



## Scientific communication and the nature of science: An illustration of oscillations from researcher's proximity to researcher's distance in scientific titles and its pedagogical implications

### La comunicación científica y la naturaleza de la ciencia: ejemplos de oscilaciones entre la proximidad y distancia textuales del investigador a través de los títulos científicos y sus implicaciones pedagógicas

VIVIANA SOLER<sup>1</sup>

Citation / Para citar este artículo: Soler, V. (2014). Scientific Communication and the Nature of Science: An illustration of oscillations from researcher's proximity to researcher's distance in scientific titles and its pedagogical implications. *Colombian Applied Linguistics Journal*, 16(2),291-302.

Received: 26-May-2014 / Accepted: 14-Aug-2014

#### Abstract

Although positive science has progressed under the spell of the objectivity paradigm and the primacy of its method, scientific discourse shows how this paradigm has not survived for long. Based on our research on scientific titles, the purpose of this work is to reflect on the demythification of this paradigm through title discursive strategies. Thus, 1) reflections on science, particularly its communicative potential, from the point of view of the epistemology of science are provided, and 2) examples from a title database including 570 research and review paper titles written in English in the fields of biological and social sciences are analyzed as excerpts of pendulations to communicate knowledge via total agency concealment, particularly following an object-based approach, to agency textual proximity. These title oscillations illustrate how scientists choose to show themselves in the process of knowledge communication and give clues on how to explicitly teach these strategies. Though restricted to a specific example, these clues shed light on what issues regarding the communicative approach of science could be explicitly taught to effectively guide title reading and writing in science.

**Keywords:** English for specific purposes, scientific communication, objectivity, scientific titles, science rhetorics.

#### Resumen

Basándonos en nuestros estudios sobre títulos científicos, este trabajo reflexiona sobre la desmitificación del paradigma de objetividad según las estrategias discursivas de los títulos científicos. Por tal razón: 1) se reflexiona sobre el quehacer científico, particularmente la comunicación, desde la perspectiva de la epistemología de la ciencia, y 2) se analizan a la luz de la perspectiva de la Gramática Sistémico Funcional ejemplos tomados de una base de datos construida con 570 títulos científicos de artículos de investigación y de revisión en inglés en áreas de ciencias biológicas y sociales. Nuestras reflexiones muestran que en la comunicación del conocimiento a través de los títulos, el científico/comunicador elige mostrarse u ocultarse en el texto a través de distintas estrategias de discurso. Si bien nuestras reflexiones se restringen a un territorio muy pequeño de los artículos científicos, como lo es el territorio de los títulos, las oscilaciones observadas no solo ilustran esta elección sino que también determinan claves a seguir hacia una enseñanza explícita que garantice la escritura y lectura apropiadas de los títulos científicos.

**Palabras clave:** Inglés con fines específicos, comunicación científica, objetividad, títulos científicos, retórica de la ciencia.

<sup>1</sup> Instituto de Investigaciones Bioquímicas de Bahía Blanca (INIBIBB), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) - Universidad Nacional del Sur (UNS), CCT-CONICET Bahía Blanca, Argentina. [insoler@inibibb-conicet.gob.ar](mailto:insoler@inibibb-conicet.gob.ar)

## Introduction

The ethos of science has been defined in terms of the principles of universalism, communism (i.e. sharing knowledge), disinterestedness, and organized skepticism when approaching claims (Merton, 1973). Independently of supporters or critics of Merton's ideas, that he laid the foundation for an analysis of the institutional norms of science is a fact whose relevance cannot be neglected. He is the father of the definition of the ethos of science as "a set of cultural values and mores governing the activities termed scientific" (Merton, 1968, p. 605). That is, he was interested in identifying the cultural values and mores which regulate the scientific work rather than in explaining the procedures for the validation of knowledge. The latter was in fact the issue to which attention was subsequently shifted in an attempt to shed light on the construction of the contents of knowledge by analyzing controversies which generated changes in scientific paradigms (Kuhn, 1962). Furthermore, it was not until the emergence of the reflections of the Edinburgh School and Barnes and Bloor's (1982) observations in favor of relativism that the link between production and validation of scientific knowledge to socio-cultural context was achieved.

The next stage in this *racconto* on science work/knowledge production corresponds to Collins (1985) and the Bath school, both focusing their attention on the interactions within and through which interests, preferences, and beliefs are formed. Later, "how features of the social world, and more generally of everyday life, become played upon and turned into epistemic devices in the production of knowledge" (Knorr-Cetina, 1992, p. 119) became the *leitmotif* through which scientific objects started to be seen as social and cultural constructions revealing how they are firstly technically constructed in the laboratory during the "science-in-the-making" process (Latour, 1987, p. 4) and further symbolically

processed as "ready-made science" and reported through discourse (Latour, 1987, p.4).

On the other hand, whereas the concept of "nature of science" refers specifically to the epistemology of science and points mainly to intrinsic values and assumptions of scientific knowledge, for other specialists (Garritz, 2006; Nielsen, 2013), this concept refers to other broader issues, such as the functioning of science, how science develops, builds and communicates the knowledge it generates, and the methodology for the dissemination and validation of knowledge, among others. Thus, within the frame of the nature of science, researchers have adopted –and still do– different positions on what science and its product, i.e. scientific knowledge, are. Nonetheless, whatever concept of science is advocated, it is necessary not to identify science as of a unique nature but to conceive it as practices in different environments and in different relationships to accomplish a variety of purposes, one of which is the communication of knowledge. Following Nielsen (2013), these practices are modes of communication. Highly advanced scientific papers are not only a very good example of science as a cultural, social, and institutional practice designed to carry out specific projects, the findings of which are the essence of knowledge, but also a reflection of different linguistic choices through which scientists textually construct their representations or interpretations of a particular object of study. This is because behind research as a process in search for truth is the rational researcher, who, through such process, makes original contributions to knowledge. For this to occur in science, there must be an object of study upon which to conduct research which can thus be graphed as a tripartite activity involving i) the object of study, ii) the researcher and iii) the research process through which the object of study and the researcher are linked. This then confirms that there is a mirroring of the real external world in the real internal world of

the researcher. Still, this image of science as a reflection of reality is not fully complete unless a fourth element is added to this tripartite activity graph: the researchers' peers or his audience. This fourth element, in turn, introduces the notion of science as communicative text, thus making of science a fourth-partite activity, rather than a tripartite one, involving the object of study, the researcher, the research process, and the audience to whom the research conducted is reported.

The myth of objectivity has been questioned by epistemologists and philosophers of science on the basis that it is not possible to consider the knowing subject and its object of knowledge as independent of one another. Rather, in terms of Latour and Woolgar (1986), it is convenient to appropriately grasp the social and cognitive arrangements that are inextricably developed, adapted, and transformed by the knowing subject in relation to his object of knowledge. Thus, based on performative scientific practice, viewing scientific knowledge as the measure of an empirical reality that is external to the knower is not admissible (Pickering, 1984) or, following Bazerman (1988, p. 14), that "the popular belief of the past century that scientific language is simply a transparent transmitter of natural facts is, of course, wrong." In line with this, and because of the four above-mentioned constituents of research, the researcher and the object of study are *sine qua non* for research to occur, our focus of attention on this opportunity is particularly centered on the researcher as communicator of knowledge, mainly on how his presence is rhetorically revealed or veiled in a particular section of highly advanced scientific papers: the title. For the sake of assigning a tidy presentation to our analysis, attention will be paid firstly to science rhetorics at the service of researchers to fluctuate between presence and absence in highly advanced scientific discourse, and secondly to scientific titles as indicators of these fluctuations in the production and communication of knowledge.

In view of the above, the present work presents an illustration of one of the numerous science language and discursive issues whose analysis in the light of linguistic trends, such as Language for Specific Purposes (LSP) and Systemic Functional Grammar (SFG) (Halliday, 1985), demonstrates the usefulness of teaching communication explicitly as part of science work. The case example chosen for the present work focuses on the language strategies to communicate knowledge in highly advanced scientific titles, particularly on how scientists choose to show themselves in the process of knowledge production and knowledge communication in this small territory of scientific articles. Our observations are thus related to the treatment of objectivity in science and are centered on samples of highly advanced scientific titles, which are, in turn, samples of peer-to-peer discourse.

## Science Rhetorics

Merton's third principle of the ethos of science (1973), i.e. disinterestedness and organized skepticism when approaching claims, can be interpreted as being rhetorically shown through the absence of researchers in a research study, thus guaranteeing that there is no interest in claiming that something is true. The scientific method adheres to an objectivity paradigm which, in turn, eliminates biases and idiosyncratic influence from the body of knowledge. Therefore, textual authorial evidence in highly advanced scientific discourse is minimal to prioritize the object of study, imprinting a note of objectivity and neutrality all throughout a given research (Nash, 1990). In linguistic terms, this is known as agency concealment (Master, 1991) through which the researcher can either distance or hide himself from the text. To this end, agentless passives (Quirk, 1973) and nominalizations (Halliday, 1985) become key linguistic strategies through which human action can be hidden in an attempt to make the object of study become the focus of attention, the final effect being a

value-neutral objective characterization of entities and facts (Lemke, 1990).

In other words, the presence of researchers in highly advanced scientific discourse has been traditionally considered as a sort of being present without being present, a conception that has surely served the orthodoxy of manuals and authors' instructions proclaiming impersonality in scientific writing. Still, the question remains as to what extent the researcher is linguistically hidden from the research he conducts? Or in other terms, even when there are, in fact, linguistic resources such as agentless passives and nominalizations, do they ostensibly hide the researcher's action in all that has to do with a given study? The answer is definitely no because research is a human activity (Gross, 1990) and, in presenting a claim, researchers cannot avoid expressing an attitude on it.

A concept that, in our view, is thus key to addressing these issues is that of authorship, whose origins could be traced in the field of literature studies as of the beginning of modernity and whose meaning has fluctuated from putting the author as the center of gravity around the text (Barthes, 1987), to silencing him in texts to make the reader the center of gravity of a text (Jauss, 1987). In the context of these fluctuations, it was Bajtin (1999) who restored the concept of authorship as that of being indicative of a place of maximal hierarchy in a text, claiming that it is the author who operates as the agent through whom the way of seeing the world is actively directed. It therefore becomes clear that authorial presence or visibility in scientific discourse is a fact and that different degrees of such presence can be identified ranging from authorial total distance/concealment to proximity/involvement in the text. All the above in this section perfectly fits to epistemic issues on science work. Observing how these epistemic issues are materialized through language to communicate knowledge is a useful starting point to further plan in what way science communication must be included in English for

Specific Purposes (ESP) and English for Academic Purposes (EAP) syllabi.

The reasons why linguistic practice needs attention within the field of science rhetorics and as part of science routine lie in that the conception of the nature of science underwent crucial changes with the passing of time. Much of 20th century rhetorical theory has revisited the belief in neutral, objective knowledge (Bazerman, 1988; Gross, 1990) by challenging the "sacrosanct" nature of science and its presumed impersonality. Such new direction within science rhetorics also led to conclusions that demonstrate that highly advanced scientific reports are not only informative but also persuasive (Gross, 1990). However, although such epistemological and rhetorical conclusions which equaled the informative and persuasive potential of scientific communication and challenged science presumed objectivity and neutrality have prevailed as of the 20th century, they have not dominated the pedagogy of science writing and communication. ESP and EAP are therefore central to designing a pedagogy that could interact with science rhetorics, science epistemology, and philosophy of scientific language.

Different ESP studies have been carried out on authorial proximity/absence in highly advanced scientific texts. Attention has been paid, for example, to i) researcher's presence through modality and hedges (Hyland, 1994; Salager-Meyer 1994) materialized in the mood structure of the clause (Halliday, 1985); ii) researchers' positioning regarding their or others' studies (Dressen, 2003; Thompson & Yiyun, 1991); iii) stance (Baratta, 2009; Hunston, 2000), and authorial self-mention (Hyland, 2001). However, little attention has been paid to the grammaticalization of objectivity/impersonality and authorial visibility in science. Discourse analysis, mainly critical analysis (Fowler, Hodge, Krees, & Trew, 1979) of journalistic texts and the principles of Systemic Functional Linguistics (SFL, Halliday, 1985) are, in our view, key to addressing

oscillations from objectivity to authorial presence/visibility in texts. Discourse analysis claims that instead of being neutral copies of reality, news are a representation of a reality and that such representation is materialized through the author's scale of values and ideologies. In line with this, research papers (RP) are a representation of an object of study constructed in terms of a very heterogeneous set of parameters among which the researcher's view of the world, his intentions towards the object of study and to his audience, his inquiries, his attitude, his style, etc. are of pivotal importance in such representation where transitivity (further described below) is central in terms of SFL principles.

On the other hand, there is a technical lexicogrammar which provides the structures necessary for the construction of the scientific experience (Halliday & Martin, 1993). The analysis for the identification of such lexicogrammatical structures, mainly centred on transitivity, has revealed the researcher's textual presence or distance in all the sections of the RP (Martinez, 2001) except the title. Our work is therefore an attempt to fill this niche and by so doing, further evidence in favor of the inclusion of science communication issues in ESP and EAP syllabi could be secured.

## Scientific titles

The observations on scientific titles herein reported derive from three previous cross-generic and cross-disciplinary studies, the first of which examined the most recurrent title structural constructions written in English (Soler, 2007) in RP and review papers (RVP) in two fields: biological sciences (Biochemistry, Biology, and Medicine) and social sciences (Anthropology, Linguistics, and Psychology). The second of these studies followed the same analysis as that of the first study but on titles written in Spanish (Soler, 2009) and the third study, which was conducted on a database including 1140 titles from English and

Spanish, fused results from the former two and analyzed them following a statistical, comparative and contrastive approach (Soler, 2011). From the structural point of view, our studies indicate that there are four title constructions: i) nominal-group titles, ii) full-sentence titles, iii) question titles and iv) compound titles. Although question titles belong to the full-sentence category, in all instances of our former research they have been analyzed as a separate category for reasons of clarity. Of these four categories, nominal-group titles were found to be the most recurrent in the two genres considered, in all the disciplines analyzed and in the two languages considered. Thus, for reasons of brevity in relation to the main topic of this paper, our further observations will be centered only on this type of title structure in English. The examples considered all belong to our formerly built 570-title-database (for details on how our title-database was constructed see Soler, 2011).

Our analysis was centered on the identification of the most recurrent strategies that show whether or not scientists project themselves in titles to communicate knowledge. There are no previous studies on these strategies, particularly in scientific titles. This may be due to the fact that titles have not yet been seen as part of the territory of scientific articles as assessed in a study of writers' visibility in research articles and research article abstracts by Lorés Sanz (2008) who claims that "the territory of scientific articles ... starts in the abstract" (p. 106). However, titles prove to be not only part of the territory of scientific articles but also the beginning of such territory and, more importantly, they are textual units which, if appropriately formulated, become clear indicators of either researcher's presence or concealment.

Identifying what the researcher wants to do appears to be key in the choice of strategies which evidence total objectivity, i.e. researcher's concealment, or researcher's presence/visibility. In terms of SFL, there are recurrent lexicogrammatical patterns in genres

that contribute to the construction of “the uncommonsense interpretation of reality which distinguishes science as a discipline” (Halliday & Martin, 1993, p. 23). Such representations of reality derive from particular selections made from the transitivity system available to scientists for the organization of experience. This transitivity system indicates how language is structured in order to represent actions and entities. This, in turn, leads us to think that in the process of choosing what to represent, the researcher has, in principle, the following alternative starting points: i) the representation of the object he will study, ii) the representation of the research he will carry out, or iii) the representation of his interpretations. These alternatives, in turn, seem to be key markers of different degrees of authorial visibility varying from total agency concealment to an easily identified authorial proximity to the text.

Therefore, if the focus of attention is put on the representation of the object of study, titles under the nominal group structure are likely to be the best strategy to this end. A nominal group is “a rhetorical structure which developed as the prototypical discourse pattern for experimental science” (Halliday & Martin, 1993, p. 7). It is a structure formed of a noun known as head (obligatory element) and an optional set of modifiers that may operate either as premodifiers or postmodifiers. A nominal group may thus consist of only the head (and it is still considered a group) as in:

- Seminalplasmin. *BioEssays* 17:415–423, 1997 (Biology RVP title)

or of a long string of words as in:

- German noun inflection. *J. Linguistics* 35:1–42, 1999 (Linguistics RP title)
- Temporal bisection in children. *J. Exp. Child Psychol.* 80(2):142–159, 2001 (Psychology RP title)
- Folded monomer of HIV-1 protease. *J. Biol. Chem.* 276(52):49110–49116, 2001 (Biology RP title)

- Long-distance transport of bulk goods in the pre-hispanic American southwest. *J. Anthropol. Archaeol.* 20(2):230–243, 2002 (Anthropology RP title)
- Glucocorticoid receptor expression in the spinal cord after traumatic injury in adult rats. *J. Neurosci.* 19(21):9355–9363, 1999 (Biochemistry RP title)

Total agency concealment is observed in the above-listed titles which are, metaphorically, unbiased photographs whose photographer is the researcher whose tracks pass fully unnoticed precisely to make the object of study be the center of attention. In this sense, they are indeed epitomes of objectivity. Nevertheless, these titles were surprisingly very low in number in our title-database (Soler, 2011), a finding which operates in favor of the demythification of the objectivity paradigm in science.

Schuster (1990) identifies two types of objectivity: an objectivity proper derived from laboratory experiments and an objectivity that results from the association of such experiments with science in general, with the discipline to which such experiments correspond, and with the community. In his view, the prerequisites for objectivity are logical coherence and observational fidelity, the latter being associated with the certainty that arises from basic knowledge and observable phenomena which are not contaminated by the interpretation of the researcher. Within this framework of objectivity, it is possible to confirm that the five above-listed nominal group titles fit to these two types of objectivity.

Another useful tool to trace the tracks of the researcher in a title is the passivity/activity dichotomy. That is, is the title a representation of the object of study or is it a representation of an action carried out by the researcher? In the former case, the researcher appears as having a passive or no role at all and his visibility/presence/proximity may thus either be null

or pass unnoticed. In general, this passivity coincides with zero-process (verb) titles. In the latter case (activity), tracks of the researcher's visibility/presence/proximity to the text can be identified in varying degrees as the researcher is shown as i) the observer/evaluator of the object of study, ii) the doer of an action although he is not at all mentioned in the title structure, or iii) the interpreter of findings. Let's consider each of these representations in particular.

### Researcher as observer/evaluator of the object of study

In principle, the absence (zero process) or presence of a process (i.e. the presence of a dynamic verb in traditional grammatical terms) in titles is central to help identify textual tracks of the researcher. This is because in terms of SFL processes require participants, one of which is the researcher independently of whether or not he is mentioned, thus showing different degrees of visibility/presence/proximity to the text. The examples below show these oscillations via zero-process title structures to title structures including a process:

- The upper dentition and face of *Pondaungia cotteri* from central Myanmar. *J. Human Evol.* 43(2):143-166, 2002 (Anthropology RP title)
- The morphosyntax of WH-extraction in Irish. *J. Linguistics* 37:67-100, 2001 (Linguistics RP title)
- Crystal structure of *Klebsiella aerogenes* UreE, a nickel-binding metallochaperone for urease activation. *J. Biol. Chem.* 276(52):49359-49364, 2001 (Biology RP title)
- Interleukin-10 polymorphisms in Spanish multiple sclerosis patients. *J. Neuroimmunol.* 131:168-172, 2001 (Biochemistry RP title).

Agency concealment (Master, 1991) is observed in the above-listed zero-process titles which display an object-based approach. Nonetheless, that titles are built on a zero-process

structure does not necessarily guarantee that they are indicators of total agency concealment. Let's consider the following examples randomly taken from our database:

- A radical approach to enzyme catalysis. *BioEssays* 17:431-443, 1995 (Biology RVP title)
- The best of all possible words. *J. Linguistics* 37:1127-1143, 2001 (Linguistics RVP title)
- A positive view of peer acceptance in aggressive youth risk for future peer acceptance. *J. School Psychol.* 39(3):239-252, 2001 (Psychology RP title)
- A critical review of the validity of ego development theory and its measurement. *J. Personal. Assess.* 77(3):541-567, 2000 (Psychology RVP title)
- The fundamental role of pirouettes in *Caenorhabditis elegans* chemotaxis. *J. Neurosc.* 19:9557-9569, 1999 (Biochemistry RP title)
- Essential control of an endothelial cell ISOC by the spectrin membrane skeleton. *J. Cell Biol.* 154:1225-1234, 2001 (Biology RP title)
- Neuroprotective and neurorestorative strategies for Parkinson's disease. *Nature Neurosc.* 5:1058-1061, 2002 (Biochemistry RVP title)

Although the seven above-listed titles are built on a zero-process structure, they are not indicators of a neutrally-objective presentation of the topic or item being looked at, but of an evaluation of such topic or item. Thus, and although there is agency concealment in the sense that the researcher is not at all mentioned in the titles, the researcher's projection/presence in the text is perfectly visible through an evaluation. In this particular case, the strategy through which evaluation is materialized is the use of adjectives (radical, fundamental, best, essential). In addition, if we think again in terms of titles as photographs, we begin to see that sharpness on the focus of attention on the object of study is either too weak or null because the focus falls on a quality of an entity rather than on the entity itself. This confirms that as observational fidelity decreases, evaluative

observation increases, which, in turn, helps to identify the researcher's visibility in the title.

### Researcher as doer of an action although he is not at all mentioned in the title structure

Other recurrent mechanisms through which the researcher's visibility/presence/proximity can be identified are nominalizations and –ing agentless passives. Nominalization is the mechanism through which processes (verbs) or properties/qualities (adjectives) are transformed into nouns after metaphorical rewording. This is a distinguishing feature of scientific discourse. Words with the grammatical function of nouns but which, from a semantic point of view, encode processes are considered to be “nominalized processes” or “nominalizations.” Nominalization benefits are both grammatical and semantic. From a grammatical point of view, nominalizing a process allows the addition of modifiers, which, in turn, facilitate full description of entities in a synthetic way, i.e. in an economic way. From a semantic point of view, nominalized processes become more “thing-like” as though acquiring the status of entities, an effect which seems to be specially appropriate for scientific writing as, through nominalization, processes acquire the nature of factuality. It is thus in this way how researcher's visibility passes unnoticed as in:

- Elucidation of a telic infinitive. *J. Linguistics* 37(2):313-337, 2001 (Linguistics RP title)
- Estimation of torsional rigidity in primate long bones. *J. Human Evol.* 43(2):229-239, 2002 (Anthropology RP title)
- A longitudinal study of the development of shifts of gaze to a peripheral stimulus in preterm infants with transient periventricular echogenicity. *J. Exp. Child Psychol.* 82(2):116-140, 2002 (Psychology RP title)
- Characterization of regulatory elements on the promoter region of p16<sup>INK4n</sup> that contribute to

overexpression of p16 in senescent fibroblasts. *J. Biol. Chem.* 276(52):48655-48661, 2001 (Biology RP title)

- Comparison of transcatheter closure of secundum atrial septal defect using the Amplatzer septal occluder associated with deficient versus sufficient rims. *Am. J. Cardiol.* 90(8):865-869, 2002 (Medicine RP title)
- *In vivo* localization of DNA sequences and visualization of large-scale chromatin organization using lac operator/repressor recognition. *J. Cell Biol.* 135:1685-11701, 1996 (Biology RP title)
- Social analysis of mortuary evidence in German, protohistoric archaeology. *J. Anthropol. Archaeol.* 20(1):369-384, 2000 (Anthropology RP title)

Though not at surface structure, it is evident that all of these examples involve a process (elucidate, estimate, characterize, compare, localize, visualize, and analyze) at the deep structure level, and that the doer of these processes is the researcher who, though not at all mentioned at the title surface structure, can be easily perceived. Much more evident is the researcher's proximity to the text when a process in the –ing agentless form involving an animate agent is used, as in:

- Telling general linguists about Altaic. *J. Linguistics* 35:65-98, 1999 (Linguistics RP title)
- Circumscribing referential domains during real-time language comprehension. *J. Mem. & Lang.* 47(1):30-49, 2002 (Linguistics RP title)
- Identifying critical cross-cultural school psychology competencies. *J. School Psychol.* 40(2):115-141, 2002 (Psychology RP title)
- Tracing of enteric neuronal pathways. *Neurogastroenterol. & Motil.* 13:1-18, 2001 (Medicine RVP title)
- Discussing treatment options and risks with medical patients who have psychiatric problems. *Arch. Int. Med.* 162(18):2037-2044, 2002 (Medicine RVP title)



## Researcher as interpreter of findings

As to the interpretative role of the researcher, Pinch (1985) introduces the term “externality” in the interpretation of observational results to indicate a sort of movement from given experimental evidence towards interpretation. As interpretation progresses, it becomes more external and more detached from the object of study. Consequently, if interpretation progresses along with evaluation in the externality scheme (Hunston, 1994), the degree of certainty decreases, thus implying that the more interpretation there is, the lower the degree of observation fidelity and certainty. This also shows that researcher’s passivity gives place to researcher’s activity although there are no visible grammatical tracks of him. Interestingly, the indicators of the researcher’s interpretative role can be of different grammatical nature, e.g.

iii.a) Nouns:

- Constraints on intonational phrasing in English. *J. Linguistics* 34(1):181-211, 1998 (Linguistics RP title)

The noun “constraints” implies a mental exercise through which the researcher isolates the limitations of the object of study (in this case, “intonational phrasing in English”) after having fully studied such object and perhaps after having identified the benefits of such object as well as after having compared and contrasted both the benefits and the constraints. Independently of whether or not these were indeed the steps followed, Hunston’s concept of externality (1994) can be observed.

iii.b) “as-interpretative” structures:

- Persistent negative t waves in the infarct-related leads as an independent predictor of poor long-term prognosis after acute myocardial infarction. *Am. J. Cardiol.* 90(8):833-837, 2002 (Medicine RP title)
- Ethnohistoric analogues for storage as an adaptive strategy in northeastern subarctic

prehistory. *J. Anthropol. Archaeol.* 21(3):301-328, 2002 (Anthropology RP title)

- Inhibition of verbal memory retrieval as a consequence of prior retrieval. *J. Mem. & Lang.* 46(3):606-621, 2002 (Psychology RP title)
- Consultant problem understanding as a function of training in interviewing to promote accessible reasoning. *J. School Psychol.* 40(4):197-212, 2002 (Psychology RP title)
- Usefulness of finger blood flow during exercise as a marker of functionally significant coronary heart disease. *Am. J. Cardiol.* 90(7):756-759, 2002 (Medicine RP title)

Interestingly, of the above-listed examples in group iii.b), the last shows a double interpretation of the object of study. One focuses on the consideration of finger blood flow during exercise as a marker of coronary heart disease and the other, on the usefulness of this consideration. Through this title, the concept of externality (Hunston, 1994) helps to corroborate that as interpretation increases, the researcher becomes more external in the sense that he can be identified as a separate/external entity from the object of study although he is not linguistically mentioned in the text. This is an evidence of how he projects himself in the title structure and therefore how this can be considered a sign of his presence.

## Conclusion

Within the complex process that progresses from the “science in-the-making” stage to the “ready-made science” stage, scientific communication is constitutive to knowledge and as such, it not only becomes central to the nature of science but also supplements the epistemological view of science sustained to date. In line with this, although they are small textual territories, scientific titles demonstrate to have an effective communicative potential that contributes to the progress of knowledge.

Titles, in particular, are the result of an act through which researchers position themselves

by means of linguistically realized actions in the process of knowledge communication. Researchers and written scientific discourse are mutually and reciprocally fused through the mechanism of agency (Master, 1991) which could be seen as having two different directions. One direction concerns scientific discourse which involves genres and cultural practices, both of which position researchers in their articles, and therefore in their titles. The other direction concerns the researcher himself as a communicator who can make choices in relation to those practices to choose the means by which to project and construct a particular persona in the text, and, in so doing, carry out identity/visibility work.

Although a limitation to our reflections could be the fact that they circle around a very small territory of RP and RVP, they allow us to identify the different roles that the researcher plays in the process of knowledge communication, namely as i) observer/evaluator of the object of study, ii) doer of an action, and iii) interpreter of findings. In scientific titles, these roles are textually fulfilled through different language mechanisms and reveal oscillations from communicator's textual absence (invisibility) to communicator's textual presence (visibility) in the process of knowledge communication. Due to their recurrence, these oscillations, whose study can, in turn, be extended to all sections of RP, RVP, and other written scientific contributions, are an important issue worthy of being analyzed in the fields of epistemology, philosophy of science, nature of science instruction, and ESP and EAP pedagogy. Joint research among epistemologists, philosophers of science, and linguists is therefore a necessary tool for a pedagogy towards a translation of the topic of "science as communicative practice" in changes to curricula, learning outcomes, and assessment tools.

## Acknowledgements

Thanks are due to Dr. Patricia Vallejos from the *Departamento de Humanidades, Universidad Nacional del Sur (UNS)*, Argentina, for her comments, cooperation, and guidance in the present study. The author is also grateful to an anonymous referee for his/her constructive observations which greatly improved this paper. This work was supported by grant 24/1205 from UNS to Dr. P. Vallejos, director of the project "Textual aspects of scientific knowledge", within which this study was carried out.

## References

- Baratta, A. (2009). Revealing stance through passive voice. *Journal of Pragmatics*, 41, 1406–1421.
- Barnes, B., & Bloor, D. (1982). Relativism, rationalism and sociology of knowledge. In M. Hollis & S. Lukes (Eds.), *Rationality and relativism* (pp. 21–47). Oxford: Blackwell.
- Barthes, R. (1987). *El susurro del lenguaje. Más allá de la palabra y de la escritura*. Barcelona, Spain: Paidós.
- Bajtin, M. M. (1999). *Estética de la creación verbal*. Madrid: Siglo XXI Editores.
- Bazerman, C. (1988). *Shaping written knowledge*. London: The University of Wisconsin Press.
- Collins, H. (1985). *Changing order. Replication and induction in scientific practice*. Chicago: The University of Chicago Press.
- Dressen, D. (2003). Geologists' implicit persuasive strategies and the construction of evaluative evidence. *Journal of English for Academic Purposes*, 2, 273–290.
- Fowler, R., Hodge, B., Krees, G. & Trew, T. (1979). *Language and control*. London: Routledge & Kegan Paul Books.
- Garriz, A. (2006). Naturaleza de la ciencia e indagación: cuestiones fundamentales para la educación científica del ciudadano. *Revista Iberoamericana de Educación*, 42, 127–152.

- Gross, A. G. (1990). *The rhetoric of science*. Cambridge: Cambridge University Press.
- Halliday, M. A. K. (1985). *An introduction to functional grammar*. London: Edward Arnold.
- Halliday, M., & Martin, J. R. (1993). *Writing science. Literacy and discursive power*. London: the Palmer Press.
- Hunston, S. (1994). Evaluation and organization in a sample of written academic discourse. In M. Coulthard (Ed.), *Advances in written text analysis* (pp. 191–218). London, New York: Routledge.
- Hunston, S. (2000). *Evaluation in text: Authorial stance and the construction of discourse*. London: Oxford University Press (edited with G. Thompson).
- Hyland, K. (1994). Hedging in academic writing and EAP textbooks. *English for Specific Purposes*, 13, 239–256.
- Hyland, K. (2001). Humble servants of the discipline? Self-mention in research articles. *English for Specific Purposes*, 20, 207–226.
- Jauss, H. R. (1987). El lector como instancia de una nueva historia de la literatura. In J. A. Mayoral (Ed.), *Estética de la recepción* [Aesthetics of reception] (pp. 59–85). Madrid: Arco/Libros.
- Knorr-Cetina, K. (1992). The couch, the cathedral and the laboratory: On the relationship between experiment and laboratory in science. In A. Pickering (Ed.) *Science as practice and culture* (pp. 113–138). Chicago: University of Chicago Press.
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago: University of Chicago Press.
- Latour, B. (1987). *Science in action*. Cambridge, MA: Harvard University Press.
- Latour, B., & Woolgar, S. (1986). *Laboratory life: The construction of scientific facts* (rev. ed.). Princeton, New Jersey: Princeton University Press.
- Lemke, J. L. (1990). *Talking science: Language, learning, and values*. Norwood, New Jersey: Ablex.
- Lorés Sanz, R. (2008). Genres in contrast: The exploration of writers' visibility in research articles and research article reviews. In S. Burgess & P. Martín-Martín (Eds.) *English as an additional language in research publication and communication* (pp. 105–122). Bern: Peter Lang AG.
- Martinez, I. (2001). Impersonality in the research article as revealed by analysis of the transitivity structure. *English for Specific Purposes*, 20, 227–247.
- Master, P. (1991). Active verbs with inanimate subjects in scientific prose. *English for Specific Purposes*, 10, 15–33.
- Merton, R. K. (1973). *The sociology of science: Theoretical and empirical investigations*. Chicago: University of Chicago Press.
- Merton, R. K. (1968). *Social theory and social structure*, 3rd enlarged edn. New York: Free Press.
- Nash, W. (1990). The stuff these people write. In W. Nash (Ed.), *The writing scholar: studies in the language and conventions of academic discourse* (pp. 8–30). Newbury Park, California: Sage.
- Nielsen, K.H. (2013). Scientific communication and the nature of science. *Science and Education*, 22, 2067–2086.
- Pickering, A. (1984). *Constructing quarks: A sociological history of particle physics*. Edinburgh: Edinburgh University Press.
- Pinch, T. (1985). Towards an analysis of scientific observation: The externality and evidential significance of observational reports in physics. *Social Studies in Science*, 15, 3–36.
- Quirk, R. (1973). *A university grammar of English*. Harlow: Longman.
- Salager-Meyer, F. (1994). Hedges and textual communicative function in medical English written discourse. *English for Specific Purposes*, 13, 149–170.
- Schuster, F. G. (1990). Los límites de la objetividad en las ciencias sociales. In R. Gaeta & N. Robles (Eds.), *Nociones de la epistemología*. Buenos Aires: Eudeba.
- Soler, V. (2007). Writing titles in science: an exploratory study (Research and Discussion Note). *English for Specific Purposes*, 26, 90–102.
- Soler, V. (2009). Títulos científicos en lengua española: Estudio exploratorio. *Lebende Sprachen*, 2, 50–58.

- Soler, V. (2011). Comparative and contrastive observations on scientific titles written in English and Spanish. *English for Specific Purposes*, 30, 124-137.
- Thompson, G., & Yiyun, Y. (1991). Evaluation in the reporting verbs used in academic papers. *Applied Linguistics*, 12, 365-382.

