The Journal of Applied Linguistics and Applied Literature: Dynamics and Advances, Volume 5, Issue 2, Summer and Autumn, 2017, pp. 61-80

Hybridity of Scientific Discourses: An Intertextual Perspective and Implications for ESP Pedagogy

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Abstract

In light of a large number of admirable attempts which look at scientific discourse from social, dialogic, and interpersonal points of view, the propositions which consider scientific discourse as an interactive endeavor are now well-established. By the force of our social constructivist gyrations, we have developed glimpses of a social, cultural, and historical dimension in which the discourse of science operates. These glimpses indicate to us how much the discourse of science is part of the complex webs of human's social interaction. Recognizing this social, cultural, and historical nature, the present paper attempts to highlight the heterogeneity and hybridity of scientific discourse and indicate a number of ways scientific discourse is influenced by non-scientific discourses. Recognition of this hybridity helps the author develop a preliminary framework based on the concept of vertical intertextuality and reveal how modern scientific discourses borrow generic, stylistic, and rhetorical conventions of non-scientific discourses. The paper concludes with some of the implications of the developed perspective for ESP pedagogy and suggests a number of genre-related, style-related, and register-related pedagogic tasks.

Keywords: Hybridity, Scientific discourse, Intertextuality, ESP pedagogy

ARTICLE INFO

Article history:
Received: Friday, February 16, 2018
Accepted: Sunday, April 8, 2018
Published: Sunday, December 2, 2018
Available Online: Monday, November 26, 2018
DOI: 10.22049/jalda.2018.26150.1048

Online ISSN: 2383-2460; Print ISSN:2383-591x;

Getting rid of some traditional misconceptions: an evolving social constructivist movement

In light of a large number of admirable attempts which look at writing from social, dialogic, and interpersonal points of view, the proposition which considers written discourse an interactive endeavor is now well-established (see, for instance, Knorr-Cetina, 1981; Widdowson, 1984; Duszak, 1994; Hunston, 1994; Martin, 2000; Hoey, 1988, 2001; Thompson, 2001; Mei & Allison, 2005; Miller & Charney, 2008; Nelson, 2008). These attempts have helped us characterize written communication/written text in terms of features as:

- co-produced by authors and by readers to whom texts are directed;
- engaging writers and readers in a covert interaction;
- a physical record of a dialogue;
- a series of writer responses to anticipated reader reactions;
- collaboratively constructed, with communicative space left for the readers;
- a site for interaction;
- taking place under the principle of reciprocity;
- communicative homeostasis; and
- an interactional act.

In fact, in light of such scholarly thinking, something which was once conceived of as an asocial and purely intrapersonal act of communication has come to be recognized as a social and interpersonal act in which negotiation of meaning without taking care of the anticipated reactions of the potential audience is impossible. However, in defining the same act in the sphere of science, our consciousness of this rhetorical, communicative, and social character has long been suppressed. Due to a historical alienation developed towards the discourse of science, there has been a strong desire to wipe scientific communication in general and written scientific communication in particular off any social and interpersonal character. This alienation is strongly felt in advice such as the following given to writers of scientific prose (Bazerman, 1984, p. 163-5 as cited in Hunston, 1994, p. 192):

- the scientist must remove himself from reports of his own work and thus avoid all use of first person;
- scientific writing should be objective and precise, with mathematics as its model;
- scientific writing should shun metaphor and other flights of rhetorical fancy to seek a univocal relationship between word and object; and
- the scientific article should support its claims with empirical evidence form nature….

This alienation, as Halliday (1993/2004) rightly argues, is the outcome of the picture that science represented: "… a universe regulated by automatic physical laws

and of a vast gulf between humanity and the rest of the nature" (p. 199). This vast gulf has long dissociated scientific discourse form its historical, cultural, social, and interpersonal origins and networks of meaning making, the outcome being a picture of a faceless, objective, impersonal, and asocial discourse. This positivist conception of science defines knowledge as objective, individualistic, ahistoric, and asocial, gives knowledge a data-driven and/or cognitively necessitated character beyond the control of people, and sees scientific formulation as the outcome of impersonal application of decontextualized, methodological rules.

Nevertheless, by the force of our social constructivist gyrations, we have been gaining glimpses of a few different dimensions in which the discourse of science operates. These glimpses have been showing us how much the discourse of science is part of complex webs of human's social interaction. Research from the social construction of knowledge has clearly shown us that scientific discourse is a social construct, and its success is at least partly accomplished through strategic manipulation of rhetorical features. This movement locates participant relationships at the heart of scientific discourse, assuming that every successful text must display the writer's awareness of its readers. Within social constructionism, the terms in which the world should be understood are considered as social artefacts, as the outcomes of historically situated interactions and interchanges among people. Defining the process of understanding in terms of active, cooperative enterprise of persons in relationships and on the basis of the vicissitudes of social processes (e.g. communication, negotiation, conflict, and rhetoric), social constructionists characterize the concept of science in terms of the following features (for a full account of these features, see Gergen, 1985):

- Social constructionism confronts the traditional western conception of objective, individualistic, ahistoric, asocial knowledge;
- Social constructionism removes knowledge from the data-driven and/or the cognitively necessitated domains and situates it in the control of the people in interaction and relationship;
- Social constructionism rejects the proposition that scientific formulation can be the outcome of impersonal application of decontextualized, methodological rules; and
- Social constructionism sees the construction of knowledge as the responsibility of persons in active, communal interchange.

With these characteristics being highlighted, social constructionism situates scientific meaning making within a social, cultural, and historical context and encourages us to see the scientific meaning making as an at least partially humane act.

Recognition of a hybrid nature as one of the major implications of a social constructivist conception

A significant implication of characterizing the discourse of science in terms of social constructivist position would be recognizing the *hybridity* of such discourse. In fact,

being social, historical, and cultural necessarily implies that scientific discourse is in a constitutpive relationship with other social, cultural, and historical discourses surrounding it. Recognizing the social, cultural, and historical nature of scientific discourse simply means that it cannot be a homogeneous means of transmission of knowledge; heterogeneity is an integral quality of such discourses. This heterogeneity and hybridity implies that scientific communication does not operate in a vacuum and its qualities are constantly shaped and reshaped by the qualities of other discourses. Recent research on the discursive qualities of scientific discourse has revealed some of the ways non-scientific discourses have penetrated into scientific/academic discourse. In light of the empirical evidence from such research, we will have a closer look at some of the instances of the penetration of non-scientific discourses into scientific ones.

*Penetration of **popularization** discourse into the discourse of science*

In his insightful discussion on the problem of negotiation between linguistics (as a science) and practice of language teaching (where the findings of the science of linguistics have been traditionally and conventionally been expected to be of some relevance and application to non-scientists), Widdowson (2003) argues that scientific representations are and should be necessarily remote from every day experience, and from the immediate awareness of ordinary people. To Widdowson, this abstraction and distance from real life concerns and everyday life discourse plays a key role in the development of scientific knowledge. He claims that scientists' representations of phenomena do not need to be the replications of those phenomena as they occur in the real world – the terminology science uses, its discourse in general, will be correspondingly remote from every day experiences. In his opinion, what scientists do is to formulate their own version of reality on their own terms and in their own terms. Of course, Widdowson has been struggling to use this line of reasoning to persuade his readers of the justification for applied linguistics as a mediator between linguists and practitioners. However, I feel that this picture of science as something necessarily remote from the access of everyday life users and consumers has been fundamentally altered by the introduction of the so called "popularizing discourses". Popularizing discourses have been developed to bring the discourse of science down to the extent that non-scientist public audience can also access the findings of science.

In his detailed account of the popular science discourses, Hyland (2009) provides a very technical treatment of the concept of popularization by concentrating on the question, "popular with whom?". The question and the way it has been answered shed light on the variations we find in popular science genres. For instance, *scientific TV documentaries* are characterized by the use of strongly narrative storylines in which shaping and reshaping reality often take the form of a detective story. Through this arbitrary adoption of a position on an issue rather than

a variety of positions, the format suggests that the average viewer can only cope with one clear 'narrative' no matter how deceptive such a view of the world may be. Curtis (1994) believes that this detective narrative-like presentation of the realities emphasizes the human over scientific and promotes a particular normative view of science. However, in *popular science books*, the narrative structure of the documentaries is replaced by a more discursive presentation in which the confident assimilator (not a skeptical detective) provides a detailed understanding of a topic. This popular genre can be characterized by gradual reconstruction of a commonsense world into a technical one through recognizable cultural allusions, setting scientific work more clearly in historical contexts, emphasizing humanist and social elements, offering an ideological interpretation of the world, deploying the familiar academic signals of tentativeness and circumspection, and referring to relatively esoteric scientific knowledge as the common property of writer and audience. Hyland also deals with *science journalism*, as another mechanism of popularization of science, and discusses how the organizational patterns (foregrounding the main claim, focusing on the object of the study rather than the disciplinary procedures, the use of visuals), accommodation of readers (different ways of framing information for the non-expert audience, avoiding jargons, offering glosses, management of the cohesion by the writer, emphasizing the credibility of the source of information being reported) and expression of stance and attitude (hedging, abundant use of attitude markers, frequent use of personal pronouns and questions, considerable use of similes and comparisons) help the authors of journalistic science articles address a public reader community. This is a discourse which establishes the novelty, relevance, and newsworthiness of topics which may not seem to warrant lay attention by making information concrete, novel, and accessible. This discourse allows a non-specialist audience to recover the interpretive voice of the scientist.

Illustrative and empirical evidence of this aspect of hybridity comes from Myers' (1994) investigation of "the narrative of science and nature in popularizing molecular genetics." To show how the discursive structure of popular articles differ from scientific articles, the researcher compares the two genres on three levels – organization, syntax, and vocabulary. The comparison generally reveals that the different audiences not only set the facts out differently, but actually construct different views of science: while the professional article, written for a specialist scientific community, creates a narrative of science, following the arguments of the scientist's claim, the popularizing articles create a narrative of nature by focusing on the object of study rather than the scientific activity and endow the facts with much greater authority and certainty. This contrast is clearly manifested in the three levels selected for the purpose of comparison/contrast in this research. In organizational level, for instance, the organization of each section of research articles involves

juxtaposition of several related statements into a simultaneous order of argument, whereas in popularizing articles the statements are organized into a sequence. In syntactic level, research articles tend to use complex sentences, and complex phrases that bring a number of clauses into a single sentence while in popularizing articles the same content is expressed with a series of simple sentences. In terms of terminology, the researcher refers to examples in which the popularization substitutes for some scientific term an explanation or a rough equivalent in the general vocabulary. However, there are also cases which indicate that the writers of popularization often have to battle with editors to preserve some of their specialized terminology. The evidence provided by this research should be seen as part of my attempt to show that due to some social pressures (here the need to inform the public of the findings of science) scientific discourse may lose some of its essential qualities and bring in itself a number of discursive qualities belonging to other discourses.

Previous research on the differences between scientific and popular scientific discourses shows that these also differ in terms of the interpersonal system of meaning-making. A good example of such work which has concentrated upon interactive and interactional metadiscourse is Crismore and Farnsworth's (1990) study of professional and popular papers written by Stephen Jay Gould. The researchers reported a more frequent occurrence of interactive metadiscourse in the professional genre and assigned this difference to the difference in length of these two genres. They argued that since popularizations tend to be shorter than professional papers, writers of popular texts have less need of frame-markers to guide readers through a lengthy or complex text. Regarding the use of interactional metadiscourse, Crismore and Farnsworth found fewer hedges and boosters in the Gould popularization compared with the professional paper and more attitude markers and commentary. These differences were also explained by reference to different functions of epistemic devices in negotiation of knowledge claims with different audiences. The fact is that in negotiation of knowledge claims with an expert community, you are faced with a more skeptical audience and this requires an appropriate balance between scientific caution and assurance.

Fahnestock (1986) confirms this in her analysis of different degrees of tentativeness in an article from *Science* and the popularized transformations of that article in *Newsweek* and *Time*. Her findings show that the tentativeness found in the original scientific article was absent in its transformed versions; the transformed versions instead displayed a more amplified picture of certainty and claims. The elimination of hedges and boosters in popularization seemed to add to the significance and newsworthiness of the subject and glamorized the material for a wider audience.

*Penetration of **instructional/pedagogical** discourse: access limiting vs. access enhancing discourses*

A second dimension form which the hybridity of scientific discourses can be approached is the way it is influenced by the needs of the participants of **educational/pedagogical contexts**. Science has long been taught in schools and universities, and, as Halliday (1993/2004) rightly argues, the participants of educational settings have often complained about the alienated spirit of the discourse of science. Consequently, adjusting the discourse of science to teaching/learning requirements has been a major challenge.

Hanrahan's (2010) critical discourse analysis of teacher talk in science classrooms is an interesting instance of studies on the quality of the discourse of science as adjusted to the instructional needs. This research focuses on the extent the two teacher participants have been able to creatively adapt the hegemonic discourse to make science accessible and relevant to the needs of their students. The researcher investigates the discourse practices of teachers who have been nominated as having classes where students are generally believed to be positively engaged in science, during the years in which science is most likely to be a compulsory school subject and regularly taught. The research identifies certain differences between the discourse practices of the two teachers. This was indicated by the different ways they talked about science, by the way they kept or shared control, and by the way the learning environment was represented as a place of work or as a learning community. While one of the teachers represents science, both implicitly and explicitly, as being almost entirely about things and about classifying material processes in scientific terms, and having little to do with students' lives and interests, the other teacher makes science directly relevant to everyday happenings and social experiences by using nonspecialized language. Moreover, Mr. D's class exemplifies a work-oriented classroom, with completing tasks, being obedient, observing strict hierarchical roles, and having right answers all taking priority over personal understandings, whereas Mr. L's class exemplifies a learning community orientation: personal understanding is a high priority, and taking risks and making personal decisions (and mistakes) are seen as natural. In Mr. L's class there is a supportive community environment in which people can do the tasks within different lengths of time.

The researcher sees the differences between the two discourses in terms of *access limiting discourse* versus *access enhancing discourse*. In access limiting discourse, school science is portrayed as being for future scientists only with little concern for anyone who does not have familiarity with it. In access enhancing discourse, however, school science is portrayed as the natural expression of everyday events; it is open to anyone regardless of prior experiences and attitudes.

This analysis suggests that enacting an appropriate hybrid discourse which employs scientific terminology and argument accompanied by appropriate features of other pedagogical discourses can engage and energize students and be seen as better geared to teaching and learning. This hybridity is seen as a response to the pedagogical needs of the participants of a specific instance of scientific communication and would constitute a significant dimension of the concept of hybridity I am to develop in this paper.

Attempts to create a ***balance between theoretical propositions*** *and* ***social possibilities***

Science should be able to create a balance between abstract theoretical positions and social realities and possibilities; without such ability "heady remains heady and humdrum, humdrum" (Widdowson, 2003, p. 8). Part of the hybridity of discourse is triggered by such a requirement. There seems to be a consciousness among scientists that whatever is presented as a scientific proposition should appeal to the active reasoning power of the implied reader and help the reader link those propositions to a certain working environment. This consciousness influences the way scientific discourse is structured and a clear manifestation of this could be found in the frequent penetration of what is known as interactive metadiscourse into the discourse of science.

Henderson (2001) has concentrated on one such metadiscourse feature (i.e. examples) in Adam Smith's *Wealth of Nations* – a classic, seminal work in economics. Henderson's investigation of examples in Smith's scientific prose results in the identification of three broad categories: current examples – drawn from contemporary economic experience and written about in the present tense; historical examples – which refer to economic conditions in the classified world or in medieval England; hypothetical examples – which may or may not have an authentic existence in the world beyond Smith's texts. Henderson interprets the frequent use of examples in Smith's scientific prose as an attempt to appeal to the active reasoning power of the implied reader, fundamental to the development and justification of the proposition being presented, to help the reader activate the knowledge of certain working environments and to secure the cohesion of the chapters. According to Henderson, the recurrent use of examples creates a balance between theoretical propositions and social possibilities; mingled with the spoken language sense hidden in Smith's work, this gives his scientific discourse a systematic and *teacherly* approach. Henderson sees smith's work as packed with exemplification, presented within a wider pedagogical strategy that could be thought of as "planned repetition" or even "extensive familiarization technique".

The empirical evidence reported in the study above further confirms the constructivist position that scientific discourses do not and cannot operate in a vacuum; they cannot be isolated from social possibilities and historical processes.

*Penetration of **dialogic/cooperative** discourse*

Even highly prestigious and influential scientific texts like Darwin's *The Origin of Species* manifests scientists' inherent desire for **assessment of likely truth**, their **affective response** to the material, and their attempt to **engage readers in a dialogue**. This case which can be conceived of as a typical example of a scientific text with **dialogic** qualities has been investigated by Crismore and Farnsworth (1989). The research has mainly concentrated on Darwin's use of hedges, boosters, attitude markers, and commentary in his text. An interesting finding of this research is that it has resulted in identifying 890 instances of such metadiscourse markers in *Chapter One* of *The Origin of Species*, which sets out a framework for the book, and *Chapter Four* which presents the theory of natural selection. The significance of this research lies in the fact that what used to be seen as an influential scientific text and still counts as a typical representative of pure hard science is nothing but the voice of a cautious scientist who resorts to metadiscourse resources such as hedges, boosters, and attitude markers to indicate the relative uncertainty of his claims. Crismore and Farnsworth's work develops an image of a scientist which fundamentally differs from the impressions developed by dominant alienations: "the tentative, cautious, naturalist; the modest, gentleman naturalist; non-assertive, tactful presenter of ideas; the trustworthy expert, the childlike human being given to wonder – in short, the nonthreatening, endearing Mr. Darwin" (1989, p. 101).

This dimension of scientific discourse can be characterized as **cooperative** since it implicitly and explicitly invites the reader community to cooperate in the construction of a scientific reality. This dimension clearly shows that construction of scientific knowledge is an interpersonal act: a scientist's success in persuading the audience is intimately bound to designing a social network within which the scientist's stance and the audience's engagement are patterned in a cooperative fashion.

*Scientific creativity and **accountability to shared experience***

The cooperative dimension outlined above is sometimes manifested in scientists' **community-situated/community-bound** voice. In a typical investigation of this dimension of scientific prose, Kuhi and Alinejad (2015) provided a functional analysis of self-mentions in Stephen Hawking's works. The study utilizes Tang and John's (1990) continuum of authorial presence in writing (No 'I', 'I' as the Representative, 'I' as the Architect, 'I' as the Recounter of Research process, 'I' as the Opinion Holder, 'I' as the Originator) and finds out that while all forms of self-

mention frequently occur in Hawking's prose, more than two-thirds of the self-mentions in the corpus perform a 'representative' function.

The researchers examine this function in a wider sociological framework – one in which the beliefs of human communities are explained by reference to aspects of their social organization; this is something hard science largely escaped until relatively recently. The alleged impartiality, neutrality, impersonality, and objectivity of hard science discourse seemed to give it a unique epistemological status which placed it beyond the bounds of sociological activity, whereas the findings of this research emphasized a model of science in which "independent creativity is disciplined by accountability to shared experience" (Richards, 1987, p. 200). This function is performed by the *representative* role of self-mentions. It is through this role that a scientist coordinates and approves his scientific methods and findings through public appraisal and peer agreement. This finding seems to confirm the claim proposed by Hyland (2009) that "communication system is … the basic structural component of the scientific community, and an understanding of knowledge involves an understanding of how "I" is employed in the social justification of belief" (p. 33).

*Penetration of **competitive** discourse*

Unlike the cooperative and engaging atmosphere of Hawking and Darwin's prose, scientific discourses may sometimes sound more **competitive, inflating,** and **threatening**. Persuasion in scientific argument is not always achieved by an audience-friendly discourse. It seems that achievement in scientific communication sometimes requires an irenic atmosphere in which the audience is threatened to surrender.

In an interesting study on this rather rare quality of scientific discourse, Hoey (2000) focuses upon Chomskyan discourse in linguistics. Hoey bases his argument on the assumption that until relatively recently, it has been difficult to offer new ideas in linguistics without using Chomskyan transformational-generative grammar as bearings, and anyone who has tried to do so has been in danger of being dismissed as hopelessly out of the mainstream of linguistic thought and science. This has happened, according to Hoey, due to several factors including the theoretical vigor of Chomsky's contribution, the sense of autonomy and identity Chomsky has granted to linguistics and the theoretically elegant combination of old and new in his linguistics. Hoey, however, argues that, in addition to the factors mentioned above, there is a rhetorical characteristic in Chomskyan scientific prose that helps him survive; this rhetorical capacity is manifested in the smart manipulation of two strategies:

1. Inflate the apparent merit of your own argument by emphatically calling them 'striking', 'powerful', 'convincing', and so on. Deflate your opponents' argument by means of the corresponding antonyms.

2. Warn your opponent that if he did not accept your theoretical viewpoint, your data, or your argument,
   (i) Then he would be guilty of irrationality and/or
   (ii) Then your common field, as a field of research, would be destroyed.

Through a clever use of evaluation, in particular by evaluating negatively any reader whose assumptions about language and linguistics differ from his own, Chomsky pre-empts criticism of his ideas. His evaluations are so embedded in the structure of clause and that of the discourse that they are difficult to challenge. Few if any clauses encourage the readers to ask questions like "what do you feel about this?". Overuse of evaluation, interweaving evaluations with situational elements, and presentation of arguments without basis are unique qualities of Chomskyan scientific prose (while the normal practice in scientific discourse is that either evaluation is offered and then a reason for that evaluation and basis follows, or the situation is presented first and then evaluated). Chomsky attacks alternative position and adopts a threatening tone towards any reader whose views of linguistic theory or method is different from his own.

*Penetration of **commodification** discourse*

One particular instance of the penetration of non-scientific discourses into the discourse of science is what Fairclough (1992a, 1992b, 2002) has called "**marketization**" or "**commodification**". He believes that the "order of discourse" in higher education is restructured on the basis of the model of more central market organizations. In Kuhi (2014), I have reviewed a large number of academic/scientific discourses whose micro and macro features have been affected by the process of commodification; however, an interesting instance which would particularly contribute to the development of the present argument is the investigation carried out on research articles by Yakhontova (2002). Comparing abstracts written by Ukrainian/Russian writers and those by Western scholars, the researcher shows that Ukrainians/Russian abstracts look like short research articles, tend to be rather global in describing their research, and are in general more impersonal than their English counterparts emphasizing not so much the novelty of interpretation, but rather its continuing and non-conflicting character, whereas abstracts written by Western scholars produce the impression of clear-cut and quite 'abstract-like' texts that emphasize the originality of a particular piece of research and try to impress or even intrigue the reader. Yakhontova sees these differences as attributable to Western scholars' experience of ever-increasing demands in promoting their research during the process of struggling for publishing opportunities, academic positions, or additional funding. This reality of market society – the necessity to win international recognition of target addressees, which is eloquently expressed in the conflict of 'selling or telling' – inevitably influences scientific discourses and makes them more and more commodified. This promotional tendency can be seen in such features as rhetorical strategies of

indicating a gap, question-posing, and counter-claiming that facilitate the presentation of research as novel, strong claims for originality, reader-friendly and clearly organized structure of text, and, amongst other things, eye-catching titles.

Hyland (2009) seeks this shift in the amount of GDP spent on scientific research in Western countries and reports that much of the 3 percent of GDP spent on scientific research flows into universities and academic disciplines which are engaged in the competition to absorb more of the economic resources. Similarly, Rose (1998) argues that modern science would not develop without the evolution of industrial capitalism:

From Chaucer's Treatise on the Astrolabe, to the astronomy, mathematics and physics of Galileo, Descartes and Newton, the impetus and application of scientific discovery was in the maritime expansion of European trading and colonialism, and warfare between imperial powers. From Priestley to the present day, physical, chemical and geological sciences have developed in tandem with the beginning, expansion and technologization of mass industrial production, for which mercantile and imperial expansion provided the capital. (p. 237)

The quotation should be seen as significant in that it reveals the recognition of historical processes in the development of science with a particular emphasis on the commodifying forces. The outcome of these historical forces is that scientific discourses are shaped by the market-driven atmosphere of scientific research and, as Fairclough (2002) suggests, scientific discourses are increasingly permeated by a promotional agenda not dissimilar to that of advertising. This is where another dimension of the hybridity of the discourse of science emerges.

*Traces of **writer-responsible** and **reader-responsible** cultures*

Part of the variation and hybridity we have outlined above has to do with whether the scientific research is published in a **writer-responsible** or a **reader-responsible culture**. The fact is that some of the qualities of scientific texts are shaped by the culturally constructed assumptions and expectations of writers and readers on the distribution and assignment of responsibilities. These cultural assumptions and expectations might determine the shares and responsibilities of writers and readers in the negotiation of scientific meaning: whether the writer should struggle to make the meanings comprehensive based on the implicit interaction with the feedbacks of an implied reader or this is the reader himself who is responsible to reconstruct the meaning independently? The point is that the scientist/author's approach to this question does not develop in a vacuum; it is a culturally constructed approach. However, whatever the choice is, it will certainly influence the structure of scientific text. A writer-responsible scientific text would consequently resort to a more frequent use of comprehension facilitators (Henderson's 2001 analysis of Adam Smith's *The Wealth of Nations* as reviewed above is a clear instance of a scientist composing in a writer-responsible culture). The scientists/authors' attempt to facilitate the meaning-making process would result in abundant use of micro

interactive metadiscourse resources (e.g. transitions, code glosses, frame markers, endophoric markers, etc.) (In Kuhi 2011, I have demonstrated this quality in a wide range of academic genres including scholarly textbooks, introductory textbooks, handbooks, and research articles). This would, of course, result in clear, reader-friendly macro textual organization (e.g. the use of titles, subtitles, etc.). Yakhontova (2002) also attributes some of the differences between American and Russian/Ukrainian scientific texts to the affiliation of scientists/authors to reader-responsible and writer-responsible cultures.

*Penetration of **ideological/political** discourse*

A final dimension from which the hybridity of scientific discourses can be explored is the **ideological contexts** within which scientific research is taking place. The fact is that scientific/academic research has to fit the broad ideological/political context. If the evidence suggested by the empirical research on the sociocultural quality of the discourse of science is persuasive enough, we need to acknowledge the fact that ideological/political forces play a significant role in how the scientific research takes place and how it is reported through scientific/academic genres. Yakhontova (2002) also confirms this proposition in an attempt to explain the origins of variation found in the texts produced by scientists working in post-Soviet contexts. The wider sociopolitical and economic context should be seen a major factor in exploring the origins of hybridity.

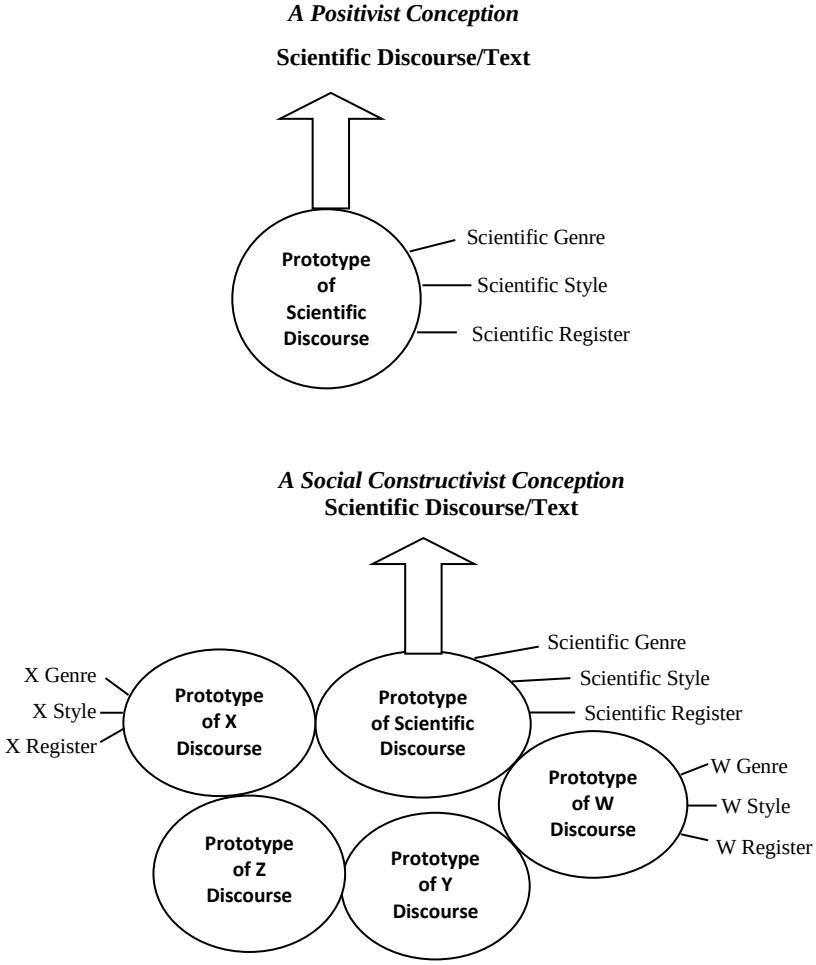
In concluding this section, I should highlight a significant point: the boundaries between the dimensions I have outlined are not that much rigid. I have just tried to move from the empirical evidence suggested by investigations of scientific discourse and outline a number of perspectives from which the hybridity of such discourses can be understood. However, I believe that a comprehensive framework would emerge when these assumptions are tested against a quantitatively significant number of scientific texts. Since in this investigation I am partially motivated by pedagogical concerns, in the rest of this paper I will explore the concept of hybridity from an intertextual point of view. I assume that this perspective can have significant pedagogical potentials and implications.

An emerging model of hybridity: an intertextual perspective

What I have developed above on the nature of scientific discourse and the way it is influenced by other discourses can also be approached form an intertextual perspective. I find this perspective significant in that it would facilitate our understanding of some related concepts like scientific genre, scientific register and scientific style and would help us deal with the challenges we face in characterizing these terms. This is what I will do in the forthcoming section of the paper. The French scholar Julia Kristeva (1986) who introduced Bakhtin's work to Western societies has offered a very useful distinction between 'horizontal' intertextuality and 'vertical' intertextuality. She reserves the term 'horizontal' to define the way texts build on texts with which they are related sequentially (or syntagmatically),

while the term 'vertical' intertextuality is used to characterize the way texts build on prototypical texts that are paradigmatically related to them. Using this distinction, we can argue that the non-scientific discourses we outlined above are in a kind of paradigmatic relationship with the discourse of science. This paradigmatic relationship forces scientific discourse to re-adjust its generic, registeral, and stylistic features so that the expectations emerging from other contexts can be appropriately met (instances of this readjustment were reviewed in previous sections). This is the very outcome of a paradigm shift in the discourse of science: a shift from an objective, faceless, impersonal, and positivist nature to a constructivist, social, and interpersonal paradigm. This shift has encouraged the discourse of science open its doors to the influence of other discourses. I have tried to characterize this shift in Figure 1.

Figure 1. An intertextual representation of the hybrid nature of the discourse of science



Such an approach to the intertextual dimension of hybridity would enable us to perceive relations between the functions of one discourse and those of other relevant discourses. It could be argued that these relations jointly contribute to the development and maintenance of what we call 'scientific discourse'. It seems that scientific discourse in general and its generic and stylistic features in particular are loosely arrayed in an intertextual network as they interact with, draw upon, and respond to other discourses and their generic, registeral, and stylistic features. This *constitutive intertextuality* (or what Fairclough calls 'interdiscursivity') involves borrowing generic, stylistic, and rhetorical conventions and forms to create a scientific text, "thus merging what may be originally distinct orders of discourse to create new discourses" (Hyland, 2006, p. 57). This is the way the meaning making system of scientific discourses works. Through the interaction between academic discourse and other discourses, which implies a process of drawing upon and responding to other orders of discourse, scientific discourses are adjusted and adapted to the *social*, *cultural*, *historical*, *pedagogical*, and *ideological* expectations of scientists/authors and their intended audiences, and this ensures the continuity of scientific institutions. As Hatim and Mason (1990) argue, this hybridity and intertextuality is a force which extends the boundaries of meaning and meaning making. In *S/Z* (1970), Barthes describes texts [and discourse] undergoing this force as displaying a limitless perspective of fragments, of voices from other texts [and discourse], other codes. Indeed the whole process may be characterized as a process of *discourse-switching* and *discourse-mixing* in which we obviously see a shift form one sign system (one meaning-making system) to another *in response to a variety of socio-psychological circumstances dictated by particular communicative needs and requirements*. Such features, in fact, confirm the very basic claim of social constructivism that science is not a 'given' in the sense of a monolithic entity always understood in the same way; it is a social construct created by different groups and of course for different groups with different interests and different expectations.

Developing an ESP Pedagogy with Hybridity-Sensitive Character

Current thinking in ESP theory tells us that development of successful ESP programs depends on deeper understanding of both the processes (discourses) and the products (texts) of target communicative events and acts. This assumption is telling us that if we are to develop English for Science Purposes programs which prepare our learners for effective communication in target communicative tasks, we cannot turn our backs to the hybrid character of scientific texts and discourses. In the preceding sections of this paper, I attempted to deal with this hybridity and outline the major dimensions of it. However, the question how this hybridity should be dealt with in ESP pedagogy still remains to be discussed.

First of all, emphasizing the intertextual/interdiscursive character of scientific discourse fundamentally influences our objectives in ESP pedagogy. I believe that a

deeper awareness of this character of scientific discourse would be possible within a critical ESP pedagogy. The sort of critical approach I am advocating here has some affinities with work in critical language awareness (see Fairclough, 1992), which is part of the larger focus on critical language study and critical discourse analysis (e.g. Fairclough, 1995). The principal focus of such a theoretical framework would be to show how scientific discourse is both constituted by and constitutive of social relations, how language use in scientific communication is determined by broader social and ideological relations and in turn reinforces those relations. This approach will inevitably necessitate a critical exploration of the notion of scientific discourse community and how it is that certain forms of scientific knowledge and ways of communicating that knowledge have evolved and been shaped in the way they have. Within this approach, novice members of scientific discourse community would be required to switch practices between one scientific setting and another, to control a range of generic features appropriate to each scientific setting and to handle the meanings and identities that each set of generic features evokes. This would enable our learners to understand that the ways we use language in scientific communication are patterned by social institutions and interpersonal relationships among the participants of such discourse. Through this critical pedagogy, we should be able to raise the learners' awareness of the fact that scientific discourse is not a homogeneous, faceless, objective and transparent medium of communicating scientific knowledge, rather it is a social construct with deep cultural, social, and historical origins. Here language does not represent; it constructs. A hybridity-sensitive critical ESP pedagogy should radically challenge representationalism and universalism in scientific communication and move towards a framework which enables learners identify the different social and cultural origins of scientific discourse. This approach should challenge the assumption that scientific discourse is distant from social, cultural, political, and ideological concerns. Hyland (2009) argues that emphasizing intertextuality and interdiscursivity of scientific/academic discourses necessitates the analysis of 'symbolic power' of such discourses and texts. His contention is that in order to raise [the learners'] awareness of the symbolic power of these discourses, we need to resort to a version of critical analysis inspired by Systemic Functional Linguistics (SFL) (Halliday, 1994). SFL would help us see language as systems of linguistic features offering choices to users, but these choices are considerably circumscribed in situations of unequal power. This will help us analyze the relations between different contextual factors and the generic, stylistic, and register features of scientific texts in a dialectical view in which particular discursive events influence the contexts in which they occur and the contexts are, in turn, influenced by these discursive events. This view will emphasize cultural and historical aspects of the knowledge constructed by scientific discourses.

A hybridity-sensitive ESP pedagogy should actively engage the novice members of scientific discourse community in recognizing *intertextual/ interdiscursive signals*. These are genre, style, and register-related properties of scientific discourse/text which trigger the process of intertextual/interdiscursive search, setting in motion the act of semiotic processing (I have referred to some of these signals in my review of some research on the hybrid nature of scientific discourse above). Having identified these intertextual/interdiscursive signals, novice members of scientific discourse communities would embark on the more crucial exercise of charting the various routes through which a given signal links up with its pretext (the prototype which has become hybrid with scientific prototype), or, as these routes are two-way systems, a given pre-text links up with its signal. These pretexts (or prototypes) are the sources from which intertextual/interdiscursive signals are drawn, to which they refer, or by which they are inspired. The departure point of this analytic journey can be three major properties of scientific discourse - genre, style, and register. Each level can incorporate a cyclic awareness-raising structure which begins with exposure tasks, continues with analysis tasks, and ends in production tasks (a very practical instance of this approach to awareness-raising can be found in Weissberg and Buker, 1990). The following tasks would be helpful in engaging the learners in recognition of what I have called intertextual/interdiscursive signals:

a. Genre-related tasks

- engage the learners in analyzing the cognitive organization/schematic structure/move structure of the same scientific genres or rhetorical sections of the same genres produced in different cultures; these types of analyses can focus upon the sequencing, frequency of occurrence, distribution and formal properties used for performing a specific functional act;
- engage the learners in analyzing the cognitive organization/schematic structure/move structure of different scientific genres or rhetorical sections of those genres produced for different purposes and different audiences; these types of analyses can focus upon the sequencing, frequency of occurrence, distribution and formal properties used for performing a specific functional act;
- engage the learners in analyzing the cognitive organization/schematic structure/move structure of the same scientific genres or rhetorical sections of the same genres produced in different disciplines; these types of analyses can focus upon the sequencing, frequency of occurrence, distribution, and formal properties used for performing a specific functional act;

b. Style-related tasks

- engage the learners in analyzing different degrees of formality in different scientific genres with different purposes and different audiences;

- engage the learners in analyzing different degrees of formality in similar genres produced in different cultures and different disciplines;

c. Register-related tasks

- engage the learners in analyzing the syntactic and lexical properties of different scientific genres with different purposes and different audiences;
- engage the learners in analyzing the syntactic and lexical properties of similar scientific genres produced in different cultures and different disciplines.

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