Metaphor in the ESP engineering context

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Abstract

The explicit use of metaphor in the EFL classroom has been documented to enhance the communicative skills of learners (Cameron & Low, 1999; Cortazzi & Jin, 1999; Low, 1999; Littlemore & Low, 2006). ESP learners with a technical background, however, are not usually trained on the presence of metaphor in their knowledge field, or on its use. The aim of this paper is to analyze the unprompted use of metaphor in the verbal responses given by a group of Spanish civil engineering undergraduates when depicting visuals related to their area of expertise. The responses of the students were obtained from a questionnaire completed in the classroom which was later crosschecked with the answers given by a group of professional civil engineers. This was done to compare the occurrence of metaphor as a descriptive verbalizer in the academic and the professional contexts. The results confirm the use of general metaphor in both groups, and the use of field-specific metaphor particularly in the professional engineers (in order to avoid confusion with the engineer students) group, which appears to suggest the evolving character of metaphor in the civil engineering discourse community. We conclude by highlighting the dynamicity of metaphor in the civil engineering context. From a pedagogic viewpoint, it would be advisable to concentrate on metaphor as a learning feature by considering three main dimensions: conceptual, linguistic and visual. This could be carried out by offering students corpora-driven examples of metaphor visibility in the different civil engineering genres, addressing non-verbal elements, such as sketches, drawings, designs and pictures where metaphor may be used. The theoretical framework for this study draws from conceptual metaphor theory and conceptual integration theory combined with a multimodal approach to metaphor (Fauconnier & Turner, 2002; Deignan, 2005; Steen, 2007; Fauconnier & Turner, 2008, Forceville, 2010; Kress, 2010).

Keywords: metaphor in engineering, academic and professional communication, multimodal approach, conceptual metaphor, engineering English.

Resumen

Análisis del uso de la metáfora en el contexto de la ingeniería

Diversas publicaciones (Cameron y Low, 1999; Cortazzi y Jin, 1999; Low, 1999; Littlemore y Low, 2006) explican que el uso explícito de la metáfora en la clase de lengua extranjera puede mejorar las destrezas comunicativas de los alumnos. Sin embargo, los alumnos de inglés especializado de carreras técnicas no suelen recibir docencia sobre la presencia o el uso de la metáfora dentro de su área de conocimiento. El objetivo de este artículo es analizar el uso espontáneo de la metáfora en las respuestas proporcionadas por un grupo de egresados españoles de cuarto curso de ingeniería civil (a los que se les pidió en un cuestionario pasado en clase que describieran concisamente diversas imágenes pertenecientes a obras de ingeniería. Dichas respuestas fueron comparadas posteriormente con las obtenidas por un grupo de ingenieros civiles en ejercicio con el fin de analizar el uso de la metáfora como verbalizador descriptivo en el contexto académico y profesional. Los resultados confirman el uso de metáforas genéricas en ambos grupos y el uso de metáforas específicas particularmente en el grupo de ingenieros, lo cual parece señalar el carácter evolutivo del uso de la metáfora en el ámbito discursivo de la ingeniería civil. Concluimos destacando el dinamismo de la metáfora en el contexto de la ingeniería. Desde el punto de vista pedagógico, sería aconsejable abordar el estudio de la metáfora desde tres ejes principales: conceptual, lingüístico y visual. Dicha tarea se puede llevar a cabo ofreciendo a los alumnos ejemplos reales de metáfora extraídos mediante análisis de corpus de los géneros más importantes de la ingeniería civil, incluyendo elementos de la comunicación no verbal, como por ejemplo esbozos, diseños, dibujos o ilustraciones que usen la metáfora. El marco teórico de este estudio se apoya en la teoría conceptual de la metáfora y la integración conceptual acompañada de un enfoque multimodal (Fauconnier y Turner, 2002; Deignan, 2005; Steen, 2007; Fauconnier y Turner, 2008, Forceville, 2010; Kress, 2010).

Palabras clave: metáfora en la ingeniería; comunicación académica y profesional; enfoque multimodal, metáfora conceptual, inglés para ingeniería.

Introduction

Experience, environment, or academic training could shape the way people communicate including their word choice. Similarly, language reflects the way things are perceived, categorized, or how perspective is applied. As Littlemore (2009: 13) puts it: "language reflects general cognition". To refer to this phenomenon, in cognitive linguistics construals are used. Construals

correspond to usage and correspondingly to salient and entrenched terms (Littlemore, 2009). In turn, perception, sensory-motor activities, and interaction with environment, including language, are shaped by the characteristics of the human body and its senses. This idea is central to conceptual metaphor theory that claims that metaphor is a tool common to both thought and language (Lakoff, 1987; Kövecses, 2006). If the latter is experientially grounded, so is conceptual and linguistic metaphor. In metaphor, abstract concepts are understood in terms of concrete, physical ones. In other words, physical concepts act as a source domain for abstract concepts in the target domain. This paper specifically aims to check metaphor use in the engineering context, as well as related mechanisms such as metonymy. Firstly, the use of metaphor in the engineering context is shown. Secondly, the responses that engineering students provided when asked to verbalize their perceptions are examined. More particularly, the main elements analysed in this work have been:

a. The use of metaphor in the academic stage.

b. The use of metaphor in the professional stage.

c. Variation and comparison of metaphor use between engineering students and professional engineers.

To achieve this, we have drawn from research concerned with the presence of metaphor in various engineering genres (Roldán-Riejos, 1999; Úbeda Mansilla, 2001; Roldán-Riejos, 2004; Roldán-Riejos & Úbeda Mansilla, 2006; Robisco Martín, 2009). In addition, evidence was gathered from a previously compiled linguistic corpus on civil engineering metaphor (Roldán-Riejos & Protasenia, 2007). After discussing the results obtained, we conclude with some remarks about metaphor use in the engineering domain and some pedagogical advice for the future.

Theoretical framework

Discourse studies of metaphor usually catalogue linguistic metaphor as a type of figurative speech (Deignan, 2005; Littlemore & Low, 2006) in particular attending to its use. Cameron (2003) suggests that metaphor as a linguistic expression is always contextualized and on the Metaphor Analysis Project website (Cameron, 2010), she provides a definition of linguistic metaphor:

"the use of a word or phrase that brings (or could bring) some other meaning to the contextual meaning". According to this definition, the word or phrase that brings "the other meaning" that contrasts with the main topic of the text is the vehicle and the main theme of the text is the topic. In addition, metaphorical expressions are better studied at the discourse level – that is, mostly focusing on their textual function – according to genre and to function in discourse (Roldán-Riejos & Úbeda Mansilla, 2006). Previous studies on the use of metaphor in engineering communication carried out with Spanish and English data have chiefly followed conceptual metaphor theory (Caballero 2003a & 2003b; Roldán-Riejos & Úbeda Mansilla, 2006), yet the analysis of linguistic metaphor in context has further expanded into complementary theories such as Conceptual Integration. The Conceptual integration theory can address not only blends, but also a variety of cognitive operations such as categorizations, frames, viewpoint shifts, counterfactuals, metaphor and metonymy situated in context. The Conceptual integration (blending) theory could explain mappings and construals used in engineering, as shown below.

Blends are defined as cognitive operations able to combine and create new concepts from different inputs or domains (Fauconnier, 1997a; Fauconnier & Turner, 2002). Grady, Oakley and Coulson (1999) in their example of A SURGEON IS A BUTCHER, present a generic space that splits into two inputs spaces (the medical space and the commercial space of a meat seller), and a new blended space that emerges containing both shared and new characteristics. Deignan (2005: 222) points out the advantages of a new third mental space that is shaped with inherited and at the same time unique structure, rather than simply taking input from the source domain into a target domain. Blends provide a dynamic view of meaning construction by combining generic domains, and source and target domains fusing into emergent meaning. In engineering, we can identify blend examples that derive from various source domains, eventually acquiring innovative senses (Úbeda Mansilla, 2001; Úbeda Mansilla, 2002; Roldán-Riejos, Úbeda Mansilla & Santiago López, 2011). For instance, inputs from the domains of psychology and medicine may merge with engineering, giving out terms that have a frequent use in engineering such as: "stress", "vulnerability", "excitability", "fatigue", etc. Figure 1 shows a network of two mental spaces that can be frequently found in engineering.

Mental spaces are dynamic packages of information created in discourse. Fauconnier (1997b: 1) literally refers to "very partial assemblies constructed as we think and talk, for purposes of local understanding and action". In addition, mental spaces "are built up dynamically in working memory but

can become entrenched in long-term memory" (Fauconnier, 1997b: 3). Figure 1 also represents the mental spaces that may be simultaneously evoked whilst discussing the wellbeing of people in bodies, such as medical care and aesthetic elements (for instance, a good figure).

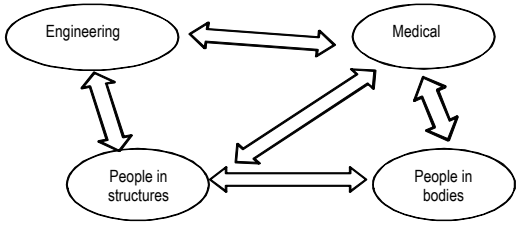

Figure 1. Network of mental spaces connecting medical and engineering inputs.

Matching spaces can be evoked to refer to the welfare of people living or visiting a built structure (such as a "building"), that mentally activates not only physical factors (for instance, good lighting or good views) but also aesthetic ones (like the nice shape of the building). As a result, a new structure would emerge out of these spaces and inputs by fusing the healthy (therapeutic) and the aesthetic sides. According to Fauconnier and Turner (2002: 132), this process involves a "double-scope network". This means that the different organizing frames of the inputs contribute evenly to the blend, which should be innovative. In engineering, the welfare of people living in a building is concerned with feeling comfortable inside by receiving the right quantity of light, enjoying a pleasing view, the absence of distracting noise, the right temperature and ventilation. At the same time, it has to do with the building presenting an external pleasant shape as a result of an adequate previous design, as represented in Figure 2.

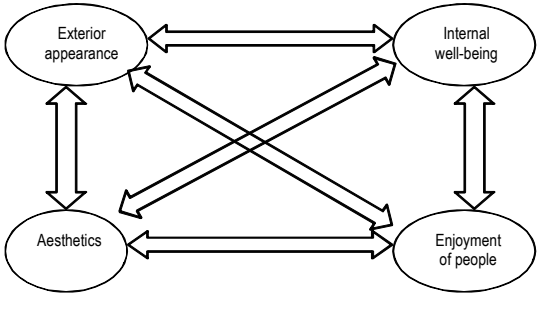

Figure 2. Double scope network combining aesthetic and medical blends.

Given the relevance of design shown in their external representation of buildings, the visual component of engineering artifacts deserves due consideration. For this purpose, a multimodal and comprehensive analysis is needed. Kress (2010) claims that it would be inaccurate to consider only speech and writing to analyse human communication. As an example, in the research of classroom communication, he proposes to add social, semiotic and multimodal factors or modes (for instance, intonation, gesture, images and action) to language. Kress (2010: 81) considers the dynamicity and intricacy of human communication through the study of "multimodal ensembles". In a similar tenor, Forceville (2010: 58) argues for the convenience "to research not just verbal, but also non-verbal and multimodal tropes" throughout training. Both Kress and Forceville point out the "multimodality" of meaning and, in particular, the role of semiotic inputs to produce meaning. Accordingly, meaning construction is not restricted to linguistic elements; it also needs other channels, such as the visual, and therefore requires the use of a variety of cognitive abilities. Seemingly, it makes sense to extend this approach to engineering, where examples of linguistic metaphor triggered by visual input (Caballero, 2003a & 2003b; Roldán-Riejos & Úbeda Mansilla, 2006) have been underlined.

In civil engineering, the bridge designer is likely to represent superimposed images in the actual shape of a bridge. Hence, both the bridge's practical use and its iconic/artistic stance are considered engineering goals. Calatrava (2008), a reputed engineer and architect, has declared that he designates and elaborates his works as "artefacts" and "sculptures". An example of this is the Alamillo Bridge (see Figure 3), which was designed as a portico to the Seville World Exhibition 1992, popularly known as "Expo". This cable-stayed bridge has been commonly depicted as a harp, a fan, and a swan that glides over the Guadalquivir River[1]. Therefore, apart from its typical use as a bridge to cross a river, the iconic interpretation of the bridge depends upon the conceptual relations of representation, analogy and intentionality. For example, in viewing the bridge like a swan the aquatic bird frame, the colour frame (the main pylon of the bridge is white) and the explicit intention of the designer to make it slender and to convey a sense of movement are all compressed. One of the most important issues for an engineer who designs a bridge, a highway, or a dam, is to consider the way these structures integrate into the environment. It is different to build in the middle of an urban area from locating a structure by a harbour or in a valley. Therefore the setting – that is, the context – is likely to influence the choice, the design and possibly

the visual metaphor that may be implied. As a result, visual metaphor may be influenced by context in the same way as conceptual metaphor is influenced by topic (Kövecses, 2010).

Figure 3. Alamillo Bridge in Seville (Spain).

In this case, the outcome of the activated conceptual relations, for example the relations of analogy/similarity, role-value and cause-effect from the inputs about the bridge resembling a swan, combine the analogical compression of the bridge mapped as an aquatic bird. In turn, this is coupled by the aesthetic blend of the beauty/elegance of a swan, which metonymically (PART/WHOLE) accounts for the beauty/smartness of the bridge. The mapping in this blend is iconic because the shape (the swan) reflects the meaning (the bridge or the elegance of the bridge, if interpreted metonymically). It also reflects the intentionality of its design, since the engineer intended the bridge to become a landmark and to integrate it as such in the urban landscape.

In the case of representing the bridge as a harp[2], other compressions, such as the musical sound of the water movement or the musical sound of air when flowing through and across the cables may be involved. The mapping of the bridge as a fan involves folklore local elements associated with the host city, Seville, which are added to the compression. Calatrava (2008) has acknowledged that he envisaged this bridge as a dialogue between its deck and the holding pylon. In short, principles of conceptual metaphor, conceptual integration theory and multimodal analysis have been taken into account to complete the present study.

Methodology

This paper focuses on the verbal responses provided by a group of civil engineering students of English in the 4th year of their studies (out of a six year-degree). The answers were directly elicited after looking at various engineering images (see full questionnaire in the Appendix). The civil engineering degree includes the subject of English which is learnt from an ESP approach. Most students have a B1 or B2 level of English according to the Common European Framework of Reference for Languages (CEFR). The pictures shown consisted of three different bridges and participants were asked to write a word that would best convey their perception of each picture. The aim was threefold:

1) to analyse the construals created by the students;
2) to identify the use of metaphor; and
3) to compare their answers with those obtained from a group of 10 civil engineers.

There was only a difference in the procedure followed for both groups, namely that the students answered the questionnaire in the classroom and the engineers were offered online access (through Monkey Survey). In the information provided, all participants were asked to put across their first impressions about the pictures, preferably using one word (although a few participants used two words). The reasons to ask for this responded to an attempt to gather straightforward and genuine replies from respondents. No further indications were provided in the question so as not to influence or contaminate responses. Even though the main purpose of the survey was to identify the choice of construal and in particular the use of metaphor, no mention of metaphor was made in order to obtain uncontaminated answers. The three bridges shown were all contemporary bridges and selected at random: *Príncipe de Viana* bridge in Lérida (Spain) built in 2010; Millennium bridge in Newcastle (United Kingdom) built in 2000; and *Ponte do Millenio* bridge in Orense (Spain) built in 2001. These pictures are included in the final Appendices. Additionally, to verify a possible relation between metaphor use and professional experience, a few preliminary questions were added to get additional information about the participants' background and degree of expertise.

The methodology was developed in two major stages:

Stage 1: The starting point derived from a study of the literature about (conceptual and linguistic) metaphor in architecture and civil engineering language (Úbeda Mansilla, 2001; Roldán-Riejos, 2004; Roldán-Riejos & Úbeda Mansilla, 2006; Roldán-Riejos, Úbeda Mansilla & Santiago López, 2011). Likewise, data drawn from a linguistic corpus previously compiled in Spanish and English from engineering electronic journals (Roldán-Riejos & Protasenia 2007), spanning a 5 year period was consulted. Through the application of corpora-driven software (ANTCORD), a list of lexical tokens arranged according to frequency was compiled (in this case adjectives, verbs and adverbs were discarded to focus on nouns). After this, linguistic metaphors were manually identified following the method proposed in Steen (1999) and by the Pragglejaz Group (2007), and eventually tokens were contextualized through the use of concordances. Table 1 includes some examples of the most frequent linguistic metaphors drawn from this corpus, primarily extracted in Spanish and subsequently translated into English.

Spanish	Estado	Estribo	Boca
	Comportamiento	Cabeza	Envejecimiento
	Vida	Estados	Almas
	Tratamiento	Pie	Auscultación
	Límite	Fisura	Intervención
	Eficacia	Flexión	Rótulas
English	State	Stirrup	Mouth
	Behaviour	Head	Aging
	Life	States	Souls
	Treatment	Foot	Auscultation
	Limit	Fissure	Surgery
	Efficiency	Flexion	Kneecaps

Table 1. Metaphoric tokens from the corpus arranged according to frequency.

Despite their high frequency in civil engineering discourse, the basic meanings of many of these tokens evoke parts of the human body ("head", "stirrup", "foot", "mouth"), processes affecting the human body ("behaviour", "life", "aging") or contain a medical sense ("treatment", "auscultation", "surgery"). Looking at the concordances of *tratamiento* ("treatment"), it has actually proved to collocate with other terms bearing a potential metaphorical load, such as *envejecimiento* ("aging") and *diagnóstico* ("diagnosis"). All in all, these data point out analogies that are usual in the way engineers conceive their work. As an illustration, the Turning Torso high-rise building in Malmö (Sweden) designed by Calatrava was inspired by the human body in movement. Embodiment is exemplified in this case and in others, for example the Blinking Eye bridge (a lift bridge in Newcastle). Hence, reasonable linguistic

proof on the occurrence of metaphor in engineering can be gathered. Furthermore, the analogical nature of engineering work in particular examples appears to suggest a ubiquitous role of metaphor (Ungerer & Schmidt, 2006: 147). These conclusions lead to the next step in the study.

Stage 2: Metaphors in engineering are often expressed in lexical terms that may evoke a visual source. Engineers have to resort to drawings and sketches not only during the design stage of buildings and artefacts but throughout the whole construction process. Once finished, the completed work is usually arranged to metaphorically suggest visual images. Manterola, a Spanish civil engineer, parallels the design of a bridge to laying a ribbon on the surrounding ground:

> The idea is just as if we detach a stretch of land from its support to overcome an obstacle. The ribbon that represents the road is taken apart from the ground in order to speed up and due to that separation, the river or the valley prevents the ribbon from advancing. (Manterola, 2010: 57 – our translation from Spanish original)

It is not surprising then that engineering products can be depicted through metaphoric language such as: "the jagged fan of five overscaled concrete fins" (Caballero, 2003b: 150) used to describe a building. At this point, it is advisable to distinguish between specific vs. non-specific metaphor, since both types were found in the submitted data. Non-specific metaphor would be generic, not pertaining to a particular domain. For example, "fish mouth" chosen by one student to describe a bridge would be a non-specific metaphor. By contrast, a specific metaphor such as "fan" would be related to a particular area of expertise and therefore it is likely to be shared by the discourse community. As the Pragglejaz Group (2007) pointed out the procedure to identify individual words with metaphorical meaning runs as follows: "for each lexical unit, determine if it has a more basic contemporary meaning in other contexts than the one in the given context". Another principle from the Pragglejaz Group (2007: 3) is that "basic meanings tend to be: more concrete; what they evoke is easier to imagine, see, hear, feel, smell, and taste; it is related to bodily action; it is more precise (as opposed to vague); and it is historically older". Therefore, the contextual meaning has to be confronted with the basic meaning/s: "The contextual meaning contrasts with the basic meaning and can be understood by comparison with it" (Pragglejaz Group (2007: 6). We have followed this method to identify metaphor use by the participants in this study.

Results and discussion

Table 2 contains seven categories that were established to classify the construals obtained and have been arranged according to function.

Abbreviation	Construal	Function
GN	General Noun	Participants use a non-technical abstract noun
ASN	Area Specific Noun	Participants render a noun clearly pertaining to area of expertise
ASA	Area Specific Adjective	Participants render an adjective clearly pertaining to area of expertise
SN	Subjective Noun	Respondents provide a subjective evaluation noun that could be catalogue as merely individual opinion
SA	Subjective Adjective	Respondents provide a subjective evaluation adjective that could be catalogue as merely individual opinion
Mph	Metaphor	This is used to reflect metaphor use of any type
Mn	Metonymy	This is used to reflect metonymy use of any type

Table 2. Distribution of construals and their corresponding functions.

Examples grouped under this distribution are included in Table 3.The rationale behind this classification mainly responds to practical reasons, since any response could be subject to the specificities of this technical field.

Participants Categories	Students	Engineers
GN	*Estética* (Aesthetics)	*Belleza* (Beauty)
ASN	*Tirante* (Tie)	*Pasarela* (Footbridge)
ASA	*Estable* (Stable)	*Atirantado* (Cable-stayed)
SN	*Complicación* (Complication)	*Ficción* (Fiction)
SA	*Curioso* (Curious)	*Innecesario* (Needless)
Mph	*Ojo* (Eye)	*ADN* (DNA)
Mn	*Cinta de Moebius* (Möbius strip)	*Arco* (Arch)

Table 3. Examples of grouped construals.

Table 4 included data arranged in percentages according to the aforementioned construals. The total number of students' replies that was analysed was 62, and 39 in the case of engineers.

Our findings reveal a significant number of subjective adjectives (SA) used by students (26%), which matches a similar frequency in the engineers' group (26%), the latter also reflecting a high use (23%) of Subjective Nouns (SN) and a reasonable number of Area Specific Adjectives (ASA) (15%). Probably, this can be attributed to the fact that engineers are used to issue

technical reports containing personal and professional evaluative opinions. Metaphor use is remarkable in the case of students (18%). This fact is, nevertheless, analysed below.

Abbreviation	Students		Engineering	
	Frequency	Percentage	Frequency	Percentage
GN	5	8%	3	8%
ASN	7	11%	3	8%
ASA	12	19%	6	15%
SN	7	11%	9	23%
SA	16	26%	10	26%
Mph	11	18%	4	10%
Mn	4	7%	4	10%

Table 4. Construal frequency and percentage.

Metaphors are classified in Table 5 attending to their thematic content. Previously, they were identified according to the Pragglejaz Group's (2007) instructions. Specifically, group 1 refers to the notion of "shape", since most examples contain a variety of them. This first group was further broken down into two subgroups. Subgroup 1.1 includes metaphors that could be considered conventionally typical of civil engineering. That is to say, they are common in engineering technical language. By contrast, the subgroup 1.2, while still referred to "shape", comprises non-specific metaphors – that is, generic, non-technical metaphor. The online Oxford English Dictionary (OED, henceforth) was used to check the basic meanings of the cases included. For instance, in the OED "fan" is generically defined as: "a handheld device, typically folding and shaped like a segment of a circle when spread out that is waved so as to cool the person holding it". Nevertheless, "fan" is also a frequent metaphor in civil engineering because it designates a cable-stayed bridge with fan-shaped cables (contextual specific meaning).

Metaphor type		Students	Engineers
1. Shape	1.1 Specific	Fan	Harp
		Harp	
		Butterfly	
		Saddle	
	1.2 Non-specific	Fish mouth	Jaws
		Sailboat	
		Eye	
2. Other disciplines (like Biology)			DNA
3. Other			McDonald's

Table 5. Metaphors thematically arranged.

In the case of the McDonald's metaphor, it appears to have a strong derogatory meaning, and the analogy of the bridge construction with a lack of technical preparation could be inferred, similar to the fast food chain production. It could also be considered a metonymy in the sense that we identify the restaurant with the food served in it. The contextual meaning contrasts with the basic meaning and can be understood by comparison, by questioning the bridge's basic conditions. In addition, MacDonald's may have further metaphorical implications as a symbol of mass consumption.

Table 6 shows the percentages of metaphor use distributed by groups. Metaphors referred to shape present a higher ratio in all groups. However, whereas engineers used a higher amount of specific metaphors (40%), students used general non-specific ones (50%). This phenomenon could suggest that metaphor use undergoes a developing process in the different (academic and professional) stages of engineering.

	Students		Engineers	
	Frequency	Percentage	Frequency	Percentage
Shape Specific Metaphor	3	25%	2	40%
Shape Non Specific Metaphor	6	50%	1	20%
Other disciplines	3	25%	1	20%
Other	0	0%	1	20%

Table 6. Metaphor frequency and percentage.

Occasionally we found that metaphor and metonymy co-existed in the same figure of speech and could be interpreted either way. In fact, metaphor and metonymy, though quite different in their cognitive mechanism, can work together in a continuum where they become difficult to dissociate. This phenomenon has been named as "metaphonymy" (Goossens, 1995: 160). For example, two particular construals of THE FORM FOR THE WHOLE metonymic relation were elaborated showing a strong visual association with geometrical shapes, as shown in Figure 4. At the same time, they also turned out to be metaphorical, reflecting embodiment and a geometrical analogy simultaneously. The upper pictures illustrate an analogy between DNA representation and the shape of Ponte do Milenio whereas the lower ones depict Möbius strip (a type of twisted cylinder, a mathematical object) evoked by the Newcastle Millennium Bridge.

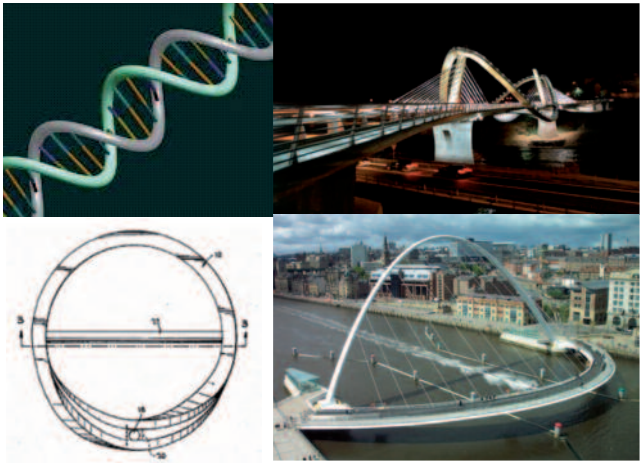

Figure 4. Dual metonymic and metaphoric associations.

The main difference between metonymy and metaphor is that metonymy does not "transfer" meaning in a relation of similarity, instead it "combines" meanings within the same domain. This relation can be PART/WHOLE. It can be said that metonymy creates contiguity between two concepts, whereas metaphor works by establishing a comparison between them. According to the Pragglejaz Group (2007), metaphor basically deals with comparison, whereas metonymy would express "a stand-for, or part-for-whole, relationship that differs from comparison processes" (Pragglejaz Group, 2007: 31). For differentiation, they suggest the proof of the "like" test in the case of metaphor. For example, *a bridge is like an eye*. All in all, the result seems to be that students lack familiarity with the use of metaphor or metonymy in their speciality and their use of metaphor seems to be rather intuitive. Therefore, the inclusion of metaphors in ESP training could make students more knowledgeable about these aspects of the specific language of their discourse community. We likewise recommend considering the multimodal aspects of metaphor, since both metaphor and metonymy occur in engineering communication, notably in the visual form. The use of authentic examples from corpora and exploring the meaning of existing engineering structures could help to make students aware of this phenomenon.

Conclusions

In this paper, examples of the use of metaphor in the domain of civil engineering have been examined. As a derivation of its use in this field, conceptual, linguistic and visual aspects have been taken into account both in the academic and professional stages. The starting point of this study was to carry out an in-depth analysis of the construals used by a group of engineering students and experts to portray visual examples of their specialty. To this end, some insights about the way in which engineers may interpret and convey images of their specialty area are presented. In the analysis of results, the occurrence of metaphor is particularly highlighted including an attempt to shed light on the different use of specific and non-specific metaphor according to professional expertise. Finally, given the ubiquity of visual metaphor in civil engineering, we consider fit to introduce a multimodal approach that deals with all possible scenarios of metaphor identification and metaphor use in the classroom. This could be done by working with authentic examples of linguistic, conceptual and visual metaphor in engineering communication and could be implemented through corpora driven data. Nevertheless, further studies dealing with pedagogic action on the role of metaphor in the ESP engineering classroom are still necessary.

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NOTES

[1] Alamillo bridge is compared to Erasmus bridge in Rotterdam, commonly nicknamed as "The Swan" URL: http://todaunaamalgama.blogspot.com.es/2012/08/el-sevillano-errante.html [24/04/12]

[2] URL: http://www.plus.es/noticias/puente-forma-arpa-Alamillo-cumple-anos/20120229csrcsrsoc_3Tes/ [10/03/12]

Appendix: The questionnaire

DEPARTMENT OF APPLIED LINGUISTICS
ETSI CAMINOS, CANALES Y PUERTOS (CIVIL ENGINEERING)
UNIVERSIDAD POLITÉCNICA DE MADRID (UPM)

The following questionnaire is part of ongoing research work on academic/ professional cognition and meaning construction. Its results will be considered in the design of a higher education large study coordinated by the UPM (Technical University of Madrid), Spain. The objective of the questionnaire is to obtain information about your perception and comprehension techniques in various examples.
Please try to answer each question, by ticking√, filling in the blanks, or answering as needed.
When you finish off the questionnaire please send it to:
Profs. Ana Roldán-Riejos & Paloma Úbeda Mansilla
Departamento de Lingüística Aplicada a la Ciencia y Tecnología
FAX NUMBER: +34-91 3365386
DIRECT PHONE: 34-91 3365386
E-MAIL ADDRESS: aroldan@caminos.upm.es & paloma.ubeda@upm.es
Thank you very much for your help!

1. Personal Profile

1.1. Are you a Civil Engineering? □Yes □No
Your major is ----------
1.4. What is your gender? □ Male □ Female
1.5. What is your age?
25-30□ 31-35□ 36-40□ 41-45□ 46-50□

2.1. **To design** a bridge/building or any type of structure what is your main consideration? Please number 1-5 according to importance: 1 highest, 5 lowest:

	-1	2	3	4	5+
Its overall shape					
Its foundations and each single element					
Its future stability					
Its environmental integration					
Other (please specify):					

2.2. When **considering** any type of building/structure, your main concern lies in: (please number 1-5 according to importance: 1 highest, 5 lowest):

	-1	2	3	4	5+
Its aesthetics					
Its design calculations					
Its future behaviour					
Its cost					
Other (please specify):					

2.3. **When talking** to a colleague about any type of building/structure, you tend to: (please number 1-5 according to importance: 1 highest, 5 lowest):

	-1	2	3	4	5+
Draw a picture					
Use a diagram					
Use mathematical calculations					
Explain with words					
Others (please specify):					

2.4. When **reading** about building/bridge construction or any other built structure, you spend more time with and pay more attention to: (please number 1-5 according to importance: 1 highest, 5 lowest):

	-1	2	3	4	5+
Pictures, diagrams, charts, tables					
Mathematical calculations					
Text about it					
Similar examples					
Others (please specify):					

2.5. In **the civil engineering/architect profession** what is the importance given to the following? (Please number 1-5 according to importance: 1 highest, 5 lowest):

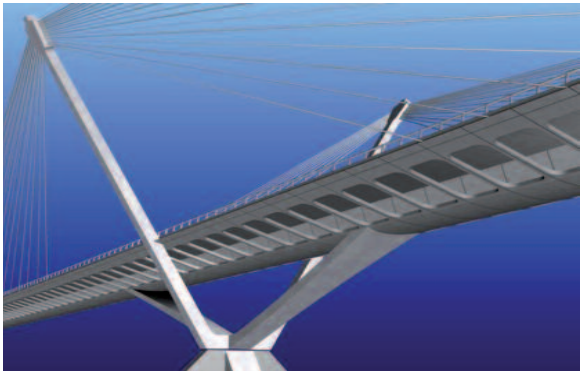
	-1	2	3	4	5+
Not exceeding the budget					
Its durability					
Its appearance					
Its utility					
Others (please specify):					

2.6. Now please specify what **you consider** more important according to **your own personal** experience (Please number 1-5 according to importance: 1 highest, 5 lowest):

	-1	2	3	4	5+
Not exceeding the budget					
Its durability					
Its appearance					
Its utility					
Others (please specify):					

2.7. Take a quick look at each of these pictures/drawings and write one word that better illustrates your perception:

2.7.1. Please, write a word that better illustrates your perception._____



2.7.2. Please, write a word that better illustrates your perception._____

2.7.3. Please, write a word that better illustrates your perception._____

Thank you very much!