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New research genres and English prosody: an exploratory analysis of academic English intonation in Video Methods Articles in experimental biology

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ABSTRACT

The digital multimedia environment where research communication develops nowadays has important consequences for EAP course design (Pérez-Llantada 2016), since speaking and visuals are ever more decisive for communicative success (Crawford-Camiciottoli and Fortanet-Gómez 2015). However, intonation manuals have remained virtually unchanged for decades, reflecting a time of limited access to actual academic intonation in use. To countervail this situation, we draw on Hafner's (2018) multimodal analysis of experimental biology Video Methods Articles by examining the intonation used in an exploratory corpus of the Researcher's Introduction section, identified as the most hybrid in generic nature. Our analysis suggests that traditional Hallidayan intonation explained in handbooks like Hewings (2007) and Brazil (1994) fails to capture phenomena observed in our corpus. These intonational phenomena (mostly deviations from traditional tonicity) have been found to be consistent with genre-specific factors like communicative purpose and move structure. Consequently, a broader revision of academic intonation materials is proposed.

Keywords*: English for Academic Purposes; digital research genres; English intonation; English pronunciation teaching*

I. INTRODUCTION

I.1. Background

Today more than ever, research communication and science dissemination are mainly digital multimedia activities. This communicative environment shapes the practices of both producers and consumers of scientific texts, which is discernible in the emergence of new academic genres and the adaptation of more traditional ones to the new contexts. Consequently, in the interest of providing appropriate frameworks and pedagogical insights for English for Academic Purposes, the study of academic and professional genres in recent years has been concerned with genre change and innovation (Hyon 2018, Pérez-Llantada 2016, Tardy 2016) as well as intertextuality and interdiscursivity (Bhatia 2017, Hafner and Miller 2019).

After the journal article and its orbiting part genres (see Pérez-Llantada 2013), the academic blog stands as the most widely studied digital research genre, with studies (Luzón 2013a, 2013b, Zou and Hyland 2019, 2020) focusing on the linguistic strategies deployed by academic blog writers to adapt scientific discourse to a hybrid, highly interactional genre with a wider, diversified audience. In writing, other digital research genres that have been explored include web-based texts for crowdfunding science (Mehlenbacher 2017), online conference announcements (Lorés 2018), virtual special issue introductions (Mur-Dueñas 2018), and graphical abstracts (Sancho-Guinda 2016). Some relevant studies addressing oral digital research genres cover work on research dissemination videos (Luzón 2019), video methods articles (Hafner 2018), webinars (Ruiz-Madrid and Fortanet-Gómez 2017), and online poster sessions (D'Angelo 2012). Interestingly, all these studies but the last make use of Multimodal Discourse Analysis (cf. Kress and van Leeuwen 2001). This analytical framework, common in the study of other oral academic (i.e. not online or research) genres (see Morell 2018, Querol-Julián and Fortanet-Gómez 2012, Valeiras-Jurado et al. 2018), is highly convenient to capture the combination of semiotic resources that the digital medium affords and provide valuable insight into the synergies achieved by the different modes of scholarly communication online. This presentation, if succinct, is enough to gain an impression of how rich and diverse the present-day repertoire is when new digital research genres are added to the existing pool of academic genres.

Adding to studies that address the genres of interest directly, there is also increasing scholarly interest in understanding the contexts of generic practices and the different constellations of genres that arise, which is mainly achieved by researching intertextuality and interdiscursivity (Bhatia 2017, Hafner and Miller 2019) and especially by implementing ethnographic methodologies (Paltridge et al. 2016, Swales 2019).

All in all, this situation of growing scholarly interest in new forms of research communication appears to favour studies which highlight the hybridity and interdiscursivity of texts in new contexts, as well as the exploitation of the multimodal resources of the digital environment. However, to the best of our knowledge, no research has tackled intonation in these investigations. We argue that intonation can contribute to the exploration of both types of phenomena, as a linguistic resource

subject to contextual constraints and as a mode contributing to the meaning-making process of multimodal expression. Consequently, this paper presents an initial approach to the study of intonation in relation to digital research genres and discusses the pedagogical implications of some preliminary yet valuable findings.

I.2. Aim and rationale

Previous research with a similar topic is scarce and usually different from the research interests of this project. Crystal and Davy's (1969) famous work on stylistics, featuring mainly prosodic analysis, considers a "modality" dimension corresponding to what has been defined as genre in ESP/EAP since Swales (1990). However, this dimension is just a minor part of a proposed framework for stylistics studies. Johns-Lewis (1986b) presents a different problem in exploring prosodic characteristics of "discourse modes". These "modes" are reading aloud, acting, and conversation, so this study also falls short of linking intonation to generic configuration. Cheng et al. (2008) present a valuable corpus-driven study of intonation in discourse including an academic sub-corpus with a variety of non-research-related text types like the student presentation or lecture. Nevertheless, their selection does not strive for genre representativity, as their interests lie in other factors. Indeed, their text labels are reminiscent of MICASE (Simpson et al. 2002) which refers to "speech event types" rather than genres. Something similar happens with the few studies of intonation related to genre from the systemic-functional perspective (e.g. Rivas and Germani 2016), since genre conceptualization in Systemic-Functional Linguistics (Martin et al. 1987) departs from our research interests. Finally, O'Grady (2020) has recently argued for register studies to incorporate prosodic analysis. Reviewing these studies shows that there is scholarly interest in the study of intonation in discourse, even if ESP/EAP research has yet to address genre in connection with intonation.

Genre studies that include intonation are mainly restricted to multimodal analyses, as in the above-mentioned work. Understandably, these analyses cannot afford to dwell on intonation for too long, considering it together with other semiotic modes. We also understand that general studies of oral discourse usually overlook the spoken component and investigate transcripts of spoken events. This is often due to the sheer

nature of the research design since many methodologies were devised and refined to investigate the wording component of discourse.

Therefore, this paper presents the first steps into intonation analysis of digital research genres. Our central thesis is that the English intonation system is used rhetorically like any other linguistic system: genre restricts or permits the available choices according to the purpose of the speaker, the intended audience, and the formal constraints of rhetorical structure. Accordingly, we want to contribute to current research by answering these research questions: What is the interplay between intonation and genre? Is a general English intonation framework appropriate to analyse digital research English? And consequently, are English intonation manuals appropriate for the teaching of academic oral skills?

In the following sections, the analytical approach, some preliminary results, and an original proposal for the adaptation of intonation manuals to the teaching of Academic Spoken English (ASE) for digital research genres will be presented.

II. CORPUS AND METHODS

II.1. Text selection and move analysis

Owing to the exploratory nature of this study, it takes a qualitative approach in order to gain insight as to how to proceed with the analysis of more data in future research. Therefore, we have close-analysed a small-scale ad-hoc corpus of five texts so as to observe with detail the interaction between genre and intonation.

These texts are clips from Video Methods Articles (VMAs) published by the *Journal of Visualized Experiments*. VMAs are online videos featuring on camera the demonstration of methodological procedures of different disciplines within the broad fields of biology, medicine, or engineering. The production of the video, controlled by the journal itself, follows the acceptance of a double-blind peer-reviewed manuscript proposal. Hafner (2018) analysed VMAs for generic integrity, rhetorical structure and multimodal expression. Thus, they constitute an optimal object of inquiry to start delving into intonation analysis, as a digital research genre that is emergent but sufficiently

established in its discourse practices to be analysed for a stabilized-for-now rhetorical structure.

Hafner (2018: 27) identifies, between the Video Intro and final Closing Credits, the possible moves for five possible sections in VMAs. An initial Overview presents the viewer with a straightforward summary of the procedure, followed by the Researcher's Introduction, which highlights its advantages, applications, and innovative value. The procedure is performed in the main section, Demonstration, while a voiceover gives recipe-like instructions. Then, the Representative Results section shows interesting application. The video concludes with the Researcher's Conclusion, recapitulating the previous information. This rhetorical analysis is convenient to explore the meanings of intonation, as it provides an understanding of what each section is trying to accomplish.

In his study, Hafner (2018) chooses to exemplify multimodal analysis in the Demonstration section, as it exploits visual resources to communicate procedural knowledge. Likewise, we have focused our analysis on the Researcher's Introduction (RI) section, where researchers face the camera and make statements about their research. This interesting hybridization of promotional and scientific discourse makes it attractive for intonation analysis to investigate what strategies researchers deploy for the particular purposes of the genre. Indeed, the other sections consist of voice-over explanations which are usually read by the journal's professional voice actors.

Out of Hafner's (2018) corpus of 11 VMAs in experimental biology, 7 of them are open-access. We have analysed the RI sections of the five most recent of these, in order to avoid considerations of genre change over time, which is beyond the scope of this project. The videos were extracted from the source code of the webpage. Each VMA's section of interest was clipped, its audio track was extracted for later intonation analysis, and it was transcribed manually. Each clip was coded as VMA-RI plus numbers one to five (e.g. VMA-RI1), as shown in Table 1 with information about the year of publication, size, length, original times, and reference.

Table 1. Corpus items.

Item	Year	Words	Length	Time	Reference
VMA-RI1	2011	46	20''	00:56-01:16	https://doi.org/10.3791/2638
VMA-RI2	2012	34	14''	01:06-01:20	https://doi.org/10.3791/3037

VMA-RI3	2013	63	22''	01:17-01:39	https://doi.org/10.3791/50762
VMA-RI4	2015	96	35''	01:10-01:45	https://doi.org/10.3791/50974
VMA-RI5	2016	110	43''	00:21-01:05	https://doi.org/10.3791/54112
Total		349	2'14''		

Hafner's (2018: 27) possible rhetorical moves for the RI section are:

1) Introducing Self,

2) Forecasting the Demonstration,

3) Explaining Significance,

4) Introducing Additional Researchers,

5) Inviting the Audience.

In Moves 1 and 4 the speaker simply presents the researchers involved, usually by providing their name and credentials. Move 2 anticipates the procedure to be demonstrated, while Move 3 focuses on the implications and novelty of the technique. Finally, Move 5 serves as a link to the next section, asking for the viewer's involvement. Each move was assigned a colour code for analysis with Microsoft Word's highlight tool.

II.2. Intonation analysis

Intonation is the linguistic apparatus which manipulates pitch in speaking for different semiotic purposes. This exploratory study approaches intonation analysis from the phonological model described in Tench (1996), which continues Halliday's (1963, 1967) identification of three systems that combine for intonational meaning. First, tonality refers to the division of the utterance of spoken discourse into successive Intonation Units (IUs). Second, tonicity refers to IU-internal analysis by identifying the tonic syllable, defined as the last pitch-prominent syllable. Third, tone refers to the selection of pitch movements associated with the tonic. This model has been influential for other models and is adapted in intonation manuals without making reference to its terminology (Hewings 2007, Mott 2011).

Our methodology combines instrumental and acoustic observations of intonational phenomena (Wichmann 2013). In short, instrumental pitch visualization software has informed and validated manual acoustic coding. Therefore, intonation analysis has followed a three-stage process: first, acoustic analysis marking up the text; second, instrumental observation with the Praat computer program (Boersma and Weenink 2019); lastly, modification of the initial acoustic mark-up.

Tonality is mainly concerned with the identification of boundaries between IUs, which are typically thought to correspond to pauses in speech. However, since these are phonological categories and not physical/phonetic incidents, boundaries are in practice more difficult to recognize (Roach 2009): speakers may make IU-internal pauses or proceed to the next IU without making a pause. Therefore, we have followed Cruttenden's (1997) and Tench's (1996) cues to boundary identification, marking them with a vertical line (|). As an illustration, we have not assigned a boundary to the filled pause "er" in (1), as it would create a boundary at an odd grammatical juncture and as the first part of the unit does not include a tonic syllable. Conversely, in (2), despite the absence of a pause between "solution" and "and", pitch and rhythm are clearly distinct to signal a boundary.

(1) | and the two people that will er present that | are my two PhD students | (VMA-RI2)

(2) | as the solution | and the setting | for each prepared exosome solution | has to be performed individually | (VMA-RI4)

Tonicity is mainly concerned with the identification of the tonic syllable, i.e. the last prominent syllable of IUs. The tonic syllable has also been referred to as the nucleus of the IU (Cruttenden 1997), so that the syllables preceding it are called pre-tonic or pre-nuclear. In turn, these syllables can be described as head and pre-head, the former being the syllables from the first stress to the tonic and the latter being the unstressed syllables before the start of the head. Tonicity analysis is therefore implicated in the internal structure of the IU. Consequently, we identify two types of tonic phenomena. First, the tonic syllable is marked with the associated tone explained below. Second, other prominent elements in the pre-nuclear segment are identified, mainly the phenomenon of having an acoustically perceptible jump from a relatively low pitch to a higher one in a non-tonic syllable. We refer to this phenomenon as a step-up in pitch, marking it with

a caret (^). We did not find other relevant variations in the head in our exploratory corpus.

Finally, tone is the movement of pitch in the tonic syllable. Focusing on the tonic syllable, only primary tones (Tench 1996) have been identified: the fall, marked with a backslash (\); the rise, marked with a forward slash (/); and the fall-rise, marked with a combination of both (\/). An example of text with the whole mark-up system can be seen in (3).

(3) | the demon^stration of this method is \critical | as the so/lution | and the /setting | for each prepared \exosome so/lution | has to be performed indi\vidually | (VMA-RI4)

Here, there are five IUs (tonality) delineated by boundaries (|). Tonic syllables (tonicity) can be identified by the preceding tone mark (tone). And the tonic phenomenon of step-up in pitch can be seen in "demonstration", marked with a caret before the stepped-up syllable. Note too that the fall-rise is a compound tone and the rise may be realized at a point later than the tonic syllable, as in "exosome solution", where the tonic syllable is the first syllable of "exosome" despite the rise taking place in the second syllable of "solution".

III. PRELIMINARY RESULTS

III.1. Rhetorical structure

The most common move configuration in our corpus (three of five) is a two-move section consisting of Move 3 (Explaining Significance) followed by Move 4 (Introducing Additional Researchers). VMA-RI1 consists of Move 3 alone and VMA-RI2 is dissimilar, having Move 2 (Forecasting the Demonstration), then Move 4 and a final Move 5 (Inviting the Audience). These two are the shortest and also the oldest, suggesting that the rhetorical configuration of the section has gained stability with time. Moreover, the most frequent moves found are arguably the most promotional and interactional, which suits the overall communicative purpose of the section to highlight the advantages, applications, and innovative value of the technique in question.

III.2. Intonation and genre

Tonality analysis in VMAs reveals a total of 63 IUs: 22.2% consist of whole clauses, and 47.6% higher-order clause constituents (19.0% subjects, 15.9% adverbials, and 12.7% predicates). Large IUs are typical of scripted/prepared speech and, more interestingly, fulfil the expectations of the genre, as boundaries are found at junctures that are critical for showcasing what they are presenting. For instance, (4) shows whole pieces of information with only one idea per IU and a final prepositional phrase with its own IU, "in a single analysis", which is the main asset of their presentation, thus enacting Move 3 (Explaining Significance).

(4) | the ^main ad\vantage of this /technique | is that by ^using mass spectrometry-based prote\/omics | we can simul^taneously quantify most of the known PTMs on histone \/proteins | in a single a\nalysis | (VMA-RI5)

The selection of tonic syllables is related to boundary placement, as boundaries follow the words which have been made prominent. Thus, in (4), "proteomics", "proteins", and "analysis" are nuclear. Instead, "advantage" is prominent even if not IU-final, for "technique" has been de-accented as a context-predictable lexical item. This usage of tonicity also corresponds to the purpose of the section within the VMA genre: as an opening section, the main ideas are presented in an unmarked way by accenting the relevant technical words; as a persuasive section foregrounding the rest of the VMA, the emphasis is on the benefits of the methodology explained.

Tone choices are quite straightforward and respond to general English usage of intonation. Rises (15.9%) are used to indicate shared knowledge; falls (55.6%) to introduce new information, and fall-rises (28.6%) to introduce new information while indicating sharedness or incompleteness. The greater incidence of falls relates to the act of introducing a new technique, while rises and fall-rises together (44.4%) can be expected in a digital research genre, where the audience has some familiarity with the content.

The use of appositions in Move 4 (Introducing Additional Researchers) shows how these explicative devices mirror the tone selection of their antecedents. This reinforces the identification of the noun phrases by assigning them the same tone and contributes to the function of introducing the researchers and providing their credentials, as seen in (5) and (6):

(5) | Natarajan \Bhanu | a \research /specialist | and Kelly \Karch | a graduate \student | (VMA-RI5)

(6) | as^sisting the procedure will be Clare \Hayes | a research a\ssistant in our group | (VMA-RI3)

In sum, an initial three-system analysis of the data in our small-scale corpus would corroborate the idea that intonation plays a specific role in the social action carried out by the genre, considering its communicative purposes and its situational context.

III.3. Step-ups

Even if pre-tonic intonational phenomena were not considered in the initial design of the study, as a first approach to the study of intonation in relation to generic configuration, we have allowed for the data to yield relevant results outside our pre-conceived framework. Thus, from a data-driven perspective, we have found step-ups (i.e. jumps to a higher pitch in non-tonic syllables) to be sufficiently present in our corpus and discourse-relevant to merit scholarly discussion even in this early stage research.

In (4), three examples are indicated by the caret symbol (^). The stressed syllables in "main", "using", and "simultaneously" are made prominent by receiving an acoustically perceptible higher pitch. This is confirmed by instrumental measurement, showing respectively a 79%, 87%, and 80% pitch increment, as opposed to "single" in the same utterance, which is just initial in the IU head without a step-up and presents a 48% higher pitch than its preceding syllable.

Interestingly, intonation manuals conceive of step-ups as phenomena that occur in two positions: the beginning of the head, i.e. the first stressed syllable, creating what has been variously called "high key" (Brazil 1994: 97), "onset" (Collins and Mees 2013: 145), or "stepping head" (Mott 2011: 242, Tench 1996: 132); or the tonic syllable itself, e.g. in Brazil (1994) and Hewings (2007). However, our results show occurrences of step-ups at stressed syllables other than the first in the IU or the tonic. The only reference we have come across mentioning such possibility is a brief notice to dismiss "anomalous tone units" in Roach (2009: 142). Consequently, we refer to occurrences considered in textbooks as "canonical", meaning they are officially recognized, while

occurrences of step-ups at other places will be called "non-canonical". In a count of 63 IUs in our corpus, 31.8% (n=20) have a step-up of either type, 19.0% (n=14) being canonical and 12.7% (n=8) non-canonical. Canonical step-ups are present in (4) and (6); non-canonical step-ups in (7):

(7) | this method can help answer ^key questions in RNA bi\ology | such as how the interplay of ^different RNA binding \proteins | regulates RNA \processing | (VMA-RI1)

Exploration of the functions of this intonational device suggests, first, the introduction of new topics in Move-initial IUs, and second, contrast or highlight, which corresponds to the function of Move 3 (Explaining Significance) itself. Our exploratory data did not reveal functional differences between canonical and non-canonical step-ups.

IV. DISCUSSION

The data suggest that relating intonation usage to genre is not only possible but perhaps necessary, as the general English intonation framework would only partially account for the intonational functions observed. Therefore, manuals covering features of this type require a few significant modifications for the teaching of those English intonational strategies that contribute to the development of academic oral skills. This section discusses these points against the backdrop of current theoretical and methodological reflections in EAP. Lastly, Section V delineates a pedagogy of the step-up as a genre-driven phenomenon.

The approach to spoken academic language does not seem to need to differ from the approach to rhetorical choices such as hedging in academic writing. Paltridge et al. (2009: 37-41) explain that creating an appropriate academic-sounding text involves not only linguistic choices (e.g. active vs passive voice) but also rhetorical choices (e.g. "whether to express oneself diffidently"). Good command of the academic language at a linguistic and rhetorical level is thus said to ensure the use of a communicatively adequate academic style.

However, while stylistic features of academic writing have been extensively documented in the field of EAP (e.g. Hinkel or Swales and Feak mentioned by Paltridge et al. 2009), generic features of spoken academic style have received much less

attention, except within the field of English pronunciation. Very little work investigates Academic Speaking, whereas Academic Writing has a repertoire of well-known publications covering a wide range of aspects (e.g. English 2011, Lillis and Curry 2010, Paltridge et al. 2009, Ravelli and Ellis 2004).

On the other hand, Academic Spoken English (ASE) seems to have generated two types of materials: guide-like books, such as Reinhart (2013) or Blanpain and Lafutt (2009), which may deal with spoken genres and discuss intonation but adopt a skills perspective in connection with general features of oral production; and text corpora such as BASE (Thompson and Nesi 2001) or MICASE (Simpson et al. 2002), driven by the notion of speech events and only covering traditional ones. Consequently, multimodal, digital genres such as VMAs do not fall within the scope of coursebooks and corpora. Indeed, only less academic/formal publications (e.g. Thaine 2018) have considered English pronunciation and EAP. Still, these approaches seem underpinned by theoretical and methodological reflections similar to those in introductory EAP textbooks such as Charles and Pecorari (2016).

All these ASE materials and theories foreground skills, lexico-grammar and rhetorical structure, although pronunciation is known to have an impact on efficient communication in academic spoken genres:

> The skill of listening involves activating several sources of knowledge, including the phonology, syntax, semantics and pragmatics of the language, along with body language such as eye contact and gesture. In order to understand speech, listeners must decode auditory and visual signals (often referred to as 'bottom-up processing') and must also construct meaning from the input (often called 'top-down processing'). (Charles and Pecorari 2016: 154)

However, despite the limited role of pronunciation for general ASE (as one of several "sources of knowledge" in "bottom-up processing"), the concept of *genre* can be used to highlight the rhetorical, communicative importance of pronunciation. When Charles and Pecorari (2016: 156) address "listening comprehension in lectures", phonology emerges as meaningful precisely because of 'delivery', a genre-related aspect: "In terms of delivery, students often have problems due to speech rate, accent and pronunciation, and it has been suggested that lecturers should slow their speech rate". This perspective implies the possibility of presenting certain aspects of pronunciation as genre-driven teaching/learning topics (even if considered a "difficulty"). It also allows these authors

to invite the EAP practitioner to provide input to "lecturers" as a way of raising "awareness of good practice" while underscoring that "it is clearly necessary to teach students to cope with these difficulties" (ibid.). Step-ups can thus be viewed both as a type of generic input and as a type of generic difficulty.

We also argue that the pedagogy of the VMA genre, like the lecture, requires us to take account of both sides of the process: the producers of the genre and their typically academic audience. As we see it, the VMA is part of an academic context demanding "not just listening, but also making a spoken contribution to the discourse" (Charles and Pecorari 2016: 161).

Nevertheless, VMAs are not general, spontaneous spoken discourse; rather, we view them closer to genres like the conference presentation, as the type of "academic speech event" which Charles and Pecorari (2016) call "monologue", which "can be rehearsed and even scripted to some extent". Interestingly, this EAP-manual description of academic monologue as a rehearsed and somewhat scripted product contains elements that link it to the description of "prepared speech" given in, for example, Hewings' (2007: 114) pronunciation-centred coursebook *English Pronunciation in Use Advanced*:

> In most contexts, when we speak we are making up what we say as we go along. However, many people at times need to plan and prepare speech more formally, and read this aloud from a written text or develop it from notes. For example, students and academics may have to give presentations or lectures in class or at a conference.

Hewings (2007) already mentions and connects the same genres ("presentations"), type of user ("students and academics"), and setting ("conference"), with similar pedagogic purposes.

Hewings' analysis characterizes 'prepared speech' by a number of "features of pronunciation" which include Step-ups. In Unit 57 (Hewings 2007: 120), the author explains that we can use "a step-up to a relatively high pitch" to show (i) that information contrasts with previous information or what was expected, or (ii) that we are starting a new topic. One of the examples of the 'contrast' function is "Although many people think of ants as a nuisance, they play // a ⇑ VItal ROLE // in many ecosystems". The step-up on 'vital' expresses a contrast between the common belief that they are a nuisance and their actual vital role.

As regards the 'new topic' function, one of the examples provided in the book is a step-up on the word 'that' in a sentence-initial phrase like "With that in mind". The step-up occurs between a paragraph about the general topic of the impact of business and industry on the environment, and another about a proposal for making the production of environmentally-friendly cars the joint endeavour of scientists and manufacturers. The text is put in the voice of a senior manager from an imaginary car manufacturer, who uses the step-up on 'that' to separate the claim that her company is already aware of their impact on the environment from the claim for a joint effort as a new topic. The step-up indicates that the new topic, the manager's proposal for a joint effort, must be interpreted as following on from her statement of industrial awareness, that is, 'with ↑ THAT in mind'.

Not unlike Hewings (2007), Charles and Pecorari (2016: 163) also use the term 'feature' to distinguish "the features that are typical of successful presentations", and they do so as a prior step to considering "how to teach presentation skills"; among other features, "varying pitch and speech rate" are said to "contribute to interesting and lively talks".

Step-ups can thus be viewed as instances of "varying pitch", although they have a far more precise definition in the context of English Phonology. For instance, Hewings (2007: 100) explains that "the symbol ↑ is used to show a step up in pitch. In other words, the voice moves up to a noticeably higher level than it was at before". Later, as shown above, the Step-up is re-defined *functionally* in the context of 'prepared speech' (Hewings 2007: 120). Accordingly, as expected from the nature of Hewings' book, the function of intonation (here, Step-ups as a linguistic feature relevant to developing presentation skills) is narrowed down from Charles and Pecorari's (2016: 163) general function of contributing to "interesting and lively talks" to very specific communicative functions such as signalling "contrasts" and "new topics".

Reinhart (2013) seems to consciously strive to bridge the gap between English Phonology and EAP. For instance, Reinhart assigns functions to stress and intonation as used in a given genre (the 'oral presentation') even if, owing to the aims of the book, those functions boil down to the essentials of tonicity. See e.g. the analysis on Reinhart (2013: 86):

> Notice that in this example [Then after this step, // the cooled vapor travels to a condenser.///], rising intonation does not occur on the last word before the pause (*step*) but on *this*. This is probably because the speaker wants to distinguish this step from other steps in the process.

Yet, Reinhart seems to be open to considering deviations from the norm, as a later remark indicates: "no matter what the general guidelines are, rising intonation can occur on any word that the speaker chooses to highlight" (Reinhart 2003: 126). This admitted variability in the placement of 'highlighting' (displacing it from the last word of the unit to a previous word) always seems functional in the genre, just as the function of "distinguishing" above is one of several indicated (e.g. "reassuring the listener" or "clarifying"). This perspective is particularly relevant to the interpretation of the co-existence of canonical and non-canonical Step-ups in VMAs.

Evidently, because Reinhart's (2013) work focuses on ASE, she does not stop to consider or determine the range or degrees characterizing, for example, the 'rising' of intonation —this is rather a phonetician's task. Nevertheless, her remarks suggest that it is well worth examining the communicative potential of pitch modification in genres with a strong ASE component and, subsequently, that different functions can be assigned to the complex constituted by the voice moving up to various degrees of "higher level in pitch than it was at before" (Hewings 2007: 100) and the position inside the IU in which the phenomenon takes place.

V. PEDAGOGICAL PROPOSAL

V.1. The adaptation of Bradford's (1988) Intonation in Context to the teaching and learning needs originating from the occurrence of Step-ups in VMAs

Concerning the *practical* delimitation of a Step-up pedagogy, we propose to adapt materials from the theory of Discourse Intonation (DI) to the EAP needs exemplified by VMAs. Brazil (1975, 1994) developed DI from Halliday's three-system approach as in this paper. However, his focus on the communicative and informational use of intonation soon became a pedagogical drive to make intonation more accountable to communication, Brazil's (1994) *Pronunciation for Advanced Learners of English (PALE)* being the most prominent example. *PALE* is well known for including several interactive contexts such as instruction giving or taking control of discourse. These

contexts are likely to be relevant to learners who, for example, need to make oral presentations.

Before Brazil's *PALE*, Coulthard (1985) had already underscored this pedagogical drive when he made it clear that, in DI, intonation choices depend on context and that, consequently, generalizations about the intonational meanings of isolated stretches of speech without their context should be avoided. Halliday's system is, conversely, more analytical, more tied to detail, with an emphasis on IU-structure description (tonicity). Even if Brazil's IU has a structure, DI attaches more importance to the existence of IU-associated "options" (see Coulthard 1985 for a summary) than to the thorough delineation of a system as Halliday's (for a summary of work on English intonation in the Hallidayan tradition Bloor and Bloor (2013: 15) suggest consulting Greaves 2007, Halliday and Greaves 2008, or Tench 1996).

Originating from Brazil's school, Bradford's (1988) *Intonation in Context* is still geared to conversational situations (typical of DI), while presenting intonation as a system with important communicative functions in any speaker-listener interaction. Adding to its display of DI put into practice, what we value most from the book is the internal organization of its units, allowing the learner to explore the meaning conveyed by intonation before production exercises.

Therefore, our pedagogical contribution in this exploratory study is the adaptation of Bradford's system to the teaching and learning needs originating from the occurrence of Step-ups in VMAs. Another great asset in Bradford's approach is its in-context nature, since this approach is sustained by the DI claim that intonation choices are bound up with their context of occurrence. For this study, VMAs constitute the context in which Step-ups occur; to be precise, their Move 3 ('Explaining significance'), a rhetorical stage with a clear communicative function.

Despite the advantages in Bradford's method, we are aware that our pedagogical proposal must address Charles and Pecorari's (2016: 81) warning concerning the adaptation of materials for EAP, given that "published materials are written to cater to a wide, often global, audience and it is therefore highly unlikely that they will meet all the needs of your specific group of students". Accordingly, our adaptation of Bradford's method will reorganize its parts as 'tasks' in line with Charles and Pecorari's (2016: 74)

definition of EAP materials as comprising "both texts and the tasks designed to exploit them for language learning purposes". Our "texts" will be extracts from our corpus. Our "tasks" will result from the recasting of Bradford's method. Our "specific group of students" will be related to the notion of academic discourse community in terms of Swales (1990: 24-27). In this model, discourse communities are characterized as having mechanisms of intercommunication among their members, and utilizing and possessing one or more genres in the communicative furtherance of its aims, which is where VMAs come in handy. As our pedagogical proposal is constrained by genre considerations, it is geared to learners who are also advanced level researchers, which implies that our instructional strategy would have to be modified for use with novice researchers unaware of the existence and communicative advantages of new genres like the VMA.

Bradford's (1988: 3) five-step method starts with a "sensitisation" task presenting one feature of English intonation so learners "become aware of the choices a speaker can make and how they sound". Then, "explanation" describes the feature and the *meanings* of the choices available. "Imitation" and "practice activities" follow, for learners to *recognize* the feature and practice *production*. A final "communication activity" provides the opportunity "to *think about* the feature" and use it in a freer situation.

The Step-up is our intonation feature of interest, particularly as detected acoustically and instrumentally in the IUs from our corpus. We propose to present it as a linguistic choice and demonstrate how it sounds. For this latter purpose, we suggest using the Praat software, as Nagy (2014: 101) has shown that "[v]isualization tools and Computer-Assisted Language Learning (CALL) provide new possibilities for the study of suprasegmental features by enabling learners to connect the perceived auditory signal with its visual representation". Following this argument, we believe that Praat provides "adequate visual feedback" because pitch tracings are easily interpretable, unlike, e.g., spectrograms. Accordingly, we suggest extracting pitch tracings from our corpus together with their transcript (see Figure 1), thus incorporating speech visualization into Bradford's method as a pedagogical tool for sensitization purposes.

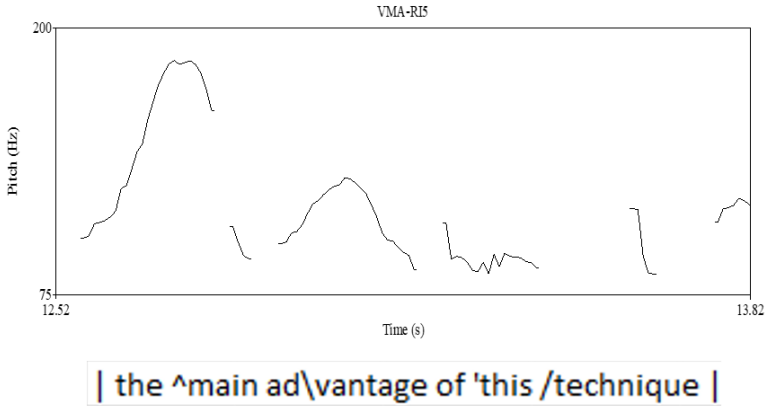

Figure 1. Praat pitch tracings with the marked-up transcription

It is indeed possible to adapt a *whole* unit to the requirements of Step-ups in the specific genre of VMAs. Bradford's Unit 7, on "Contrasts" (39-45), displays the closest topic and aims to Hewings' unit on "Step-ups", whose title highlights the phonetic phenomenon instead of the basic function. Combining its fully-fledged structure with similarity of topic and aims, Bradford's type of unit stands out as a very suitable starting point for adaptation.

Bradford's (1988) "explanation" section uses DI's "High Key", not "Step-up", with the function of expressing contrast to hearers' expectations. We use Hewings' term for its metaphorical, more intuitive nature, close to the process type of meaning of the general-English verb 'to step something up', whereas Brazil's 'key' comes from the specialized field of music.

V.2. Tasks and sub-tasks of the pedagogical proposal

V.2.1. Sensitization

V.2.1.a. Task

After adopting speech visualization as a pedagogical tool, and 'Step-up' as more pedagogical terminology, our adaptation of Bradford's sensitization substructure entails deciding on texts to replace conversation for the listening-for-gist task and on questions for learners to discuss those texts. Our choice is an extract from our corpus, accompanied by a transcript (8) with this type of heading (adapted from Bradford's

Task 1.2, and Hewings' description of Step-up): 'The parts in which the voice moves up to a noticeably higher level than it was at before are shown below':

(8) | this method can help answer ^key questions in RNA bi\ology | such as how the interplay of ^different RNA-binding \proteins | regulates RNA \processing | the main ad/vantage of this technique | is that we in\crease both | the per/formance | and the reso/lution | of our \transcriptome-wide /maps | of protein RNA inter r\actions | (VMA-RI1)

V.2.1.b. Sub-tasks

As we view Step-ups as resulting from the formal constraints of the rhetorical structure of VMAs, the learner can discuss what constitutes the reasons for the Step-ups occurring in the audio as a first sub-task. Comments elicited would be along the lines of '*communicative function*' as relates to the Move where the extract with Step-ups occurs. The next sub-task for sensitization involves listening again with pitch tracing and transcript in front, first to show the occurrence of canonical Step-ups, then for non-canonical ones. The final sub-task involves *finding* other places where speakers do Step-ups.

V.2.2. Explanation

V.2.2.a. Task

The second task, 'Explanation', describes the functions of our taxonomy of Step-ups. The strong correlation between Step-ups and Move 3 in our corpus indicates that their function is basically to provide emphasis and contrast (Hewings 2007: 120). 'Explaining significance' sometimes involves highlighting the new characteristics of the method or technique described in VMAs, and alternatively, contrasting the characteristics with those of traditional/conventional procedures. This genre-driven function is performed by placing the Step-up either "in the first prominent word of [the] speech unit" (Hewings 2007: 120; our 'canonical Step-up'), or later in the IU (hence, 'non-canonical Step-up'), since the most appropriate word for emphasis or contrast may not be the first prominent one in the unit.

V.2.2.b. Sub-tasks

For example, in VMA-RI4, "the demon^stration of this method is \critical", there is a canonical step-up for emphasis on the Theme, at the start of the IU, because the notion of 'demonstration' is likely to be key to the goal of a Video Methods Article, since the "method" proper, not its *demonstration*, will simply be 'known' information for the practitioners of this genre. Consequently, the new information (the evaluative adjective "critical", *demonstration = critical*) occurs at the unmarked position for this type of information, which is the last lexical word of an IU, and with an unmarked tone choice (falling). Later in VMA-RI4, there is also an instance of a non-canonical Step-up: "to find the ^optimal sensi\tivity /range". Emphasizing the idea of 'finding a range' (i.e. using the first prominent word) makes no communicative sense in terms of explaining significance, as the researchers want to convey that the "optimal" range is the only one that matters for their technique. Accordingly, it must be explained to learners that more than one position is communicatively available for Step-ups, that the lexico-grammar influences the position, but that the communicative function is invariable regardless: indicating what is really significant (the demonstration and, later, the optimal range) can be carried out both by a canonical step-up and by a non-canonical one.

V.2.3. Imitation

V.2.3.a. Task

This third task represents the first stage of production, which does not require sub-tasks. Having described the types of Step-ups in VMAs, repetition will not amount to mere drilling: the learner imitates the phenomenon with a conscious communicative aim in mind. Using (9) below as textual support, the learner repeats only from "by" to "vivo" (Step-ups on "vitro" and "emulates"). Knowing that the two Step-ups in these units occur in Move 3 enhances the value of repetition as a drill, since the Step-ups highlight that there are two E-coli environments but the VMA is centred around the "in vitro" one and, moreover, that, if the choice raises issues of validity, the researchers are conscious that the in-vitro environment is an emulation; it is imitation, hence, of the emphasis/contrast function described in the 'Explanation' task. Finally, imitating a non-canonical Step-up shows that a delayed Step-up may also respond to the position of the

lexical items used to shape the lexico-grammar of the function (see, in (9), the phrases "in vitro" and "in vivo", with the former occurring after an initial stress).

(9) | this method can help test \/circuits | in the field of syn\thetic bi/ology | by providing an in ^vitro e-coli en\/vironment | which ^emulates that in \vivo | (VMA-RI3)

V.2.4. Practice activity

V.2.4.a. Task

The fourth task pivots on learners as likely VMA 'practitioners'. With an upper-intermediate or higher level of English, they are expected to determine which words from (10) below (given without mark-up) are candidates for a Step-up, especially since they have been exposed to the 'Explanation' and 'Imitation' tasks proposed. The tonicity of the message in our example derives from the notion that the technique the VMA reports leads to an *increase* in speed because *prototyping* is no longer necessary, and is, therefore, more efficient than other techniques, a very relevant question to a 'methods' genre. "Increasing" (or "speed" itself) and "prototyping" become suitable words for stepping up.

(10) | the implications of this /technique | extend towards in^creasing the speed of synthetic biological de\/sign | by removing the need to conduct all ^prototyping steps in \vivo | (VMA-RI3)

V.2.5. Communication activity

V.2.5.a. Task

Finally, the adaptation of Bradford's 'Communication activity' is based on the genre itself. Therefore, learners start by looking for the information needed to respond to *JoVE*'s goal (https://www.jove.com/about/) of allowing scientists, educators and students "to see the intricate details of cutting-edge experiments" rather than read them in text articles.

V.2.1.b. Sub-tasks

Therefore, the first step in this task entails thinking of a lexico-grammar (i.e. making vocabulary and grammar choices) capable of sustaining a video demonstration aimed at facilitating scientific reproducibility; in other words, a text meant to be read aloud, i.e. a "scripted" or "prepared speech" text. Learners may be invited to access a VMA of their discipline, e.g. biology, and use it as a model. They can watch the video, which contains both voice-over and speech from one of the authors and then they can reflect on the reasons for the occurrence, in either the voice-over or the researcher's introduction, of any Step-ups they identify, especially by relating them to the function of the Move where they take place. With help from the instructor, they may also use visualization software to verify the Step-ups. Then, as a second sub-task, they can use their own research and write a VMA script which emulates the intonation in the model, i.e. its communicative purposes for the genre.

VI. CONCLUSION

Despite its exploratory nature, the present study illustrates how to account for the interplay between intonation and genre. For this purpose, we analysed a small-scale corpus of five clips from Video Methods Articles (VMAs) published by the *Journal of Visualized Experiments*. VMAs are thus dealt with as an instance of genre. We focused on their Researcher's Introduction (RI) section where researchers face the camera and make statements about their research. It is the hybridization of promotional and scientific discourse occurring in this section that made us consider the analysis of intonation as a very suitable procedure for the investigation of the strategies which researchers deploy for the particular purposes of a genre. As explained above, this approach to the study of genre is justified because a growing scholarly interest in new forms of research communication has not yet generated enough research into the communicative impact of intonation.

This said, we decided to examine the communicative potential of the changes in pitch (whether in terms of direction or relative height) shown by some intonation units in VMAs. The exact object of study was the complex phenomenon constituted by the voice moving up to various degrees of higher level in pitch and the position inside the intonation unit in which the rise to higher pitch takes place. In our study, the

phenomenon is presented as an intonational device to be referred to with the term 'Step-up'.

The main asset of the present study is that it adopts a data-driven perspective. As our main goal was to explain how the study of intonation can contribute to the exploration of the multimodal resources of the digital environment, corpus size was not considered an overriding factor for a study aimed at that type of setting. With this in mind, the preliminary results presented in this paper suggest that the general English intonation framework is not appropriate to analyse digital research English. Accordingly, as a data-driven decision, we also present a pedagogical proposal for the adaptation of intonation manuals to the teaching of Step-ups in an Academic Spoken English (ASE) genre. Our data reveal that intonation can be viewed as a linguistic resource subject to contextual constraints and as a mode contributing to the meaning-making process. In VMAs, Step-ups are used to introduce new topics in Move-initial intonation units, and also to contrast or highlight as depending on the function of a specific Move in the rhetorical structure, "Explaining Significance". On the other hand, our data do not reveal functional differences between canonical and non-canonical Step-ups.

In conclusion, our study indicates that it is not only possible to relate intonation usage to genre but that it is necessary to do so, and that, as a result, English intonation manuals dealing with these types of features should be modified to teach intonational strategies, the Step-up being a case in point. While in EAP literature the role of pronunciation for ASE is generally judged to be rather limited (as one of several "sources of knowledge" in "bottom-up processing"), in this paper the concept of *genre* has been used to highlight the rhetorical, communicative importance of pronunciation, since it examines and discusses the Step-up as a genre-driven teaching/learning topic which results from the formal constraints of the rhetorical structure of VMAs.

For this reason, we have complemented our study with a pedagogical proposal for the Step-up based on the adaptation of Barbara Bradford's (1988) method in *Intonation in Context* to the generic factors described above. The most important characteristic of our proposal is the adoption of speech visualization as a pedagogical tool, the use of 'Step-up' as a more pedagogical terminology than 'High Key', 'Onset', or 'Stepping Head', and a set of tasks in which the type of response to be elicited from the learner is based

on the notion of *communicative function* as determined by the Move where Step-ups tend to occur. This type of analysis and subsequent pedagogy is in its initial stage, and it remains to be seen whether its results, or the pedagogical proposal itself, are sustained by the analysis of a larger corpus compiled from texts similar to VMAs, or can be extended to other intonational phenomena or strategies in the genre.

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