

METAPHOR AND GENRE: AN APPROACH TO IMPROVE THE LEARNING PROCESS OF ENGLISH FOR AERONAUTICS

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ABSTRACT. *This study suggests a theoretical framework for improving the teaching/ learning process of English employed in the Aeronautical discourse that brings together cognitive learning strategies, Genre Analysis and the Contemporary theory of Metaphor (Lakoff and Johnson 1980; Lakoff 1993). It maintains that cognitive strategies such as imagery, deduction, inference and grouping can be enhanced by means of metaphor and genre awareness in the context of content based approach to language learning. A list of image metaphors and conceptual metaphors which comes from the terminological database METACITEC is provided. The metaphorical terms from the area of Aeronautics have been taken from specialised dictionaries and have been categorised according to the conceptual metaphors they respond to, by establishing the source domains and the target domains, as well as the semantic networks found. This information makes reference to the internal mappings underlying the discourse of aeronautics reflected in five aviation accident case studies which are related to accident reports from the National Transportation Safety Board (NTSB) and provides an important source for designing language teaching tasks.*

KEY WORDS. *English for Aeronautics, genre-based approach, cognitive linguistics, metaphor.*

RESUMEN. *La Lingüística Cognitiva y el Análisis del Género han contribuido a la mejora de la enseñanza de segundas lenguas y, en particular, al desarrollo de la competencia lingüística de los alumnos de inglés para fines específicos. Este trabajo pretende perfeccionar los procesos de enseñanza y el aprendizaje del lenguaje empleado en el discurso aeronáutico por medio de la práctica de estrategias cognitivas y prestando atención a la Teoría del análisis del género y a la Teoría contemporánea de la metáfora (Lakoff y Johnson 1980; Lakoff 1993). Con el propósito de crear recursos didácticos en los que se apliquen estrategias metafóricas, se ha elaborado un listado de metáforas de imagen y de metáforas conceptuales proveniente de la base de datos terminológica META-CITEC. Estos términos se han clasificado de acuerdo con las metáforas conceptuales y de imagen existentes en esta área de conocimiento. Para la*

enseñanza de este lenguaje de especialidad, se proponen las correspondencias y las proyecciones entre el dominio origen y el dominio meta que se han hallado en los informes de accidentes aéreos tomados de la Junta federal de la Seguridad en el Transporte (NTSB).

PALABRAS CLAVE. *Inglés para Aeronáutica, teoría del género, lingüística cognitiva, metáfora.*

1. INTRODUCTION

Numerous linguistic theories and approaches give information about how students acquire their knowledge of the language and about the conditions which will promote successful language learning (the Psycholinguistic theory, the Socio-cultural theory, etc). In this study, the focus will be on *Genre analysis* (Swales 1990; Bhatia 1993), which is a major approach in the field of English for Specific Purposes (ESP), and on the *Cognitive Paradigm*, with the contribution of Contemporary theory of Metaphor (Lakoff and Johnson 1980; Lakoff 1993).

Metaphors can be considered important tools to help ESP practitioners to create and design teaching materials and to accelerate the learning process of ESP students. The Cognitive Theory of Metaphor states that both thinking language are metaphorically structured (Lakoff and Johnson 1980). Then, taking into account this premise, we will provide some basic information on a series of image metaphors and conceptual metaphors related to the aeronautical discourse and on cognitive styles and learning strategies. We will argue that metaphor awareness is a useful pedagogical instrument to improve skills such as vocabulary acquisition or reading comprehension, among others². In addition, we will describe the effectiveness of the learning process through a content-based approach and a genre-centred approach. The relevance of the former has been addressed in different studies (Cuadrado Esclapez 2009; Kasper 1995, 1997; Brinton et al. 1989; Blanton 1993) which give evidence that content-based courses enhance the learners' performance in both language and academic content. Regarding the genre-centred approach, Swales (1990: 82) postulates that "this approach is likely to focus students' attention on rhetorical action and on the organizational and linguistic means of its accomplishment".

Different research have been devoted to the study of the pedagogical role of metaphors (Caballero-Rodríguez 2011; Pierce and Robisco 2010; Barcelona 1997; Boers 1999, 2000a, 2000b; Herrera and White 2000; Úbeda 2001; White 2003; Radden and Dirven 2007, among others) for the last two decades. Some of these insightful studies have dealt with the role of metaphorical issues in texts of scientific-technical disciplines but few (Robisco Martín 2004; Robisco Martín 2005a; Cuadrado Esclapez and Robisco Martín 2011; Robisco Martín 2011) have coped with the language employed in the aeronautical discourse. On the other hand, in the line of Genre Analysis research, much attention has been given to the definition of academic genres, such as abstracts (Swales 1990; Posteguillo 1996), research articles introductions (Swales 1990; Bhatia 1993; Piqué and Andreu-Besó 1998) and other sections within the research papers. Less attention has been paid to the study of non-academic genres, although there are relevant publications

such as *Worlds of Written Discourse: A Genre-Based View* (Bhatia 2004) or *The Art & Craft of Case Writing* (Naumes and Naumes 1999). However, no articles have focused specifically on the rhetorical considerations which govern aviation accident case studies.

This paper provides several activities and tasks which involve experiential learning (Rogers 1969). They have been designed with the purpose of helping students to be familiar with the role that accident case studies play in the aeronautical sector and to concentrate on the conceptual metaphors and image metaphors employed in them. They encourage students to employ cognitive strategies such as imagery, deduction, inference and grouping which have proven to be effective in language comprehension and vocabulary acquisition. They allow students to deal with five aviation accident case studies which form part of the authentic materials used in English lessons at the School of Technical Aeronautical Engineering. Accident case studies (a specific sub-genre), on the one hand, increase student motivation by giving the learner the feeling that he or she is learning the 'real' language and, on the other, enable students to become familiarized with the performance of aircraft, components and systems, and to recognize potential problems that vehicles may have.

This pedagogical practice brings us closer to the final purpose of this study: to apply a theoretical framework which combines Genre Analysis and the Contemporary theory of Metaphor in order to increase the linguistic competency of non-native students of aeronautical engineering by enabling them to cope with the abstract knowledge related to this specific field and to deal with the communicative purposes that the accident case studies intend to achieve. Results of classroom observation suggest that, with this pedagogical approach, learners' motivation and, consequently, language acquisition are higher since positive intervention is more frequent than lack of co-operation and negative interruption.

2. SOME BASIC THEORETICAL PRELIMINARIES

This section will describe the contribution of the cognitive theory with cognitive styles and strategies and with the cognitive theory of metaphor; and then, it will deal with the relevance of the genre-centred approach in the study of ESP. The chief features of content-based approach will be mentioned in section 3.

The Cognitive paradigm has offered theoretical data concerning the students' learning styles and the language learning strategies (Chamot 1990; O'Malley 1987; O'Malley and Chamot 1990) and has given empirical evidence that metaphor awareness in ESP has a positive effect in second language acquisition since it encourages students to employ metaphoric extension strategies (Low 2008; Littlemore 2004).

A general overview of some basic issues about the cognitive styles and strategies constitute relevant information in order to predict the kind of strategies or methods that could be most effective for a given individual and learning task.

2.1. *Cognitive styles*

Cognitive styles refer to the way a student processes information, thinks and infers i. e. having a particular cognitive style refers to the tendency of students to learn in a certain manner. Two of the main cognitive styles relevant to this study are:

- Field independence versus field dependence. It refers to a tendency to approach the environment in an analytical, as opposed to global way. At a perceptual level, a field independent learner can distinguish figures from their backgrounds while field dependent individuals experience events in an undifferentiated way. In addition, field dependent individuals have a greater social orientation relative to field independent personalities. However, the latter are influenced less by social reinforcement, they are also likely to learn more effectively under conditions of intrinsic motivation, as, for instance, self-study).
- Serialists versus holists: serialists prefer to learn in a sequential way, whereas holists prefer to learn in a hierarchical manner, i.e., top-down. The former use visual images and their own experience to build up understanding. The latter use elaboration strategies, such as planning and selecting, in order to relate the different parts of the new information to each other and to their personal experience. Most of the learners show a general inclination to one of the styles although there are some students who are equally at ease with either of them and some who are totally serialist or holist in their approach.

2.2. *Cognitive strategies*

Cognitive strategies (O'Malley 1987; O'Malley and Chamot 1990) refer to the specific actions, behaviours, steps, or techniques students use -often consciously- to improve their progress in apprehending, internalizing, and using the L2 (Oxford 1990). According to O'Malley and Chamot (1990), they are the following:

- Imagery: this strategy refers to the use of visual or non visual images (either generated or actual to understand or remember new information)
- Deduction: it refers to applying or analyzing rules to understand or produce language. The latter may involve misunderstandings.
- Inference: it involves guessing the meaning of words or phrases, predicting the next items or information in sequence, or predicting conclusions.

Strategies are not used in isolation. Thus, cognitive strategies (e.g., translating, analyzing) and metacognitive strategies (e.g., previewing, planning, organizing) are often used together, supporting each other (O'Malley and Chamot 1990).

2.3. *Cognitive theory of Metaphor*

Cognitive linguistics considers both metaphor and metonymy as two basic mechanisms for understanding and categorising the world. This approach distinguishes

two main types of metaphors: conceptual metaphors and image metaphors. Conceptual metaphors operate in our thought and can be defined as “a cross-domain mapping in the conceptual system” (Lakoff 1993: 203). Image metaphors map only one image onto another by virtue of its internal structure. They are usually visual (Lakoff 1993: 219). According to this author, mental images involved in metaphors have a different character to those analysed by cognitive psychologist. The image metaphors apply to conventional images that are acquired unconsciously and automatically over the years by members of a cultural community. It is significant to observe that image metaphors are structure mappings at the conceptual level, and as such can interact in different ways with conceptual metaphors. Both types serve to group metaphorical expressions.

2.4. *Genre-centred approach*

Broadly speaking, in *Genre Analysis*, an ESP student should focus on the analytical description of ESP texts, on the social context of their creation and on the communicative purpose they intend to achieve. Following the definition given by Swales (1990) and Bhatia (1993) the concept of genre relates to communicative events or acts. Genres are defined by features such as text purpose, writer/reader relationships, and the medium of communication which have implications in syntax, lexical choice, organization and layout. The result is that genres are not just texts; they are classes of communicative events which share a set of communicative purposes. According to this approach, Swales (1990: 72) claims that in an educational setting, tasks are seen as having communicative outcomes, genres as having communicative purposes and discourse communities as having communicative goals.

3. CONTENT -BASED APPROACH TO ESP LEARNING

In this section, we will begin by providing a brief theoretical background concerning the content-based approach to language teaching. We consider it the most appropriate in order to apply metaphors in the learning of English for science and technology. According to this approach, language is acquired by the students in a meaningful contextualized form in which the focus is on the acquisition of both language and information.

Content-based instruction is an approach in which language proficiency is achieved by shifting the focus from learning the language per se to the learning of subject matter. The main feature is that the organisation of the syllabus should be derived from specific subject matter associated with the interests of the academic areas of the educational context. The remainder of the contents (grammar, vocabulary, functions, skills development...) should be organised around the topic. Thus, it enables materials involving traditional skills and grammatical constructions to be integrated into the field of study of the learners. As Parkinson (2000: 383) remarks:

Reading, speaking, listening and writing skills, awareness of the audience and register as well as grammar can be taught as they become necessary for the acquisition of content and analysis of data, rather than as an end in themselves. Importantly, it enables the development of schemata for the reading and writing of important text types.

A second salient feature of this approach is that the core materials selected are authentic materials, i.e. they are selected from those produced for native speakers of the language. Consequently, they emanate from the culture being studied rather than from sources especially prepared for students of the language. Using authentic materials implies using higher order thinking skills and applying the cognitive skills students have acquired in content courses in their own language. Thus, the learners face cognitively challenging tasks since they are realistic and interesting for them (Cuadrado Esclapez 2009).

Studies suggest that, in their effort to comprehend discipline-based materials, students become aware of how to construct meaning from information stored in memory, of how to extract relevant information from the larger text context, and of how to filter out redundant or irrelevant information (Kasper 1997). Since meaning arises from the author's texts and the reader's personal experience, by this approach students get engaged in a cognitive and intellectual interaction which helps to develop language proficiency together with thinking and critical skills, both necessary for their academic experience (Blanton 1993). Meaning construction aimed at language proficiency is facilitated by activities that require the student to engage in, to interact with and to synthesize information from course texts.

With respect to students learning styles and strategies, holistic task-based and content-based programs tend to give an advantage to global learners. For this reason, in our classroom we must also provide atomistic activities which develop the skills of analytic learners, including the formal study of grammar.

On the other hand, this approach has been shown to be more appropriate for students with a high tolerance of ambiguity (Ehrman 1996). However, students with a lower tolerance of ambiguity can be helped in developing strategies for dealing with these situations through pre-task research and the use of books and dictionaries in the classroom. Indeed, with practice they may develop learning strategies like skimming and scanning skills, guessing at meaning, etc which are needed for global learning and for a high tolerance of ambiguity.

A final implication of this approach is that the teacher must have a knowledge basis for dealing with technical or scientific content. However, how deep this knowledge is depends on the level of the students. A course for first year students may need only some documentation and co-operation from his/her colleagues from other departments. Such collaboration has the added advantage of being very valuable to their academic knowledge acquisition.

As may be inferred from the previous points, it is not assumed that the learners acquire grammatical competence in the foreign language while doing exactly the same activities as they would do in a subject matter class, i.e. without paying any attention to

formal grammar. Indeed, as it has already been mentioned, even our advanced students want formal grammar in an explicit manner.

4. METHODOLOGY

Five case studies which come from accident reports available on the National Transportation Safety Board (NTSB) have been proposed as authentic materials in this study. They provide background knowledge about the content area. They were used in an aviation accident investigation carried out in the University of Nebraska in 2006³ with the aim of preventing similar accidents from happening again. The accidents took place within a period which dated between January 1999 and May 2004.

Some scientific metaphors found in these authentic texts are described in the terminological database METACITEC. This database was developed with the purpose of contributing to unfold cognitive metaphors and mental mappings in the scientific and technical fields. It consists of scientific and technical terms with clear metaphorical meaning which have been taken from reliable specialised dictionaries of several engineering fields. To create this database, different technical dictionaries were read and interpreted. The procedure adopted by the research Group DISCYT was to follow a maximum widespread approach to the definition of metaphorical terminology and consider as metaphorical any term that currently has or has had a contrast between the literal meaning and the scientific meaning. Thus, all entries involving a mapping of any sort were considered in the broadest sense as metaphors and, therefore, analysed and interpreted (see figure 1, in which *skin*, *nose*, *body* and *wing* are metaphorical terms).

A preliminary corpus was extracted from many paper dictionaries, as well as from electronic dictionaries on the web. Most of them are corpus-based, among which we may mention the following:

- Balter, D. 2004. *Aeronautical Dictionary with emphasis on ATC Communication terms*. Volumes 1&2. Victoria (Canada): Aviation Language schools Inc.
- Bhatia, A. S. 2008. *Modern Dictionary of Aeronautical Engineering: Comprehensive and Illustrated Encyclopaedic Dictionary*. New Delhi: Deep & Deep Publishers.
- Crocker, D. 1999. *Dictionary of Aeronautical English*. Teddington: Peter Collin Publishing.
- García de la Cuesta, J. 2003. *Aviation Terminology*. Madrid: Díaz de Santos.
- Velasco, J. 1994. *Diccionario Aeronáutico Civil y Militar*. Madrid: Paraninfo.
- Williamson, M. 2001. *The Cambridge Dictionary of Space Technology*. Cambridge: Cambridge University Press.
- Spencer, R. *Aerospace Science and Technology Dictionary*. Oct 31, 2004 (May 6, 2009) R. 31, <http://www.hq.nasa.gov/office/hqlibrary/aerospacedictionary/index.htm>

- Doody, D. Glossary. *Basics of Space Flight*. Feb 14, 2008 (May 6, 2009), <http://www2.jpl.nasa.gov/basics/glossary.html>
- *NASA Aerospace Science and Technology Dictionary*. Ed. William H. Allen (NasaSP-7;1965), <http://www.hq.nasa.gov/office/hqlibrary/aerospacedictionary/508/sp7intro.htm>

The gathered information from all these dictionaries provided a first list of metaphorical terms. They all constitute technical or sub-technical vocabulary, i.e. they appear systematically in this specialised language and, metaphor, in all of them, is involved in their formation. Then, they were contextualized by means of a Digitalized Corpus (Textual Corpora) which consists of 230 specialist journal articles related to twelve different areas of the aeronautical discourse (see appendix 1). The articles count with a total number of 33,649 words, with 1.044,251 tokens (running words) in text and with 981,881 tokens used for the wordlist provided by Wordsmith (Scott 1999). The existence of this collection of aeronautical texts makes it possible to analyse the use of metaphorical terms within their own context and also favours the identification of those semi-technical lexicalized metaphors which are usually generated by other metaphors in real communication. Finally, Electronic Journals and Free aeronautics pages on the net were consulted.

As it is shown in figure 1, the term is defined in the specific field of science and technology in order to discover the conceptual mappings established. It is necessary to compare this definition and the one given in general English. Then, data is noted down on various semantic levels: derivatives, compounds, related terms and type of metaphor. Finally, examples are provided to contextualize and illustrate them. (Cuadrado, Duque and Durán 2008).

Term:	Skin (aviation).
Translation:	Revestimiento.
Definition:	The material which covers the structure of an airplane.
Derivates:	
Compounds:	Skin friction.
Related Terms:	Body, nose, wing.
Type of metaphor:	Conceptual metaphor.
Examples:	This is caused by a combination of plasticity in the skin and a reduction of effective shear stiffness due to buckling. Aircraft Design, Vol. 4, Issues 2-3, June-September 2001, Pages 99-113.

Figure 1. *Metaphorical term from the terminological database METACITEC.*

5. PEDAGOGICAL IMPLICATIONS

Conceptual metaphors provide a framework for metaphorical linguistic expressions which otherwise would remain isolated terms. Their pedagogical applications are closely related to the role of metaphor in science: its exegetical and constitutive function. The former is used to explain scientific and technical concepts. The metaphorical expressions involved in this function are employed to verbalise new ideas and emotions (Cameron and Low 1999). For instance, the modern aircraft Airbus 380 is conceptualised and described as it were a city (Robisco Martín 2005a) which provides the citizens with facilities such as a business centre, a gym, restaurants, and accommodation and so on. The constitutive function is related to role of metaphor in theory building and in construction of meaning (Boyd 1993). A clear example is the aviation industry. This business, which generates nowadays more than \$1000 billion annually for the global economy, started quite recently, in 1903, when the Wright brothers made their first flight with a machine heavier than air. Then, in the previous century, this new activity made use of familiar and known terminology related to other sectors of the travelling industry in order to name the new apparatus and to develop it (Robisco Martín 2005a). As Bergman (1982) indicates, metaphors appear in novel domains which lack a certain vocabulary. Constitutive metaphors, as models of processes, can also serve to predict behaviours in science and technology, while the exegetical function is basically didactic.

Thus, metaphors can help to build meaningful relations between what students know and what they are setting out to learn (Glynn and Takahashi 1998); they also play an important role in fostering the retention of linguistic expressions in the long-term memory, in focussing attention, in interpreting experience and in codifying actions. Lakoff and Turner (1989) postulate the great persuasive power that metaphors have on us since we rely on them constantly, unconsciously and automatically.

Metaphor awareness is useful for obtaining, storing and retrieving information (White 2003; Boers 2000a, 2000b; Robisco Martín 2005b; Cuadrado and Robisco 2011, among others). Making students aware of metaphors encourages them to imply cognitive strategies (Chamot 1990; O'Malley and Chamot 1990) since, on the one hand, the conceptual metaphor creates a framework which allows the student the inferencing and deduction of linguistic metaphors found in the aeronautical discourse and, on the other, promotes the gathering of linguistic expressions and terms which are categorised and, for that reason, are more easily stored and retrieved than in isolation. Herrera and White (2000: 71) claim the following: "Once students identify the different linguistic expressions comprising the source domain in relation to the target domain, they can all the better assimilate the underlying schemas and then use them".

The schema theory claims that a reader comprehends a message when he is able to make an effective use of a mental schema that gives a good account of the objects and events described in the message. Bransford and Johnson (1972) showed that there are occasions when paragraphs are completely incomprehensible until the reader receives an

explanatory schema (such as a drawing or a title) by which to interpret them, at which time they suddenly become quite clear.

Caballero Rodríguez (2003, 2011) indicates that in order to incorporate the teaching of metaphors into the classroom, it is necessary to choose between an explicit or an implicit approach. In any case, the learning process involves mulling over the learners' needs, over the relevant conceptual metaphors to be explained, over how this figurative language is going to be introduced, over the learners' role and the teacher's role and over the way to assess the learning achieved once the process has finished. In an ESP classroom, the explicit teaching of metaphors is essential, as Caballero Rodríguez (2003) states, students are willing and need to learn the abstract knowledge reflected by the language in order to obtain a full immersion in their discipline. With this purpose, Boers (2000a) proposes that a simple way of raising students' awareness is to draw their attention to the source domain or to the origin of unknown metaphorical expressions as they encounter them in their specialist reading. Students, by using cognitive strategies such as identifying metaphorical expressions and explaining the resemblance between the target and source domain which implies contrasting and grouping attributes, may confirm the systematicity of the reasoning of abstract concepts.

Grow (1996) observed, following the same cognitive theory that there is nothing passive about reading, the activity goes far beyond the decoding step of the information-transmission model. Readers engage nearly every kind of thought process (categorizing, previewing, comparing, connecting, organizing ideas, arguing with what they read, hypothesis testing and modification, learning new concepts, problem-solving, etc) and they approach reading in the context of the entire world of their experience. The new information must be meaningful (Brown 1994) and it becomes meaningful when it is richly interconnected with what the reader previously knew, and when the reader can access it as needed.

Swales' (1990: 87) assumption that "when content and form are familiar the texts will be relatively accessible, whereas when neither content nor form is familiar the text will be relatively inaccessible" follows the line of reasoning established above. According to him (Swales 1990: 86), the knowledge of prior texts leads to sufficient recognition of informational and rhetorical structure and may invoke a formal schema. Both prior knowledge of content as prior knowledge of formal aspects of the text can contribute to the recognition of genres and guide to the production of them. Genres are tools of rhetorical action which provides not only information about the structure of a text and how a text can be analysed but also about the communicative purpose they intend to achieve.

Case studies are employed and structured differently across disciplines. In this study, a case can be considered a reconstruction of a real life situation. It is examined by applying problem-solving and decision-making skills and critical-thinking skills (analysis, synthesis and evaluation). The purpose is to establish the potential causes of aviation accidents. Due to these aspects, the use of case studies in the classroom emphasises active learning rather than teaching. They involve students in doing things and in thinking about the things they are doing. Being aware of the case structure,

deducing the parts which are inherent and identifying lexical items and grammar patterns which are repeated in them facilitate a framework within which a discussion of the key issues of the content can occur.

The case studies presented in the tasks of section 6 are short and give detailed information. They have a narrative structure; they state what happened and the circumstances of the happening, highlighting where the incident started, what factors lead to what consequences, the characters involved and the countermeasures to be taken. They contain several key elements: a code for getting specific information about the accident, –where and when–, facts, characters, events, choices and actions, causes and countermeasures.

6. DIDACTIC APPLICATION OF METAPHOR AWARENESS AND GENRE AWARENESS

With respect to Spanish students of English for Specific Purposes, their first and second language metaphorical systems are quite similar, i.e. most cognitive metaphors and images are common to English and Spanish, as well as the terminological metaphors involved. However, there may be distinctions in how a conceptual metaphor or image metaphor is instantiated through linguistic expressions in both languages (e.g., the extreme forward end of the aircraft is *nose* in English and *mouth* in Spanish). In fact, it is impossible to predict the linguistic manifestation for a particular metaphor in one of the languages. Nevertheless, the awareness of the cross-linguistic variety in figurative expressions and of the similarities and differences between the source domain and target domain can be used to increase the chances of retention of the target language, to discuss scientific issues and to understand complex aeronautical concepts.

Then, the study of metaphors not only provides important data for the study of the internal structure of mental images in science, but may also constitute an important tool for storing and retrieving vocabulary. Conceptual and image metaphors can be used in second language acquisition in different ways. Thus, while awareness of conceptual metaphors can be a tool for improving deductive reasoning and inferring (see tasks 4 and 5), image metaphors can be applied in vocabulary acquisition (see tasks 6 and 7).

It is necessary to point out that this approach is conceived to be integrated with other established methods to language teaching and learning (Carter and McCarthy 1988; Hatch and Brown 1995).

With reference to the didactic application of conceptual metaphor awareness, the following are some of the mappings and sub-mappings or ontological correspondences between the source domains and the target domains in the field of aeronautics. We assume that the similarities and the differences found between literal language and figurative language encourage learners not only to perform in a language, but also to reflect upon its use and characteristics (Boers 2000a). In addition, the awareness of these mappings involved in aviation and aeronautics can be used to increase the chances of retention of the target language since the metaphoric themes create categories which organise the lexical elements.

The following figure shows some of the mappings and sub-mappings established in the research project METACITEC, as well as some of the terms included in these mappings.

Conceptual metaphor	Sub-mappings	Terminological metaphors involved
The air is the sea	<ul style="list-style-type: none"> – Air navigation is sea navigation. – Personnel operating aboard an aircraft are a crew. – An airplane is a ship. 	navigate, crew, cruise
Air navigation is sea navigation	<ul style="list-style-type: none"> – Personnel operating or serving aboard an aircraft is a crew. 	heading, course, piloting, dead reckoning, landmark, radio beacon, rudder crew, captain
An airplane is a living body	<ul style="list-style-type: none"> – The airplane is a living being. 	body, nose, skin, bladder, belly, neck to be blind
An airplane is a bird		to fly, tail, wing, feathering, to flap
The air is the land	<ul style="list-style-type: none"> – Air routes are land routes 	air transport, two-way airway, track, flight path, congestion, traffic, landmark

Figure 2. *Mappings and sub-mappings established in the research project METACITEC.*

To illustrate our thesis, we will describe the conceptual metaphor: AIR SPACE IS EARTH SURFACE SPACE, since it can be used as an important source of tasks and activities for ESP learning. Most of the conceptual metaphors and metonymies found in the aeronautical discourse derive from our way of conceptualising the space⁴, in particular, airspace⁵. Space is a fundamental domain of human experience which is crucial to almost every aspect of our lives. Attributes related to the experience of TRAVELLING ON LAND or to the way this travelling is organised and managed are mapped onto the target domain and help students to conceptualise the abstract principle behind the process of travelling by air or of transporting goods and passengers by aircraft. Thus, learners should be aware of the inferential structure of metaphors and of the rich and coherent lexical field created. The meaning of these terms “airways”, “air routes”, “tracks”, “flight paths”, “glide slopes”, “runways”, “taxiways”, “airlines”, “airports” is facilitated if the mapping established between the source domain TRAVELLING ON THE LAND and the target domain TRAVELLING BY AIR is known. Students have to be aware that airspace is conceptualised in terms of concrete experiential phenomena what makes it more accessible and they have to feel that the

cognitive models of airspace are grounded in basic image schemas resulting from our experience. These image schemas were identified by Johnson (1987) and Lakoff (1987), as kinaesthetic experiential cognitive structures: the container schema, the part-whole schema, the link schema, the centre/periphery schema, the source-path-goal schema (which involves a starting point, a trajectory, and an endpoint), the up-down schema, the front-back schema and the linear order schema.

The tasks proposed below as well as paying attention to the mappings established in Figure 2 and to the didactic application of metaphor awareness, they also focus on rhetorical action, on communicative effectiveness and on the linguistic means of its accomplishment. Students are encouraged to spot the causes of the accident since the danger of ignoring genre is precisely the danger of ignoring communicative purpose (Swales 1990: 72). In addition, translation is involved, according to Velasco Sacristán (2009: 95) “it constitutes a valuable pedagogical and communicative means to teach metaphorical concepts and expressions with which learners of professional discourses may have difficulties with”.

The tasks have been planned to be carried out by students of mixed level (B1, B2) at the School of Technical Aeronautical Engineering. Tasks 1 and 2 focus on receptive skills; Task 3 is concerned with production in a foreign language, and Tasks 4,5,6 and 7 are designed to improve vocabulary and to understand abstract aeronautical concepts. With respect to students learning styles and strategies, most of the following tasks tend to give an advantage to field independent learners. However, we also provide atomistic activities which develop the skills of analytic learners (see Task 1 and Task 4). On the other hand, we designed some activities involving guessing and inferring for students with a high tolerance of ambiguity (see Task 3 and Task 5). Those students with a lower tolerance to ambiguity can be helped through pre-task research and the use of books and dictionaries. Finally, Task 6 and Task 7 are especially appropriate for visual learners.

Although the airline industry is extremely safe, finding a better way to continuously audit and promote aviation safety is a perpetual duty for all safety enthusiasts. The following case studies retrieved from the NTSB Accident database were used to conduct an accident investigation in order to identify potential hazards, provide recommendations and reports, and to prevent similar accidents from happening again.

Case 1. NTSB ID: LAXOOLA223

An engine forward cowling door on the number 1 engine separated from the engine nacelle during the take off rolling at Las Vegas International Airport. The separated part consequently struck the horizontal stabilizer attached to the vertical fin. The pilot described that aircraft vibrated on runway during the take off rolling. The aircraft was under an RON (Remain Over Night) check due to the complexity of maintenance. The technicians opened the engine cowling door for the needed RON check at night but failed to ensure the proper hand-over procedure with the day-shift team the next morning. In addition to the required follow-up in relation to engine inspection, the day-shift team was assigned with other inspection tasks as well (NTSB, 2001, August 21). The cause and root factor of this accident was mechanic’s failure to refasten the cowling door prior to signing off the aircraft back to service. Providing countermeasures should focus on retraining communication skills and quality assurance and re-emphasizing team work capability based on the recommendations of AC-120-5ID and maintenance resource management (MRM).

Case 2. NTSB ID: NYC02LA013

Before the landing, the captain briefed a “no go-around” for a night visual approach even though the approach was not stabilized. The airspeed was decreasing to near the speed of stall. After touch down, the aircraft manoeuvred at a nose-high pitch attitude and struck the runway on the aft fuselage. The first officer did make an initial callout about the stall airspeed but the captain did not respond. During the post-accident interview, the captain reported that she decided to land without initiating go-around because there was no traffic on the runway at night. The first officer did not challenge the captain even though the decision was wrong. The captain described that the first officer was very quiet; yet the first officer complained that the captain was self-defensive and did not like any criticisms (NTSB, 2003a). The cause of this accident was the captain’s failure to maintain airspeed resulting in both a stall and a hard landing. The factors involved were the failure of both pilots to comply with the company’s CRM guidelines, flight manual procedures, and the captain’s improper approach briefing. Providing countermeasures should focus on: (a) recurrent CRM training, (b) pilot’s flight procedure retraining, and (c) flight operation proficiency and training guidelines should come from AC-120-51D, Pre-flight SOPs, and airline’s simulator training procedures.

Case 3. NTSB ID: DCA99MA060

A McDonnell Douglas DC-9-82 (MD-82) crashed after it overran the end of runway 4R during landing ... After departing the end of the runway, the airplane failed to maintain vertical airspeed and struck several tubes extending outward from the left edge of the instrument landing system (ILS) localizer array...The airplane was destroyed by impact forces and a post-crash fire (NTSB, 2003b, p.169-170). The cause and root factors of this accident were “The flight crew’s failure to discontinue the approach” and their failure to ensure the spoilers’ extension for landing due to (a) flight crew’s fatigue and stress, (b) situational awareness of airport weather, and (c) incorrect operation of using reverse thrust after landing. Providing countermeasures should focus on conducting recurrent CRM trainings for pilots and retraining pre and post landing procedures based on the recommendations of AC-120-51D and SOPs of flight operations.

Case 4. NTSB ID: DCA03MA022

A Raytheon (Beechcraft) 1900D crashed shortly after takeoff from runway 18R at Charlotte-Douglas International Airport due to the airplane’s loss of pitch control during take-off. The 2 flight crewmembers and 19 passengers aboard the airplane were killed, 1 person on the ground received minor injuries (NTSB, 2004a, p. 13). The cause and root factors of this accident was the loss of pitch control resulted from an incorrect rigging of the elevator system compounded by the airplane’s aft centre of gravity, which was substantially out of limit. Additional contributing factors to the cause of incorrect rigging were: (a) lack of oversight of the maintenance station by the airline and the FAA; (b) improper maintenance procedures and documentation; (c) erroneous weight and balance calculation; (d) ineffective manufacturer’s onsite quality assurance; and (e) the FAA’s outdated weight and balance assumptions. Providing countermeasures should focus on: (a) revising the FAA’s weight-and-balance reference data, (b) imposing recurrent trainings for quality assurance (QA) inspectors both for airline and manufacturer, (c) providing aircraft technician’s job compliance training, and (d) ensuring pre-flight SOPs based on the FAA’s formed rulemaking procedures and inspection handbooks, maintenance trouble-shooting SOPs, pre-flight SOPs, maintenance resource management (MRM) guidelines, and AC-120-51D recommendations.

Case 5. NTSB ID: NYC03FA039

A Boeing 757 was struck by a taxiing Airbus, while parking at the gate with passengers aboard. Maintenance technicians were taxiing the Airbus. The maintenance technicians testified that both parking brakes were activated while waiting for ground crews to arrive for the follow-up procedures. He released the parking brake after the ground crews arrived and took over the residual operation. The technicians slightly increased the throttles because the aircraft did not move after parking breaks were released. The airplane struck the jet way despite the engine throttles were repositioned to idle speed (NTSB, 2004b). The cause and root factors of this accident are the aircraft technician’s lack of training in terms of aircraft system, maintenance procedures, and ground safety guidelines. Providing countermeasures should focus on: (a) imposing a recurrent training of

<p>maintenance standard operation procedures (SOPs), (b) aircraft system training, and (c) ground operation safety training based on the maintenance resource management (MRM) guidelines, AC-120-5 ID recommendations, and manufacturer’s system handbooks or maintenance manuals.</p>	
<i>Goals</i>	<i>Tasks</i>
<p><i>To focus student attention on rhetorical organization of the case studies and on its linguistic realization.</i></p>	<p>TASK ONE. Read out the five cases and identify the structure they follow and the words or phrases that are used to introduce the different parts. What is the purpose of these case studies? Determine the audience of these documents. Compare your findings with another student.</p>
<p><i>To encourage students to have a critical reflection in order to make them aware of the communicative purpose of the above cases studies.</i></p> <p><i>To improve students’ reading skills</i></p>	<p>TASK TWO. Imagine you are aircraft accident investigators, in pairs, identify in each case study the causes leading to the accident and categorize each case within one of these 10 groups: Flight operations; Ground crew; Turbulence; Maintenance; Foreign Object Damage; Flight Attendant; Air Traffic Control; Manufacturer; Passenger; Federal Aviation Administration.</p>
<p><i>To provide students with the opportunity to produce case studies.</i></p> <p><i>To encourage students to use their formal schemata to overcome potential processing difficulties derived by their possible lack of linguistic competence.</i></p> <p><i>To improve students’ writing skills</i></p>	<p>TASK THREE. Human error was found to be the major cause of aircraft accidents in the U.S. Air Force. Search a military accident which was caused by this kind of mishap and write a case study which follows the conventions of the ones above.</p>
<p><i>To make students aware of the mappings established among two cognitive domains.</i></p> <p><i>To broaden students’ technical vocabulary.</i></p> <p><i>To encourage students to group terms according to a criteria.</i></p> <p><i>To increase the chances of retention of the target language since the term air organises the lexical elements.</i></p>	<p>TASK FOUR. Read through and make a list of terms containing <i>air</i>. Terms such as <i>line, speed, craft, plane, bridge, way, carrier, port, transport, traffic</i> are widely known. Does their meaning change when they contain <i>air</i>? In pairs, be ready to determine and to explain similarities and differences between the terms (<i>line, speed, craft, plane, bridge, way, carrier, port, transport, traffic</i>) and the ones containing <i>air</i> which have been included in the list you made.</p>
<p><i>To improve students’ deductive reasoning and inferring by making them aware of conceptual metaphors.</i></p> <p><i>To make students aware of the mappings established among two cognitive domains.</i></p> <p><i>To broaden students’ technical vocabulary.</i></p>	<p>TASK FIVE. Working in pairs, imagine you are in a team meeting pooling information about the above case studies. Explain the following expressions. Why do you guess their meaning?</p> <ol style="list-style-type: none"> 1. touch down (case 2) 2. go-around (case 2) 3. callout (case 2) 4. traffic on the runway (case 2)


	<p>5. to overrun the runway (case 3) 6. to discontinue the approach (case 3) 7. to stabilize the approach (case 2) 8. crewmembers (case 4) 9. ground crews (case 5) 10. idle speed (case 5)</p>
<p><i>To encourage students to apply image metaphors in order to learn vocabulary.</i></p> <p><i>To provide students with mental images since they might constitute an important tool for storing and retrieving vocabulary.</i></p>	<p>TASK SIX. As you are an aircraft accident investigator, draw the following images.</p> <ul style="list-style-type: none"> • After touch down, the aircraft manoeuvred at a nose-high pitch attitude (case 2) • To land without initiating go-around (case 2) • Traffic on the runway (case 2) • To overrun the runway (case 3) • To discontinue the approach (case 3)
<p><i>To encourage students to retrieve terms such as bladder, skin, root, rib, nose, body, wing, tail, flap, etc..</i></p>	<p>TASK SEVEN. Label the aircraft shown in the picture, first, with terms described in the above case studies and then, with other terms you already know which come from the domain of living organisms. Which ones do you consider image metaphors?</p> <div style="text-align: center;">  </div>

Figure 2. Tasks for Learning Aeronautical English.

7. CONCLUSIONS

The study of metaphors not only provides important data for the analysis of the internal structure of mental images in science and technology which facilitates comprehension, but also may constitute an important tool in the ESP classroom for storing and retrieving scientific and technical language, especially, when following a content-based approach to language learning. Enhanced metaphor awareness as well as genre awareness on the part of the learner provides teachers of ESP a challenging but also rewarding alternative to traditional approaches to language teaching and is appropriate and valuable for a content-based instruction.

To illustrate our thesis, this paper has provided some examples of image metaphors and has described the conceptual mappings involved in AIR SPACE IS EARTH SURFACE SPACE, since we consider that they can be used as an important source of tasks and activities for ESP learning. We have argued that conceptual and image metaphors can be used to improve second language acquisition in different ways. Thus,

while awareness of conceptual metaphors can be a tool for improving deductive reasoning and inferring, image metaphors can be applied to improve ESP vocabulary acquisition. In addition, it has dealt with the rhetorical organization of case studies about aviation accidents and with their communicative purpose since both content and formal schemata of genres can contribute to their recognition and can guide to their production.

To conclude, the final purpose of this article has been to contribute to confirm that, integrated with other established methods to language teaching and learning such as genre analysis, information concerning the internal mappings underlying the discourse of aviation and aeronautics, and the awareness and classification of the image metaphors can provide an important source for designing teaching material in this field. As this paper is an experimental research “in progress” no quantitative data has been provided but classroom observation results may suggest that, by applying this pedagogical approach, learners’ motivation and consequently language acquisition may be higher than with other traditional approaches. When students were asked in a group discussion how they felt about the reading comprehension tasks they pointed out that at the beginning they were surprised because scientific texts were not expected to contain metaphors. When asked whether genre and metaphor awareness facilitated their reading comprehension, they said that awareness helped them to gain a deeper understanding of how language works and it encouraged them to make personal choices on how to use the language. When asked about vocabulary learning strategies, they indicated that conceptual and image metaphors might be considered memory management techniques which might facilitate the transfer of information from short-term to long term-memory. On the whole, they expressed that the classroom practice provided them with feelings of confidence and language competence.

NOTES

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¹ Research project financed by the regional government of Madrid and the Universidad Politécnica de Madrid. It is integrated into the research and development lines R+D (Research and Development) and belongs to the “IV Programa PRICIT” of Science and Society. It consists of a study of scientific and technical terms with a clear metaphorical word-building, which was developed for the purpose of contributing to reveal the cognitive metaphors and mental mappings in engineering fields.

² In a small-scale experiment carried out with students of economics at Université Libre de Bruxelles the results suggested, first, that the students were capable of interpreting the figurative usage of the expressions, even though only their literal sense had been explained to them and secondly, that enhanced metaphoric awareness may contribute to the retention of figurative expressions in an ESP context (Boers 2000a).

³ *Journal of Air Transportation* (Omaha 2006. Vo. 11, n^o 2; pages 113-127).

⁴ Space is defined according to Oxford Advanced learner’s dictionary as “continuous expanse in which all things exist and move”. It is an abstract concept in meaning which is grounded through more concrete experiences.

⁵ Airspace, according to the *Dictionary of Aeronautical English* (1999), is the space that lies above the earth surface which is ruled by the Federal Aviation Regulations and is subject to ATC (air traffic control) norms and rules. It is structured according to our experience of managing the earth surface although both domains show different environments each, with its own inherent characteristics as it is revealed by the metaphorical expressions of the conceptual metaphors mentioned within the text.

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