Communication design research is becoming an essential component in solving current design problems and tackling new design challenges. However, the notion of a scientific approach to communication design is still an object of discussion. The scientific research scenario in communication design is almost opposed to that of other design fields, such as engineering and product design. While the latter fields have well-defined research structures and strong communication channels, the former is still facing foundational problems. The current state of communication design research is described by a lack of a scientific rationale and ambiguous research process structures, frameworks for developing methodologies and strategies to narrow the gap between academia and professional practice.

This paper proposes the adoption of a holistic approach – metascience – to enhance and structure postgraduate communication design research. Through the adoption of key aspects of robust scientific disciplines, less experienced disciplines could improve and develop further. To identify those aspects, more experienced design fields were investigated through secondary research from books, papers and PhD thesis, and open questionnaires were sent to six key informants from the experimental sciences.

As the result of analysing collected data sets, five areas in which communication design research may benefit from a metascientific approach were outlined: research structure, assessment criteria, type of research approaches, communication channels and community links, and the gap between theory and practice. The paper discusses five particular case studies that could be seen as ways of adopting metascience to address each identified area.

Introduction

Disciplines like chemistry and biology have a robust history of academic research and their value is unquestionable (Shadish et al., 2002). Design research⁠¹ has a long history as well, but it is not very robust in all design fields (Owen, 1998). Although doctoral degrees in most design fields are awarded worldwide (e.g. by the Royal College of Arts and Reading University in the UK and by Delft University in The Netherlands) and design research centres are increasingly emerging (e.g. the Simplification Centre in London), postgraduate design research structures appear to have evolved unevenly through the different design fields. Engineering and product design have developed a substantial research structure and rich communication channels. In contrast, design fields more related to the Arts & Crafts (now often referred to as communication design fields—e.g. graphic and information design) are steps behind in the process of scientific research development (Owen, 1998).

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¹ The term “design research” is often used to referred to design studies; design experiments; development/developmental research; formative research; formative evaluation; engineering research (van den Akker et al., 2006:4), among others. In this paper, the term “design research” refers to research work and projects conducted with a scientific approach as part of the design discipline.
In communication design research frameworks and models are still blurred (Cross, 2002) and official standards for assessing “the worth of a finalised programme” have not been defined sharply (Phillips in van den Akker et al., 2006). In addition, although knowledge is generated for application in professional practice (Owen, 1998), the contribution of communication design research to professional practice (industry) is still being questioned. In other words, there seems to be a permanent gap between communication design theory and practice (Sloan in van den Akker et al., 2006:19).

The aims of this paper are to identify and provide enlightenment on what and how communication design can learn and adopt from more experienced academic research disciplines (i.e. engineering and product design, but also from experimental sciences) in order to enhance its scientific approach. These goals are reached through the concept of metascience (Bunge, 1959, 2000), a paradigm to improve academic communication design research education. The metascientific approach is proposed here as a way to integrate key scientific aspects to strengthen communication design research. Key areas of more experienced scientific and design disciplines such as research structure, assessment criteria, research approaches, communication channels, communities, theoretical models and professional practice are looked to for guidance and to develop more robust communication design research structures.

The design research review presented here is written to shed light on communication design research (which is the area of knowledge and expertise of the author), and to assist and orient researchers, examiners, PhD candidates and other members of the design community to understand the components of design-science research education.

Research aims and methodology

Aims and objectives
In order to address the points described above, this paper aims:

- To present a brief overview of the development of communication design and its current state.
- To identify key aspects, dimensions and components of communication design research which could be defined more precisely.
- To introduce metascience as an approach to improve postgraduate communication design research.
- To highlight aspects of more experienced scientific and design disciplines that could be adopted to strengthen communication design research by a metascientific approach.

The term metascience is used here to refer to a holistic approach, through which less experienced disciplines can improve the quality of their outcomes and define clearer structures by adopting key aspects of more robust scientific disciplines. Although more experienced disciplines could also benefit from this approach, this side will not be discussed in this paper.
Throughout this paper, the term ‘design’ is used as a generic word to refer to the broad design discipline. When design is used to refer to particular design fields, it is indicated.

Methodology
Secondary research from books, papers and PhD thesis of the last 30 years has been conducted to gather design research information. This review evidenced that literature which discusses scientific communication design research is scarce (e.g. Frayling, 1993/1994; Frascara, 2002; Harland, 2009); the existing literature does not explore a holistic research approach nor does it give a clear overview of the current research situation. In contrast, vast literature can be found for design research in general (e.g. Cross, 2007; Bonsiepe, 2007), and for user-centred, engineering and product design research (e.g. Owen, 1991; Cross, 2000, 2002; Bruseberg & McDonagh, 2000; Hevner, 2007).

In addition, literature review was used to collect general scientific-based information, and key informants approach (Marshall, 1996) was used to gather more specific scientific insights. While key informants approach does not represent ‘the majority view of those individuals in their community’ (Marshall, 1996), this approach has been used to complement the literature review and to add in-depth views and expert quality data. Six key informants were interviewed for this study, which responded to the five criteria of eligibility (Marshall, 1996): role in the community, knowledge, willingness, communicability and impartiality. The first eligibility criterion is the only one that can be confidently determined in advance. Once key informants are selected, the remaining four criteria should be taken into account in order to ensure valid and pertinent insights (Marshall, 1996). For this study, scientists, who were deemed as experts by colleagues and peers, and hold a position of responsibility and influence in their working places, were contacted by email through third parties but they did not have any previous relationship with the author of this paper. An open questionnaire based upon the literature review was sent to the six selected scientists via email.

Five case studies are used to illustrate the areas in which the metascientific approach may benefit communication design research. When possible case studies from communication design investigations (graphic or information design) are discussed, however, some case studies have been taken from human centre and education design when no valid cases from communication design were found.

Design as a research discipline
In Europe during the late 19th century, especially in the United Kingdom, the Industrial Revolution movement began to separate design from fine art. Design officially became a disciplinary field in 1836, when it was considered a field of study independent from that of art (Frayling, 1993/1994; Pontis, 2011a). In other words, design should not be confused with art as it has “its own purposes, values, measures and procedures” (Owen, 1998). Nonetheless, now, more than 100 years later, the disciplinary condition of design is still the subject of debate (Poggenpohl, 1979; Harland, 2009; Triggs, 2011, Pontis, 2012). Design has the key
elements to be considered a disciplinary field, although it lacks well-developed internal structures and an understanding of its methodologies and strategies (Owen, 1998). For example, design is currently a particular body of knowledge in which its professionalization has increasingly become “the product of education rather than experience alone and responsibility [has] shifted to institutions of higher learning including universities” (Erlhoff and Marshall, 2008:132-133).

Throughout the modern history of design, three major causes have been identified as having contributed to design being less established as a discipline (Triggs, 2011) and almost being removed from professional school curricula (Sloane in van den Akker et al., 2006). Firstly, design is described as a “young” and “slow learner” discipline (Owen, 1991; 1998). This has meant that its problem-solving approaches were initially defined as “intuitive, informal and cookbooky”, instead of seeking for academic respectability like the disciplines of medicine or astronomy (Sloane in van den Akker et al., 2006:28-29). Secondly, after World War II (1939-1945), the higher education industry experienced a time of prosperity as demand for professionals such as scientists and engineers rapidly grew. In most jobs, newly educated professionals replaced others without academic degrees, such as technicians (Sloane in van den Akker et al., 2006). Consequently, “the number of sites where competent work in the areas of design and engineering was being performed increased dramatically” (Sloane in van den Akker et al., 2006:29). The position of universities as privileged institutions in which to acquire specialised knowledge was debilitated in these areas. Finally, in order to have a “more respectable” view and expect “larger, direct economic rewards”, key design domains, the technical, social and managerial were moved to the industrial sector, while they were previously developed at higher education institutions (Sloane, in van den Akker et al., 2006). On this basis, design evolution has been characterised as a search for place and recognition in practice, education and academia.

**Design practice: growing demand**

The beginning of the 20th century and the development of design in this period can be summarised as: unsettled conditions, exploration of unknown areas and adoption of new tools. In Europe, social, political, cultural, and economic changes radically altered several aspects of societies. These changes were complemented by scientific and technological developments, such as the invention of colour photography by the Lumiere brothers (Meggs, 2006). In addition, the outbreak of World War I (1914-1919) changed the way life was seen and understood in Western civilisations (Pontis, 2011a,b). In this context, “graphic forms of communication experienced a series of creative revolutions that questioned their values, their approach to the organisation of space and its role in society” (Meggs, 2006:231). The term “design” started to be used to distinguish a sense of responsibility for society in the creation of visual communications instead of personal expression, like art-based objects (Meggs, 2006).

Mass production of graphic communication artwork tended to replace the initial enthusiasm generated at the end of the previous century with the Victorian era, Belle Époque and Art Nouveau among
other European movements. Avant-garde movements, such as futurism and Dadaism, grew to express society’s discontent and designers’ rejection of the past and traditions (Meggs, 2006).

The 1920s were characterised by an increasing interest in researching the problem-solving process behind artefacts, from products to graphic communication objects. This interest led to the development of rational methods, which can be seen as an attempt to “scientise” design (Cross, 2007:119). Some avant-garde movements, such as De Stijl and constructivism, presented ways of understanding design based on systematic approaches. For example, at the German design school, the Bauhaus, ideas from all advanced art and design movements were explored, combined and applied to create a functional and rational idea of design (Hollis, 2002; Meggs, 2006). Both in Europe and in the United States, artists and craftsmen “began to work with industrialists and to commit their talents to the design of industrial products” (Owen, 1991). Particularly in the United States, graphic and industrial designers started working as consultants in engineering and marketing departments (Owen, 1991).

New ideas and an increasing desire to work with different media and technology led to the investigation of unexplored areas of the growing discipline of design. Moreover, the invention of the first large-scale computers after the 1940s had an irreversible impact on design practice and industry (Kopplin, 2002; Owen, 1991; Conley, 2004; Pontis, 2007, 2011b). Progressively, computers made it possible to start testing and experimenting with an assortment of visual techniques and languages, opening up new possibilities for designers and becoming invaluable working tools to enrich outcomes and industrialise production. In addition, “computer-supported design” dramatically reduced production times. Consequently, new paradigms arose, which led to new uncertainties and generated an interest in pursuing studies related to more theoretical approaches to design, such as finding ways of improving communication by understanding the design process and methodologies (Pontis, 2011b).

Understanding the theory

A minimalist style emerged during the post World War II years. This movement, at its strongest during the late 1960s and early 1970s, mainly originated as a response to the war chaos, which resulted in the emigration of European designers to the US. In Europe, Dieter Rams’s industrial product designs for the Braun Company showed the simplicity and function-driven style of this movement (Meggs, 2006). At the same time, a deep concern for defining analytical and teachable theories about the design process grew among professional designers and architects. In order to understand how they could improve the development of design solutions, professionals like John Chris Jones, Bruce Archer and Christopher Alexander followed systematic steps that supported their ideas and structured the decision-making processes (Pontis, 2011b). The term “design method” became commonplace and was defined as a type of procedure, technique or tool for designing, which aimed to increase designers’ capabilities, helping them generate more considerations than they could do alone (Gregory, 1966; Cross, 2000; Pontis, 2011b). Back
then, all manner of things from check-lists and theoretical exercises to mathematical equations were referred to as design methods (Owen, 1991).

During this period, creativity, quality and production diversity diminished as a possible consequence of the strong rational emphasis and the increasing but uncontrolled use of technological advances. Although designers’ initial good appetite for learning and exploration seemed to freeze, new channels of communication were created to share fresh ideas. Design research journals emerged during these decades, including Design Issues (1984), Research in Engineering Design (1989) and Design Journal (1997).

The new role of designers
Throughout the modern history of design, concerns have moved from being merely about selling a product, a service or creating artefacts to being more related to the development of strategies and making sense of situations (Owen, 1991). Progressively, “design has been recognised as a critical factor for business success” (Owen, 1998). Creativity, it seems, has changed from being understood as “change, innovation, invention, new ideas and new alternatives” (de Bono, 1999:111) to being defined as the “effective application of old ideas” (Pontis, 2011b). Nowadays, solutions are more and more concerned with solving a problem than with being new or developing ultimate design artefacts. “Effectiveness rather than novelty” tends to be the new motto (Pontis, 2011b).

Visocky O’Grady and Visocky O’Grady (2008) state that the current age presents issues that are different from those of previous periods. The massive amount of information and the overproduction of cluttered visual messages generate demand for more appropriate design tools to cope with them. Similarly, Cross (2000) adds that new problem-solving strategies are required to cope with the increasing complexity of design problems. This scenario generates new interests and the search for unfamiliar types of solving strategies. As an example, both areas of design specialty and sets of skills not exclusively related to the visual aspect of the discipline are needed to find solutions for the current design problems (Pontis, 2011b). Therefore, an essential requisite to deal with the current scenario is for us to have “high-quality designers and equip them with high quality design tools: theory, methods and processes” (Owen, 1998:10). Accordingly, the role of designers has changed and adapted. A varied range of design fields has emerged in the last 10 years, including those populated by information designers, service designers, communication designers, surface designers, information systems designers, environmental designers, human computer interaction designers, among others (Chartered Society of Designers; Purao et al., 2008). Some of these fields have evolved further than others, having clearer defined boundaries, aims and objectives. In all cases, the role of designers is gradually developing from creators of design objects to facilitators of dialogue, management, collaboration and understanding (Pontis, 2011b). Design skills have become tools to help other professionals perceive the meaning of situations by mapping complexity, drawing meaning from data and thus making sense.
The next sections discuss the scientific approach to research and give an overview of postgraduate scientific and communication design research current structures.

Defining science-based research

The emergence of modern science dates from the 17th century, with the first scientific journal “Philosophical Transactions of the Royal Society,” published in 1665 (Lewis, 2002). The journal presented the growing amount of academic experimental scientific research being conducted (Lewis, 2002; Shadish et al., 2002). Works dated as early as those of William Gilbert’s (1600) On the Loadstone and Magnetic Bodies and Galileo’s (1612) Bodies that Stay Atop Water, or Move in It evidence scientific discoveries (Shadish et al., 2002). Consequently, disciplines like chemistry and astronomy have more robust histories of inquiry, scholarship and research experience than that of design (Owen, 1991,1998; Cross, 2002; Sloane in van den Akker et al., 2006). Three milestones played a major role in the scientific revolution, starting with the transition from the use of passive to systematic observation to correct errors in theory, followed by the use of planned and systematic observation to document the effects produced by experiments². Finally, the use of external equipment to control or minimise the risk of bias observation added rigour and credibility to findings and results (Shadish et al., 2002).

Not all research study is necessarily of a scientific character, and

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² An experiment is defined as an act, a procedure, or “test under controlled conditions that is made to demonstrate a known truth, examine the validity of a hypothesis, or determine the efficacy of something previously untried” (Shadish et al., 2002).
not all disciplines that conduct research are scientific disciplines. This leads to the question: how is “scientific” defined? The main difference between non-scientific and scientific disciplines is that the latter bases its aims, goals, and methodologies on objective results, while the former defines those same elements in terms of self-evident experiences, without looking for understanding or improvement. A scientific discipline must have a solid corpus of concepts, theories and tools used by its research community in their contribution to a progressive development of the specialty (Schneider, 2007:212). Scientific disciplines define standards that are applied to measure each aspect and phase involved in a research process (IUBMB, 2011).

The main concern of science is not to gather data, but how data is processed into theories and evaluated through objective methods. The goal of scientific research is to formulate, demonstrate, prove or verify (confirm or infirm) hypotheses (Bunge, 2008). However, scientific knowledge cannot be an object of universal agreement; it can contradict established theories and may benefit some researchers but not all of them. The central point of scientific research is its verifiability (Reyna in ED466791, 2002). In other words, if other researchers follow the same set of procedures, under the same circumstances, they should arrive at similar conclusions. Therefore, a researcher from any discipline should detail and explain the specific parameters followed to achieve that result; this should make those procedures verifiable in an objective way.

In short, the essence of scientific research is systematic observation, measurement and experimental work, or alternative methods that could ensure similar levels of objectivity and rigour.

**Postgraduate science-based education structure**

**Research structure**

In science-based research, PhD candidates’ subject of study must fit into the director of studies’ area of expertise and be part of one of the research projects conducted at his/her research group or centre. Furthermore, the active presence of the director of studies as well as other members of a research group during PhD candidates’ initial and training years is a key point. The director of studies initiates his/her PhD candidates into the research activity, guiding them at each step of the journey (Feuer and Towne in ED466791, 2002). Novice researchers learn skills, methodologies and problem-solving strategies from their director of studies and other members of the group. The definition of the action plan to start working with during the first year, including specific objectives, is the initial step, followed by the definition of research questions to be responded throughout experimental work.

**Methodology and scientific attitude**

Laboratory work is an intrinsic area of scientific research. Experimental work conducted in laboratories is essential for acquiring the necessary practice and knowledge to achieve valid and robust results. The “lab” becomes the place for learning, making mistakes and sharing stories. Experiments are repeated independently at least three times, and each time more tests are carried out to minimise and balance experimental errors and biological samples. Results are analysed statistically. Another
key point is to incorporate the necessary controls to avoid or minimise the risk of false conclusions. Methodology and rigour are essential to execute lab tasks and obtain valid results.

Communication channels
The sense of belonging to a research community is another key aspect of science-based research education. Research group discussions help develop initial questions to further stages (Feuer and Towne in ED466791, 2002). Group members discuss each other’s work, contributing with ideas and constructive criticism. Group discussions open up new paradigms; generate new questions, new hypotheses, new experiments and tests.

Research progress is actively shared through different communication channels. In addition to international conferences, internal seminars and journal club presentations are highly common and mandatory in science based research education (IUBMB, 2011). Each research group member is obligated to present his/her work and progress weekly, as a way of both acquiring presentational skills and obtaining feedback and criticism at each stage of his/her investigation. The sharing of discoveries and findings happens in internal seminars, and then key points and results are communicated to peers in international conferences and through peer review publications.

The scientific approach to design
Scientific research is often associated with sciences like mathematics and chemistry, and less with humanistic ones like design. However, it can be conducted for investigation in any academic field. Scientific principles are common across all disciplines and fields, but what is intrinsic to each discipline is the forms of questions, answers and decisions, as they are based on each discipline’s basic values and not on their contents (Reyna in ED466791, 2002; Feuer and Towne in ED466791, 2002). In this sense, Owen (1998) stresses that “ways of building knowledge” should respond to the needs and the “way design is studied and practiced.”

Initially, design research was conducted by psychologists, sociologists and computer scientists, as design practitioners used to consider academic research as an “alien concept” for a practice-led discipline (Poggenpohl, 1979). Nevertheless, as mentioned previously in this paper, the interest in the scientific approach to design has been a constant concern throughout the modern history of design, often referred to by different authors, including Owen (1998), Cross (2000, 2002), Schneider (2007), Bonsiepe (2007) as “scientific design”, “design science”, or “design research.”

This approach to design is concerned with the recognition of the laws of design and its activities, and the development of rules and guidelines (Cross, 2002). Poggenpohl (1979:353) explains that understanding the structure of the design activity would benefit professionals in the sense that they would be able to modify rules and control the problem-solving process, rather than “blindly following an unquestioned tradition.” In addition, design research may bring some clarity to educational aspects and learning processes by discovering the connections that establish their
characteristics, functioning and outcomes (Sloane in van den Akker et al., 2006:20). This research approach also aims to improve understanding of design and its intended users through systematic methods and the study of practices, theories and designer’s thinking and working procedures (Laurel, 2003). Thus it takes into consideration reflection on the nature of design knowledge and the contribution to the professional practice. This research approach also improves both designers’ decision-making and solution-strategy processes by encouraging them to adopt rational procedures (Cross, 2007:45). Design research outcomes vary from tools, methods and systems to improve conceptual design and decision-making to theoretical frameworks and models (Purao et al., 2008).

In other words, a scientific research approach implies “systematic design”, which means the procedures of designing being organised in a rational way (Cross, 2002), documenting data and a mixed understanding of problem-solving which combines institution and rationality.

Postgraduate communication design education structure
During the 1980s, research became the centre of design environments, supported by academic institutions and communities, which set the basis for the beginning of scientific design research (Schneider, 2007). Those research communities which spread in the 1990s across European universities and colleges, started growing at the end of that decade to become academic referents. The first PhD design programmes were structured in Japan and Europe and later considered in the United States (Owen, 1998). For guidance, these nascent research communities started following models and incorporating procedures from more experienced scientific disciplines (Owen, 1998; Cross, 2007; Boomgaard in Wesseling, 2011). However, while scientific engineering and product design research developed robust frameworks and now tend to follow the scientific model described earlier, communication design research at the postgraduate level is characterized by a different scenario.

Currently, communication design researchers are still searching for new paradigms to guide, strengthen and consolidate research evolution (Laurel, 2003). The following sections examine the main problems of communication design research.

Developing postgraduate programmes
Design research has greatly influenced the broad spectrum of design. Design education was “born from the needs of an industrial economy” (Owen, 1991) and education programmes evolved to meet that demand. As stated earlier, the definition of undergraduate communication design degree programmes as independent programmes than that of art was a response to emerging needs.

Similarly, postgraduate degree programmes, such as masters and PhDs, also responded to the growing demand for more specialised knowledge, and course structures were redefined to explore deeper areas of design not approached from undergraduate programmes (Owen, 1991). While undergraduate programmes in communication design have maturated and some universities, e.g. University of Buenos Aires, offer four- or five-year courses in which technical skills are integrated with general knowledge and critical thinking, postgraduate
programmes in those design fields still need further development. Postgraduate programme structures vary among universities and even within departments. During the initial year, some programmes include introductory weekly seminars in their curricula in which basic aspects of research are unpacked (e.g. how to write a dissertation, how to use the Harvard style), but other programmes only offer monthly tutorials and little support.

In addition, the learning journey in communication design research differs to that of science or other design fields in the sense that research groups do not tend to have ‘in-house’ PhD candidates working together with more experienced researchers or supervisors. As a result a feeling of isolation often grows among candidates.

**Lack of structure**
The research structure in communication design needs clarification. As an example, there is still “confusion and controversy” (Cross, 2002) over the nature of valid results (Hevner et al., 2004) and the definition of research methods (Owen, 1998; Phillips in van den Akker et al., 2006). In terms of the research process, obscure areas include selecting appropriate methodical approaches and then rigorously following them, adopting documenting strategies, and applying analytical and critical thinking throughout each research phase. Another common problem is that PhD candidates often prioritise the final phase of the research cycle, i.e. prototyping and testing the hypothesis, which results in the “oversimplification of scientifically-oriented research” (Phillips in van den Akker et al., 2006). Phillips (in van den Akker et al., 2006) stresses that through this “oversimplification” the “context of discovery” is being neglected. In other words, earlier stages, research, analyses and efforts undertaken to design a solution that is worthy of testing are not taken into account or valued.

Communication design often borrows social sciences models and methodologies (e.g. grounded theory, ethnography, observation, interviews, questionnaires, surveys, and video recordings among others) to understand and make sense of insights, and draw conclusions. However, to design investigations in which the human factor is not involved (or it is not the main component) but, for example, the aim is to examine a specific design outcome, those methods will not be a suitable approach. This fact evidences the need in communication design to develop its own set of methodologies.

**Disperse research community and developing communication channels**
The design research community is highly varied (Owen, 1998). Sloane (in van den Akker et al., 2006) explains that as a result, “design knowledge appears to be fragmented and dispersed”, illustrating a difference from more established research communities. On the one hand, although both science-based and non-communication design research communities have established communication channels, local, national and international conferences and regular meetings, and supportive communities of scholars, communication design is still working on developing appropriate platforms for sharing knowledge.
On the other hand, even though technology has evolved enough to facilitate almost all type of dialogues, there still seems to be a lack of communication among designers from different cultures and countries (Pontis, 2012). In terms of communication design research, South American countries are a step behind Europe. Language could be pointed to as one possible barrier, as many scientific books, journals and books of proceedings are only written in English (IUBMB, 2011). However, the communication in these design fields among European, North American and Middle Eastern countries is not as fluid as it could be for a globalised age.

Gap between theory and practice
Almost 20 years ago, Owen (1991) predicted that “at the PhD level” design skills acquired during undergraduate courses “will be employed to help create the body of knowledge that will be used in industry and taught in the masters’ and bachelors’ programmes of the future”. Nevertheless, in terms of communication design, there is a “persistent relevance gap between theory and practice” (Sloane in van den Akker et al., 2006:19); that is, between academia and industry. Despite Owen’s (2001) prediction that design researchers would find opportunities for leadership, some communication designers face difficulties finding an adequate postgraduate academic position and a place in industry.

Communication design practice seems to have been greatly influenced by the nature of design education that, excluding engineering and architectural design, has followed the fine arts model in which personal exploration replaces research (Owen, 1991). Consequently, communication design practitioners tend to use more intuitive than rational procedures (Cross, 2007; Bruseberg and Mc-Donagh-Philip, 2000), and those who complement their decision-making with scientific theories, experiments or rational methodologies are rare.

Metascience: an integrative paradigm to scientific communication design research
As previously stated, Glanville (1998), Owen (1998) and Cross (2002) accentuate the need to look at more consolidated and robust scientific disciplines where appropriate to strengthen key aspects of design research. Meanwhile, Cross (2002) states that design “needs to develop its intellectual independence, whilst seeking to emulate other disciplines in standards of rigor in scholarship and research”. Following Cross’s idea and inspired by the concept of metascience (Bunge, 1959, 2000), this paper proposes an integrative approach to communication design research, stressing the adoption of key aspects of scientific research from more experienced disciplines, e.g. engineering and product design, biology, chemistry, to consolidate its scientific approach, conducting pure communication design investigations. That is, in which the primary aim of a research study is to contribute to the communication design community (Laurel, 2003).

“Metascience”, in imitation of metalanguage and metalogic, suggests that communication design would benefit from a relationship with more experienced research disciplines. This approach bridges different types of
sciences because “it studies the foundations and procedures of all sectors of verifiable knowledge” (Bunge, 1959:19). It is worth explaining that the benefits of the metascientific approach to communication design are the areas to be examined here, those to more experienced research disciplines being out of the remit of this paper. For that, an exhaustive study of scientific and other design fields needs may be required to identify gaps or areas in which communication design aspects could be of value.

This metascientific approach emboldens the adoption of scientific aspects that would enrich the structure of communication design research and bring scientific rationale (e.g. methodologies, techniques and philosophies) closer to novice communication design researchers. This integration does not imply that communication design has to turn into an imitation of science, but to acknowledge that by appropriating structures and parameters from more experienced research disciplines, communication design could bring some clarity into, for example, the context of doctoral education (Owen, 1991, 1998; Cross, 2002; Hevner, 2007).

**Metascience in postgraduate communication design research**

Design research education in the fields of design engineering (Owen, 1998, 2001), user centred design (Bruseberg and McDonagh-Philip, 2000) and human computer interaction design (Hevner et al., 2004) has a more robust trajectory than that of graphic and information design (Owen, 1998). This reflects on the structure of their postgraduate courses, which tend to be more organised and clearly defined. Research undertaken in communication design faces a more diffuse scenario, which may benefit from this metascientific approach. The integration of scientific aspects to communication design is not to add laboratory work to the postgraduate curricula. Instead, a possible alternative would be to encourage and provide a scientific attitude in the design community.

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**Communication design research**

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Figure 2: Postgraduate communication design research areas that may benefit from a metascientific approach.

Five areas (Figure 2) in which this approach may benefit communication design research are discussed in the following sections.

**Towards a well-defined research structure**

As in science-based research, the definition of an action plan is the first step in communication design research. This plan includes the following phases: approaching a problem, posing questions, building a theoretical model, defining methodologies, testing hypotheses and contributing to knowledge. An increasing number of design research models have been defined to give clarity and structure to academic design research (e.g. Owen, 1998; Bannan-Ritland, 2003). Mostly, they present ways
and frameworks in which scientific aspects can be adjusted from a design point of view. Adopting and adapting a research model based on scientific standards may be an attempt to reduce the risk of misjudging communication design research and give each phase its appropriate value. The following is an example of a research framework that could be used to structure communication design investigations.

Case study 1: Research framework
This model emerged from the integration of educational design and learning processes. Bannan-Ritland (2003:21) merged design stages, research phases and learning structures to define a framework which aimed to provide guidance to design research. She emphasises three necessary research components: “research questions, data and methods, and the need for researchers to design artefacts, processes and analyses at earlier stages in their research that can then be profitably used in later stages.” The framework is the result of overlapping those components with that of the design process—informed information, enactment and evaluations (local and broader impacts) (Figure 3).

Defining assessment criteria
As previously stated, some research phases are not sharply defined in postgraduate communication design curricula. Equivalents to scientific method, and measures and criteria to assess the quality of communication design research remain questionable (Owen, 1998; Kelly, 2004; Phillips in van den Akker et al., 2006). In this sense, official postgraduate communication design research standards have not been defined (Kelly, 2004), despite the attempt of the Bologna Plan launched in 2005 (Bologna Process, 2005). This plan aimed to “create a European Higher Education Area (EHEA) based on international cooperation and academic exchange,” establishing common education criteria for higher education (EHEA, 2005). On this matter, postgraduate research on experimental sciences is one step further ahead. The IUBMB report (2011) provides strong evidence of the current state of experimental scientific research in terms of research education, in particular for doctoral degrees. The Committee on Education of the IUBMB (2011) has set standards and criteria for postgraduate education in which each phase relevant for a scientific investigation is strictly defined and assessed. Standards described in this report cover all parties involved in the learning process.
for becoming a scientist, including assessment criteria, research into candidate’s and supervisor’s responsibilities, and the components necessary to achieve satisfactory results. Kelly’s (2004), Edelson’s (in van den Akker et al., 2006) and Plomp’s (in Plomp & Nieveen, 2007) studies give further analysis in this area, suggesting key points on which attention should be focused in order to evaluate the quality of design research. This evidences the diverse nature of frameworks or criteria for assessing postgraduate design education, which in fact appears to add confusion instead of clarity (Phillips in van den Akker et al., 2006).

As the result of combining aspects highlighted by existing frameworks the award of a communication design doctoral degree would respond to the education and training of “competent, reliable, and self-directed individuals who have a strong sense of scientific integrity” (IUBMB, 2011:5). In addition, the graduate would have to demonstrate “the ability to pursue a problem to a meaningful conclusion” (IUBMB, 2011). The following case study presents a set of guidelines that could be used in communication design as a way to assess the quality of an investigation.

Case study 2: Guidelines for assessment
The work of Hevner et al. (2004) presents a set of seven guidelines that can be followed to structure and assess design research. Although these guidelines are not rigid or mandatory, “each of them should be addressed in some manner for design-science research to be complete”, state Hevner et al. They may be combined with “creative skills and judgment to determine when, where, and how to apply each of the guidelines in a specific research project” (Hevner et al., 2004:82) (Table 1).

<table>
<thead>
<tr>
<th>Guideline 1: Design as an Artifact</th>
<th>Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation (a theory, a concept).</th>
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<tbody>
<tr>
<td>Guideline 2: Problem Relevance</td>
<td>The objective of design-science research is to develop technology-based solutions to important and relevant business problems.</td>
</tr>
<tr>
<td>Guideline 3: Design Evaluation</td>
<td>The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.</td>
</tr>
<tr>
<td>Guideline 4: Research Contributions</td>
<td>Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.</td>
</tr>
<tr>
<td>Guideline 5: Research Rigor</td>
<td>Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.</td>
</tr>
<tr>
<td>Guideline 6: Design as a Search Process</td>
<td>The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.</td>
</tr>
<tr>
<td>Guideline 7: Communication of Research</td>
<td>Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.</td>
</tr>
</tbody>
</table>

Table 1: Set of guidelines to measure design research quality (from Hevner et al., 2004)

Adopting a multidisciplinary approach
Currently in communication design practice, professionals’ approach to problems is changing from a monodisciplinary one to a multidisciplinary one (Frascara, 2002; Purao et al., 2008). Therefore, professionals from different disciplines—e.g. marketing, engineering, technology, social sciences and communication—are frequently involved in planning and development stages, becoming indispensable components of the
modern problem-solving process. Likewise, researchers from different background disciplines appear to be combining expert knowledge to find the most appropriate action plan and set of methodologies, as generally a multidisciplinary approach tends to increase the success and quality of research studies (Kelly, 2004).

In communication design research a scientific attitude which would facilitate collaboration and dialogue with researchers from other areas of expertise, helping forward the development of multidisciplinary research work (Kelly, 2004) is still in its early days. Although in some research projects links with the social sciences are gradually being strengthened, the majority of postgraduate investigations tend to be conducted with little interaction or contributions from other disciplines. A metascientific approach would greatly benefit this particular aspect in communication design. Similarly, Owen (1998) and Purao et al. (2008) emphasise the need to strengthen relationships with research experts from other disciplines related to design, which are more established in terms of research than communication fields. Those experts would be familiar with the aims and nature of design, bringing pertinent attitudes and procedures, adding research guidance to the least consolidated design fields.

The multidisciplinary project conducted in collaboration between the College of Medicine and the College of Design, Architecture, Art and Planning (University of Cincinnati) (Zender and Crutcher, 2007) illustrates the benefits of disciplines working together.

Case study 3: Scientific information design
The ultimate aim of the multidisciplinary research collaboration between the University of Cincinnati’s College of Medicine and College of Design, Architecture, Art and Planning (Zender and Crutcher, 2007) was to develop visual language techniques capable of revealing patterns and conceptual connections in the development of interactive displays that can be used for any discipline with a finite vocabulary. However, the broader objective was to show a scientific approach to information design and the benefits of visual communication to science.

A digital designer and a biomedical scientist composed the team of this project. The starting point was to use 40 published papers about Alzheimer’s disease as the study sample. From the sample, they extracted 20 statements that express key concepts. Then, the designer of the group translated the scientific-based data into a visual object system (composed of icons, signs, glyphs and combinations of the first three objects) which displayed the most representative medical concepts extracted from the sample of study. Those concepts were used to develop the visual language techniques.

Strengthening communication channels and research community links
In particular, expansion and consolidation of a communication network for design knowledge may be a step towards drawing communication design researchers together. Communication design conferences and research centres are spread in Europe, US and Latin America, however their production and communication channels would benefit from stronger links among each other. The IUBMB report (2011) strongly recommends researchers’ active participation and positive attitude to
“present and defend their research plans, to discuss their results and interpretations, to evaluate and comment on the work of others, and to participate in discussions on technical and scientific issues.”

In other words, broader research training—e.g. peer network, preparation of proposals, discussion groups, methodological courses—and an increase in funding for a larger number of projects would undoubtedly contribute towards a fruitful evolution (Miller, 1981; Owen, 1998; Phillips in van den Akker et al., 2006) of communication design research. The following case gives an overview of the activities that are carried out in one of the few information design research centres in the UK.

Case study 4: Centre for Information Design Research (CDIR)
The CDIR, based in the University of Reading (UK), is focused on theory and practice of designing complex information. It is also an active platform with strong links with the Information Design Association (IDA), which annually organises international conferences on the field and is increasingly organising meetings in different institutions of London (e.g. Royal College of Art, Greenwich University). In addition, CDIR member’s work is published in the peer-reviewed information design journal, spreading findings and new knowledge throughout the community.

Bridging theory and practice
As a way to bridge theory and practice, scientific rationale—i.e. analytical and critical thinking, and methodical procedures—has started to be applied to problem-solving strategies in communication design professional practice (Cross, 2002). In this respect, projects in which earlier phases have been thoroughly planned increase their chances of success and of having great impact in communication design practice (Owen, 1998; Laurel, 2003; Purao et al., 2008).

Communication design research could contribute to narrow the gap if its outcomes have “high external validity but are also teachable, learnable, and actionable by practitioners” (Sloane in van den Akker et al., 2006). This disposition would broaden both communication design researchers’ and professionals’ conception about the discipline, training them to notice what aspects of other fields could be beneficial for them.

The following case study introduces a practice-led information design investigation, which findings may have direct implications for professional practice.

Case study 5: Recommendations for professional practice
Combining visual content analysis (of 209 diagrams), graphic syntax theory (Engelhardt, 2002) and qualitative methods (semi-structured interviews and phenomenographic analysis) Mølhave’s (2011:309) investigation presents a set of recommendations which ‘aim at improving the effectiveness of visual output in future design practice in educational publishing’. The methodological strategy and inductive path followed throughout the research process indicated a way to bridge theory and practice. In other words, this investigation evidences how ‘practitioners might use information design theory and descriptive models of the design process to review their practice, and use the findings to enhance it’ (2011:348).
Conclusion
The full potential of design science has not yet been achieved in all design fields. While some fields—e.g. industrial, engineering and product design—do have robust research structures and strong communication channels, other fields—e.g. graphic and information design, referred to as communication design—are several steps behind. Currently, the communication design research community appears to be still asking questions about its boundaries and goals and borrowing methodologies from social sciences instead of focusing on developing its own research framework and tools. This scenario could be seen as a consequence of the way the different design fields have evolved. Unlike product and engineering design, communication design has followed the Arts & Crafts education model, which has been mostly led by self-expression and intuition and less concerned with understanding processes and following methodologies. This could be one of the reasons why communication design still seems to be facing difficulty in developing well-defined research frameworks, and connecting and adopting components provided by other disciplines (Frascara, 2002) such as methodologies, scientific rationale, rigour, assessment criteria and research process structures.

A metascientific approach was discussed here as an attempt to contribute to the evolution of the scientific approach to communication design. This metascientific approach proposes the integration of aspects from experienced research academic disciplines into communication design research. This is presented as a dynamic collaboration in which the integration of aspects from scientific disciplines (i.e. rationale, analytical thinking, education programme structures) and from more experienced design disciplines (i.e. communication channels, methodologies, multidisciplinary approaches, design process models) has the potential of enhancing academic and industry success for all parties involved (Bunge, 2002) (Figure 4). This paper, however, has only focused on the benefits of this approach to communication design, hoping to have alert academics, students and professionals from different disciplines of its potential.

Figure 4: Hypothetical structure of design fields and scientific disciplines after adopting a metascientific approach.
A metascientific approach in communication design research may facilitate the creation of a body of knowledge, the development of more transparent pedagogical techniques, the strengthening of communication channels, and the building of bridges with allied disciplines and with industry; all requirements previously pointed out as fundamental requisites to move towards the consolidation of scientific research (Owen, 1991; Laurel, 2003; Purao et al., 2008). In addition, this approach would add clarity to the research structure, and to roles and tasks of all parties involved—candidates, supervisors and peers—in communication design research education. The integration of rigour and analytical thinking to communication design problem-solving would also lead to the definition of unambiguous action plans and research goals, which would aid in the formulation of questions and methodology, and enhance professional practice outcomes.

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References


Sheila Pontis was born in Buenos Aires, Argentina where she completed a five-year BA(Hons) course in Graphic Design at the University of Buenos Aires (UBA, FADU). When she finished her BA studies, she moved to Barcelona to complete a Postgraduate degree in Editorial Techniques and a Master of Advanced Studies degree (DEA diploma) in Information Graphics both at the University of Barcelona. In 2008 her passion for complex diagrams and information design brought her to London to complete her PhD at the London College of Communication, University of the Arts London.

Her academic and research experience includes guest lectures at the University of the Arts London (LCC,CCA), University of Leeds, University of Barcelona, Elisava School of Design (Spain), at international conferences (NCCR Iconic Criticism, IADIS, Bauhaus-Universität Weimar), and as keynote speaker at CIDAG (2010), DESIGNA (2011) and Malofiej (2012). Her work and research interests are oriented towards the conceptual aspects of information design, the creation of diagrams and design research education. Sheila’s teaching experience started back at the University of Buenos Aires (Argentina) and now is a sessional lecturer at Ravensbourne College of Design, where she teaches information design and design thinking in the Masters of Design. Sheila has over 10 years of professional experience in information and editorial design working internationally. Since the beginning of 2011, Sheila is the co-founder of MapCI, a small information design company which focuses on research, consultancy and training. She has worked for 2CV Marketing Research Agency, Uscreates Social Design, Mind the Ad, Pelagos Consulting, Baalbaki Group, Elsevier Health Division and Que Fem-La Vanguardia Newspaper, among other companies.