



## Speaking style effects in the production of disfluencies

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Received 25 October 2013; received in revised form 1 May 2014; accepted 21 May 2014

Available online 5 June 2014

### Abstract

This work explores speaking style effects in the production of disfluencies. University lectures and map-task dialogues are analyzed in order to evaluate if the prosodic strategies used when uttering disfluencies vary across speaking styles. Our results show that the distribution of disfluency types is not arbitrary across lectures and dialogues. Moreover, although there is a statistically significant cross-style strategy of prosodic contrast marking (pitch and energy increases) between the region to repair and the repair of fluency, this strategy is displayed differently depending on the specific speech task. The overall patterns observed in the lectures, with regularities ascribed for speaker and disfluency types, do not hold with the same strength for the dialogues, due to underlying specificities of the communicative purposes. The tempo patterns found for both speech tasks also confirm their distinct behaviour, evidencing the more dynamic tempo characteristics of dialogues. In university lectures, prosodic cues are given to the listener both for the units inside disfluent regions and between these and the adjacent contexts. This suggests a stronger prosodic contrast marking of disfluency–fluency repair when compared to dialogues, as if teachers were monitoring the different regions – the introduction to a disfluency, the disfluency itself and the beginning of the repair – demarcating them in very contrastive ways.

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**Keywords:** Prosody; Disfluencies; Lectures; Dialogues; Speaking styles

### 1. Introduction

This paper explores speaking style effects in the production of disfluencies in university lectures and map-task dialogues. In both corpora speech is edited on-line. However, they vary in the ways speakers adjust to communicative contexts. Therefore, distributional patterns, speech and articulation rates and prosodic disfluency/fluency repair strategies are targeted in a broader comparison of inter-corpora styles.

The expression *speaking style* is complex to define. The literature (Biber, 1988; Eskénazi, 1993; Blaauw, 1995; Barry, 1995; Biber and Conrad, 2009; Hirschberg, 2000) has documented the role that multiple dimensions of variation play in style changes, contributing to a more comprehensible view of speaking style. For Eskénazi (1993), there are three essential axes of variation: the degree of intelligibility required by the situation, the familiarity between speaker and listener(s), and the social strata of the communicative participants. The effect that the speaker intends to have on the listener is also another dimension to consider, as evidenced by Barry (1995).

Prosodic analysis has been proved to be very informative for differentiating between speaking styles (e.g., Blaauw (1995); Hirschberg (2000)). The role of disfluencies

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in this discrimination, however, has typically been rather limited: the presence/absence of disfluent events predicts speech as either spontaneous or read. But recent studies are gradually focusing on *varia* (para)linguistic properties of such events. Either *per se* or combined with other features, disfluencies have been shown to characterize social and emotional behaviour (Gravano et al., 2011; Benus et al., 2012; Ranganath et al., 2013; Schuller et al., 2013). Studies are, thus, moving much beyond the classical view of presence/absence of disfluencies for the classification of spontaneous *vs.* read speech, embracing a diverse set of domains (*e.g.*, speed-dating, Supreme Court hearings, etc.).

The aim of this paper is to characterize prosodic parameters and disfluencies' distributions in European Portuguese for a discrimination of speaking styles and for a contribution on cross-language comparisons of prosodic parameters in different domain. Along this paper we will report trends that point out to a central point: one cannot draw generic conclusions about the distributional and prosodic patterns of disfluencies without taking speaking style into account.

The paper is organized as follows: Section 2 presents the related work. The data used in this study is described in Section 3. Section 4 describes the disfluency annotation. The results of the inter-corpora distributional patterns are reported in Section 5. The inter-corpora prosodic analysis of disfluencies is conducted in Section 6. Conclusions and future work are presented in Section 7.

## 2. Related work

Disfluencies, *e.g.*, filled pauses, prolongations, repetitions, substitutions, deletions, insertions, characterize spontaneous speech and play a major role in speech structuring (Levelt, 1983; Allwood et al., 1990; Swerts, 1998; Clark and Fox Tree, 2002). There are two main perspectives in the literature to describe disfluencies: (i) as speech errors that disrupt *the ideal delivery of speech* or (ii) as fluent linguistic devices used to manage speech. For a survey on these perspectives, *vide* Kowal and O'Connell (2008). Disfluencies may be used for different purposes related to, *e.g.*, speech structuring (Clark and Fox Tree, 2002), introducing new information (Arnold et al., 2003) and producing fluent strategies in second language learning (Rose, 1998). The fluent component of these phenomena is still rather controversial, even though Heike (1981) and Allwood et al. (1990) have already pointed out the benefits of disfluencies for communicative purposes, and their contribution for on-line planning efforts.

Although the word *disfluencies* still exhibits the depreciating connotation linked to error, this term will be used for sake of terminological simplicity and for a contribution for direct comparisons with other studies. For an overview of the historical perspective of the terminological aspects associated with positive/negative connotations of the terms and of the realms of linguistic studies see Erard (2007).

It is commonly recognized that disfluencies have a specific structure: *reparandum*, *interruption point*, *interregnum*, and *repair* of fluency (Levelt, 1989; Nakatani and Hirschberg, 1994; Shriberg, 1994). The *reparandum* is the region to repair. The *interruption point* is the moment when the speaker stops his/her production to correct the linguistic material uttered, ultimately, it is the frontier between disfluent and fluent speech. The *interregnum* is an optional part and it may have silent pauses, filled pauses (uh, um) or explicit editing expressions (I mean, no). The *repair* is the corrected linguistic material.

It is known that each of these regions has idiosyncratic acoustic properties that distinguish them from each other (Hindle, 1983; Levelt and Cutler, 1983; Nakatani and Hirschberg, 1994; Shriberg, 1994, 2001; Liu et al., 2006). There is in fact an edit signal process (Hindle, 1983), meaning that speakers signal an upcoming repair to their listeners. The edit signal is manifested by means of repetition patterns, production of fragments, glottalizations, co-articulatory gestures and voice quality attributes, such as jitter (perturbations in the pitch period) in the *reparanda*. Sequentially, it is also edited by means of significantly different pause durations from fluent boundaries and by specific lexical items in the *interregnum*. Finally, it may be edited via pitch and energy increases in the repair.

The possible connections between the *reparandum* and the repair have been explored from different perspectives in the literature. Since Levelt and Cutler (1983) there is a binary tendency towards the classification of the prosodic properties of (certain) disfluencies as either copying the pitch contour of the *reparandum* or contrasting the onset of fluency in the repair with the *reparandum*, by means of increasing  $f_0$  and energy. The first strategy is classified as a parallelism between the two regions and is mainly related to appropriateness (involving, for instance, repetition and insertion), whereas the second is classified as contrast marking and is productive with error corrections (mostly substitutions). The literature is not consensual about this dichotomy. For Plauché and Shriberg (1999), repetitions *per se* can behave as parallelistic prosodic structures (copying the pitch contour of the *reparandum*) and also have some degree of contrast (a rising pattern in the repetition is related to an emphasis in the new unit), although not the one reported by Levelt and Cutler (1983). For Savova and Bachenko (2003a,b), distinct categories, such as repetitions and substitutions seem to copy the patterns of their counterparts in the *reparandum*. Moreover, for the authors there is only partial support for the contrastive nature of substitutions when this is manifested by a higher pitch range. Cole et al. (2005) sustains the parallelistic nature of both repetitions and error corrections and considers parallelism the most frequent strategy.

The contrast and parallelism strategies may also be regarded from a comprehension perspective (Levelt, 1983, 1989; Levelt and Cutler, 1983). In comprehension tasks, the information available in disfluencies can help listeners compensate for disruptions and delays in spontaneous

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