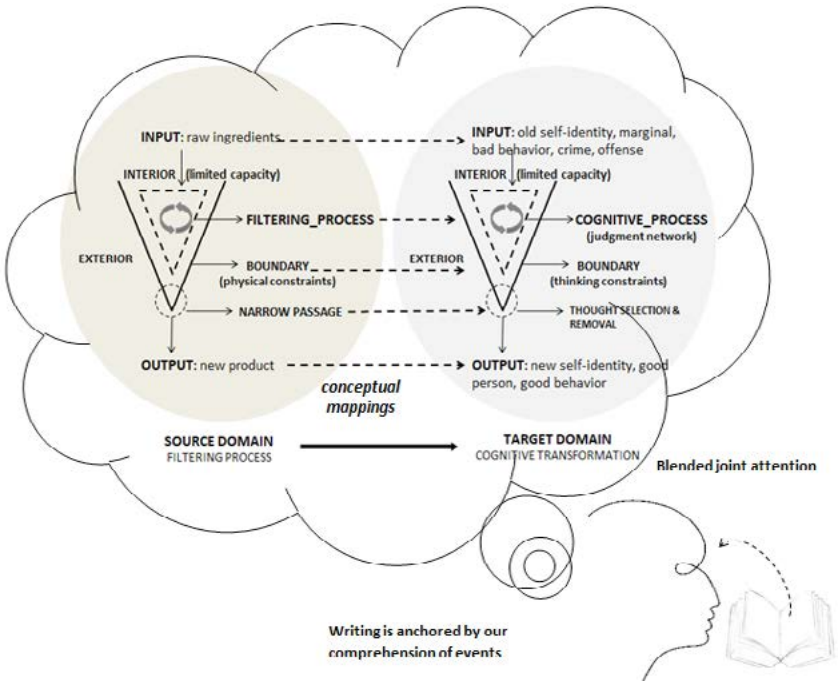
Figure 2 illustrates the metaphorical comprehension of the sequence of events that anchors the conceptualization of the cognitive process of decision-making as a filtering process.

Figure 1 - Representation of the knowledge network: classical scene of filtering a substance



Source: Own Construction (2018)

Figure 2 - The knowledge network underlying the metaphorical construction of cognitive transformation



Source: Own Construction (2018)

In Figure 2, the dashed lines represent the conceptual mappings from the source domain of the filtering process to the target domain of the cognitive transformation. These mappings include structural, inferential and causal knowledge.

The metaphorical use of FILTER in cognitive domains is pervasive in scientific writing. In the next example, the notion of decision-making is construed as a "perceptual filter". Notice that the same schema complex and imagery that are mapped in the target domain of cognitive transformation in the previous example are also mapped in the target domain of balancing life.

> **Example 2:** "…balance exists between shyness and outgoingness. Then an event happens and a perception is made: "Life is dangerous." The perception is followed by a decision: "Since life is dangerous, I must protect myself by being reserved, cautious, and quiet." The role of being shy is chosen, and the **perceptual filter** is developed. The individual then goes on to deny his/her outgoing self" (HOLDER; WILLIAMS, 2013, Adjustment Therapy: A Positive Approach To Addictions Treatment).

In this example, the notion of agency (X filters Y), illustrated in Figure 1, is more evident. The mind acts as a filter: it selects, removes and constrains ideas. Again, it is specific interpretation of entities and relations in the source domain of filter that make it possible to construct a corresponding structure in the target domain and interpret this domain accordingly.

When we talk about "perceptual filters" in life, we do not want to recall the image (the perceptual object) of a filter in the listener's mind, but we want to recall all the knowledge associated to the concept pictured by this image, and blend it in the cognitive space of balance. We zoom in the concepts of filter and the filtering process to get tools to explain and talk about a completely distinct object. When we do that, we add perceivable features: we treat a cognitive notion as a perceptible object. The mental networks are completely different, but when we blend them, we create a space for alignments and new knowledge structures. The created knowledge is the emergent structure (blended space).

> **Example 3**: "Cognitive therapists hold that behavior can be explained by examining the contents of internal mental structures called **schemata**. […] They can be changed or elaborated through new learning, but **their very reason for being is to produce meaning from raw input. Like a cognitive filter**, **they are ever ready to be applied to create an interpretable world. Everything put through the filter is automatically processed.** As such, their primary advantage lies in allowing experience to be processed with great efficiency" (MILLON; DAVIS, 2000, Personality Disorders In Modern Life).

In this example, the way the scientist reasons about the various mental operations underlying the notion of schemata is directly dependent upon specific knowledge of the source domain of filter and inferences drawn from it. This scientific analogy uses the knowledge network of the source domain (the entities involved in the filtering process and the dynamics of this process – raw ingredients are blended in a filter to produce a new substance) to construe the concept of schemata. The entities and the high-level abstract relations that are mapped from the source domain of filtering structure to the target domain of cognitive structure give rise to many metaphorical entailments. For instance, we know that filters have a limited capacity, and that it takes some time to process raw

ingredients to generate a new product; the amount of ingredients and the amount of time involved in the filtering process are constrained accordingly. We also know that the ingredients put through the filter have to blend; it needs to have a transitivity ensuring that the linked objects react to the stimuli of each other (see Figure 1).

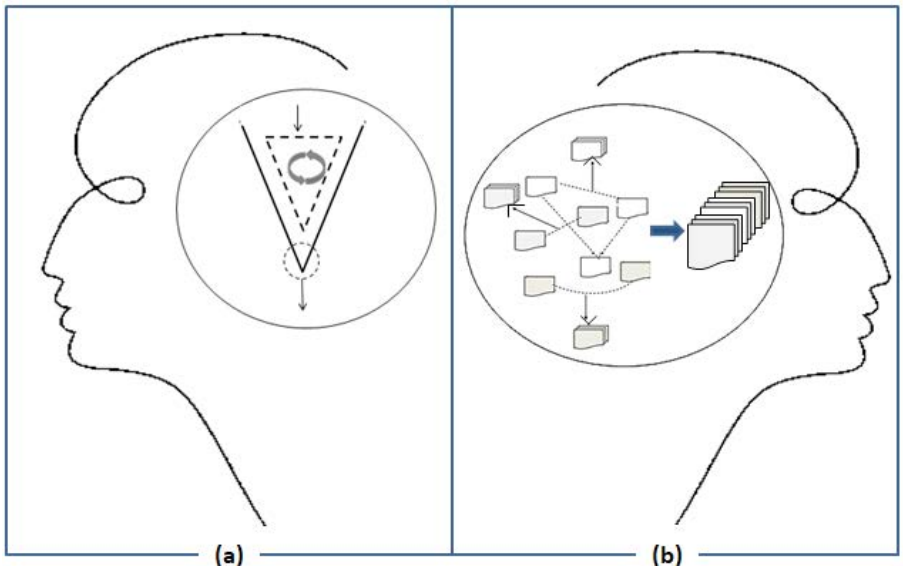
We metaphorically map these inference patterns and the image schematic structures underlying them – for instance, the physical capacity of filters is constrained by the image schema CONTAINER, whose boundary separates and constrains what is inside from what is outside; the enforced connection between objects that ensure transitivity is constrained by the image schema LINK, and so forth. These high-level abstract relations are metaphorically mapped in the target domain of schemata allowing us to construe this notion accordingly.

This scientific notion would be understood in a complete different way, if it was framed by different imagery, such as the following:

> **EXAMPLE 4**: "If we visualize **schemata** as a **series of mental file folders**, specific examples are filled mentally with more general or abstract patterns of events. Individuals may organize their schemata or mental file folders, under a broad ideological umbrella in which most information is related […] The individual can **"mentally restructure" the information by "adding, subtracting, or altering features** so that the situation fits the established mental image more readily" (LEDINGHAM; BRUNING, 2000, Public Relations As Relationship Management: A Relational Approach To the Study and Practice of Public Relations).

In this example, the concept of schemata is framed by the concept of file folders. The knowledge network of this concrete domain (the imagery, structure and inferences) is used as a background to construe the abstract notion of schemata. Specifically, the organizational and the storage features, missing in the notion of filter, metaphorically construe the idea of schemata in a complete different way. Figure 3 illustrates this difference.

Figure 3 - Representation of schemata as: (a) information processing and (b) clustering processing



Source: Own Construction (2018)

In Figure 3 (b), the dashed lines illustrate the connection between files required for their clustering, while continuous arrows illustrate the organization of related files into folders; when folders are fulfilled, they can be organized and reorganized in a way that related folders stay close to each other and far away from unrelated ones (this process is represented by the full arrow).

The comparison of examples 3 and 4 reinforces the multimodal nature of language and also the argument that writing is anchored by our comprehension of events (THOMAS; TURNER, 2011).

FINAL REMARKS

In this paper we show how multimodality operates in communication through multiple perception processes. In scientific texts, although metaphors are communicated in the verbal mode, their linguistic and conceptual configuration – instantiated by analogical processes, blending and narrative thinking – reveal them as essentially multimodal.

In our analysis, we showed how the knowledge network associated with filters and the filtering process helps to frame and construe the scientific concepts. The scientific metaphors "cognitive filter" and "perceptual filter" are used to construe the concepts of "cognitive transformation" and "schemata" in the field of cognitive psychology.

The intended contribution is to think of the metaphor in the scientific text as a trigger to see an abstract scientific construction via image schemas and thus promote blended classic joint attention in academic writing.

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