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Exchange of Disfluency With Age From Function Words to Content Words in Spanish Speakers Who Stutter

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Abstract

The main purpose of the present study was to examine whether the developmental change in loci of disfluency from mainly function words to mainly content words, observed for English speakers who stutter (P. Howell, J. Au-Yeung, & S. Sackin, 1999), also occurs for comparable Spanish speakers who stutter. The participants were divided into 5 age groups. There were 7 participants in Group 1, from 3 to 5 years old; 11 in Group 2, from 6 to 9 years old; 10 in Group 3, from 10 to 11 years old; 9 in Group 4, from 12 to 16 years old; and 9 in Group 5, from 20 to 68 years old. Across all groups, 36 of the 46 participants were male. The study method involved segmenting speech into phonological words (PWs) that consist of an obligatory content word with optional function words that precede and follow it. The initial function words in the PWs were examined to establish whether they have a higher disfluency rate than the final ones (J. Au-Yeung, P. Howell, & L. Pilgrim, 1998). Disfluency on function words in a PW was higher when the word occurred before a content word rather than after a content word for all age groups. Disfluencies on function and content words were then examined to determine whether they change over age groups in the same way as for English speakers who stutter (Howell et al., 1999). The rate of disfluency on function words was higher than that on content words, particularly in the youngest speakers. Function word disfluency rate dropped off and content word disfluency rate increased across age groups. These patterns are similar to those reported for English. Possible explanations for these similarities across the two languages are discussed.

Keywords

stuttering; developmental; exchange

Young children who have been diagnosed as stuttering exhibit higher disfluency rates on function words than on content words (Bloodstein & Gantwerk, 1967; Bloodstein & Grossman, 1981). The types of disfluency that occur on or around function words usually are pauses (filled and unfilled) or involve the whole function word being repeated (Au-Yeung, Howell, & Pilgrim, 1998; Howell, Au-Yeung, & Sackin, 1999). Repetition of function words has also been reported to occur in fluent speakers (Clark & Clark, 1977; Clark & Wasow, 1998; Maclay & Osgood, 1959). As speakers who stutter become older, there is an increase in incidence of disfluency on content words (Brown, 1945), and the types of disfluency change from occurring on whole words to occurring on parts of words (Conture, 1990).

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The occurrence of disfluencies on function words in fluent speakers and in children who stutter is, at first sight, somewhat counterintuitive, as function words are typically shorter and involve fewer consonants than content words and so would be expected to pose less of a problem for a speaker. At least two explanations have been offered to account for higher rates of disfluency on these words by children who stutter: First, repetition of function words is a common type of disfluency in fluent speakers (Clark & Clark, 1977; Howell et al., 1999). Consequently, some children referred to stuttering clinics may be fluent but have high rates of function word repetition, leading them to be misdiagnosed as children who stutter (Wingate, 2002). The classification of participants studied in the following experiment is based on secondary referrals to specialist stuttering clinics, so it is reasonable to assume that the diagnosis is appropriate. Second, disfluencies around function words may have a preventive role in stopping speakers making part-word disfluencies on subsequent content words. Consequently, when there is no repetition or hesitation around function words, the focus of disfluency shifts to content words (Howell & Au-Yeung, 2002). This second alternative is explored below.

Clark and his colleagues (Clark & Clark, 1977; Clark & Wasow, 1998) have argued that the role of function word repetition in fluent speakers is to delay when a more difficult word that follows is produced to allow more time for planning the difficult word. Repetition of function words in young speakers who stutter might also be done to allow more time for planning. If repetition ceases in older speakers who stutter, there would not then be this extra time for planning. Part-word disfluencies on content words might reflect difficulties brought about because the speaker has attempted the difficult word before its plan has been completed (Howell & Au-Yeung, 2002). This would explain the change in locus and type of disfluency observed across ages referred to above. According to this account, only function words that precede content words could play the delaying role.

To test the delaying proposal and related predictions, a unit of analysis is needed that includes instances of the different types of words that are affected at different ages (function words in young speakers, content words in older speakers). Au-Yeung et al. (1998) introduced phonological words (PWs) as one suitable means for assessing this idea. The notion, as well as analysis of the phonological word, is based on the observation that function words in English operate as prefixes and suffixes to nearby content words (Selkirk, 1984). Au-Yeung et al. developed definitions for PWs so they can be used as a tool for speech analysis. (A detailed description of the rules for segmentation of PW developed by Au-Yeung et al., 1998, and Howell et al., 1999, is given in the *Method* section.)

PWs can have function words preceding the content word, and function words can also be positioned after the content word. Au-Yeung et al. (1998) looked at the effect of function word position (before or after the content word) in PW to assess the prediction, mentioned earlier, that only the function words that precede the content word can be used for delaying content words. They confirmed that function words preceding content words are more likely to be produced disfluently than the function words following the content words within a PW unit. It was also shown that function words that occur in early positions in a PW have a greater chance of being produced disfluently than those that occur later in a PW.

In a second study, Howell et al. (1999) used PWs to test whether content word disfluencies arise when speakers stop repeating function words. According to the above interpretation, a decrease in the frequency of function word repetition over age groups indicates that older speakers have ceased delaying onset of a content word until its plan is complete. If function word repetition has the role of preventing content word disfluencies, the decrease in function word repetition should be mirrored by problems emerging on subsequent content words within the PW. To test this prediction, PWs were selected that had initial function words. In

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these PWs, there is the opportunity of establishing when delaying has, and has not, occurred on the initial function words. Howell et al. confirmed that function word disfluency (delaying) occurred frequently in young speakers who stutter and that the content word disfluency rate was low. Older speakers were disfluent less often on function words and, correspondingly, there was a markedly higher rate of disfluency on content words. Howell et al., referring to the pattern where as function word disfluencies decrease content word disfluencies increase, called it an *exchange relation*. The term *exchange* was deliberately used to convey the theoretical notion that disfluency on function words prevents disfluency on content words and that the two are reciprocally related (if a speaker delays, content word disfluencies will not occur; if a speaker does not delay, content word disfluencies will ensue). The explanation of the change to part-word disfluencies (e.g., prolongations, part-word repetitions) on content words that Howell et al. gave is that when speakers stop delaying as they get older, they start the execution of the content word before the full phonetic plan is ready. Assuming the plan is filled out left to right, the part that is ready will be the onset that is the usual locus of disfluency on content words by people who stutter (Wingate, 2002). Stopping the delay process as people who stutter get older could make the process irreversible; this would explain why stuttering in adults is difficult to treat.

The Howell et al. (1999) account of age-related changes in delaying is one theoretical interpretation of this pattern of results (the EXPLAN account of Howell & Au-Yeung, 2002). Repetition on function words might also be described in Levelt's (1983) terms as aspects of the process of repairing an anticipated speech error (where speech errors usually occur on content words). Thus, it is possible to interpret function word repetition and content word disfluency as different realizations of an underlying error, as in Kolk and Postma's (1997) covert repair hypothesis (CRH). Further consideration of these models is given in the *Discussion* section.

In this article, characteristics of the speech of Spanish people of different ages who stutter are investigated to see whether they show patterns similar to those reported in English (Au-Yeung et al., 1998; Howell et al., 1999). There is little crosslinguistic data on stuttering in general and on stuttering in Spanish in particular (the one study on Spanish people who stutter we are aware of is a case study carried out by Bernstein Ratner & Benitez, 1985). The Spanish speech data are segmented into PWs in the same way as in English. The positioning of function words relative to content words in Spanish is, in the main, similar to that in English. The exception is that Spanish is a pro-drop language (Chomsky, 1981) where the subject pronoun of a sentence can be omitted in the surface form. The identity of the missing pronoun is reflected by an agreement marker on the verb. The consequence for the current study is that the equivalent of “I I I split the group” would be “split the group” with an agreement marker on the verb. This property prohibits use of a subject pronoun to delay production of the verb. This can, however, be counterbalanced somewhat by the movement of an object pronoun before the verb. If the object of a Spanish verb is a pronoun, it is moved from a postverbal position to a preverbal position. Essentially, if Howell et al.'s (1999) findings apply to Spanish, this may lead to the object pronoun being used to delay the production of the verb. To illustrate, the Spanish equivalent of “I I I have it” would be “lo lo lo tengo” (“it it it have”) (the subject “I” is dropped but is marked by the verb agreement, and the object is placed in front of the verb). Such movement of an object pronoun is rare in English. A property that leads to similar effects in English is the “heavy NP movement” where a “heavy NP” is moved to the back of a phrase, for example, “I pick him up” versus “I pick up the baby who was crying.” “I pick him up” versus (*) “I pick up him” both constitute a PW, with “him” remaining a postcontent word in both cases. If the frequency of occurrence of English subjective pronouns and Spanish objective pronouns are similar, the pro-drop effect and the object pronoun pre-posing effect would tend to balance out if

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function words are used to delay the production of content words in Spanish. On this basis, then, similar results would be expected to occur for the two languages.

Speech of Spanish speakers in different age groups who stutter is analyzed. The data are examined to establish whether initial function words in PW are more likely to be repeated than final ones (Au-Yeung et al., 1998). The disfluency rates of function words in different positions in a PW are also examined to determine whether those nearer the beginning of a PW have a higher rate of disfluency than those that appear later in the PW (Au-Yeung et al., 1998). The relationship between disfluency on initial function and content words is examined across age groups to see whether young speakers have higher rates of disfluency on initial function words and whether, as speakers get older, the rate of these disfluencies drops off and, correspondingly, the content word disfluency rate increases (Howell et al., 1999).

Method

Participants

Forty-six monolingual Spanish speakers participated in the study. They were all native speakers of Peninsular Spanish and were diagnosed by their speech-language pathologists as people who stutter. All were reported as having developmental stuttering not associated with neurological, psychological, or other medical problems. Consent to participate was given by each participant and, in the case of children, consent was also obtained from their parents. The participants were recruited from speech clinics from various parts of Spain: Almeria, Cordoba, Granada, Madrid, Mallorca, and Santiago. The sources were private, school-based, and university-based clinics. The age of the participants ranged from 3 to 68 years, and there were 10 females and 36 males. The participants were divided into five age groups (G1–G5) in the following ranges: G1: 3–5 years old ($n = 7$), G2: 6–9 years old ($n = 11$), G3: 10–11 years old ($n = 10$), G4: 12–16 years old ($n = 9$), and G5: 20–68 years old ($n = 9$). The division into age groups is similar to that used in Howell et al. (1999), and there are a roughly similar number of participants in each age group. Participant identifier, age (only available in years), gender, group assignment, overall disfluency rate, area of Spain the participant was from, recording setting, and number of words in each sample are given in that order in Table 1. The overall disfluency rates in Table 1 were for all words (percentage of words that were disfluent out of the total sample). Samples were shorter for the youngest speakers, as is almost unavoidable with speakers of this age (column 8 of Table 1). Also, some samples of individual participants had low overall disfluency rates (column 5 of Table 1). Participants with short samples and low disfluency rates were retained in the analyses to avoid biasing the data so it would only apply to moderate and severe stuttering, and differences in overall disfluency rate were dealt with by analyzing the data by analysis of covariance (ANCOVA) as described below. The mean overall disfluency rates for the individual age groups were as follows: G1, 16.54% ($SD = 9.00\%$); G2, 10.62% ($SD = 5.44\%$); G3, 7.23% ($SD = 5.80\%$); G4, 6.28% ($SD = 4.19\%$); and G5, 10.92% ($SD = 3.46\%$). A one-way analysis of variance (ANOVA) showed that there was a significant difference in disfluency rate across age groups, $F(4, 41) = 3.98$, $p < .01$. A post hoc Tukey test showed that the overall disfluency rate for G1 was higher than that for G3 ($T = 3.329$, $p = .0151$) and G4 ($T = 3.588$, $p = .0074$). The effect of differences in overall disfluency rate across participants is dealt with in the analyses by including each participant's overall disfluency rate as the covariate in the ANCOVAs. The ANCOVA output gives the adjusted rates for each factor after the effects of the covariate (here the speaker's overall disfluency rate) have been removed.

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Speech Material

Spontaneous conversational speech samples between the participant and his/her speech-language pathologist were obtained. The recordings were usually conducted in a clinic, although there were six cases where the recording had to be made in the participant's home (indicated in column 7 of Table 1). Five of these were in the oldest age group (the remaining one was in the 10–11 year age group, G3). The recordings lasted between 2 and 20 minutes, depending on how long the participant could talk on the topics. The speech was transcribed by a native Spanish speaker (the second author). This speaker is a trained phonologist with 9 years experience in transcription. The material was transcribed using a broad phonetic transcription in fluent regions and a narrow system in the disfluent regions (see Kadi-Hanifi & Howell, 1992, for a detailed description). Single word answers such as “yes” or “no” in response to occasional prompting questions were excluded from analysis. All remaining words were classified as function or content. The function word class included pronouns, articles, prepositions, conjunctions, and auxiliary verbs, and content words included nouns, main verbs, adverbs, and adjectives (Hartmann & Stork, 1972; Quirk, Greenbaum, Leech, & Svartvik, 1985). All stressed words (not used in the current analysis) and disfluencies were marked. The accuracy of the transcriber has been assessed by comparing her transcriptions with those of another trained transcriber on seven randomly selected recordings. Agreement on word type was 95.10% (Cohen's κ = .90). Agreement on fluency was 96.65% (κ = .93) and for PW segmentation 97.10%. All scores represent excellent levels of agreement.

Segmentation Into Phonological Words Based on Lexical Status

The definition used for PW is identical to that used for English by Au-Yeung et al. (1998). This is based on Selkirk's (1984) view that function words operate as prefixes or suffixes to neighboring content words. The number of function words in each position is optional and can be zero. Au-Yeung et al. (1998) further proposed systematic rules for segmentation of PW according to these definitions by formalizing and extending the semantic sense unit rules established by Selkirk (1984) for intonational phrase segmentation. In the rules that follow, “head” refers to the main stress focus in an intonational phrase; in Selkirk's scheme for English, heads appear on the content word nuclei.

Direct rules—Two constituents form a sense unit if one of the following is true:

Rule a:

C_i modifies C_j (a head)

e.g., (1) [I know] [he is a friend of mine].

“of mine” is modifying “friend”

Rule b:

C_i is an argument of C_j (a head)

e.g., (2) “[He calls me] [a liar]”

“He” and “me” are both arguments to “calls” and “a” is related to “liar.”

Indirect rules—Two constituents form a sense unit if one of the following is true:

Rule c:

both C_i and C_j modify C_k (a head)

e.g., (3) “[This dress] [looks] [good on you]”.

“on you” does not directly modify “good” but does “looks”

Rule d:

both C_i and C_j are arguments of C_k (a head)

e.g., (4) “[He likes] [the rare] [wine]”

“the” is not directly related to “rare” but both are linked to “wine.”

The direct rules have precedence over the indirect rules. For example, in (2) the segmentation of [me a liar] into a PW is not acceptable although both “me” and “a liar” are arguments to “calls.” As indicated, “me” forms part of the PW with “calls” as the nucleus.

Procedure for PW segmentation

1. Identify all content words; each one constitutes the nucleus of a PW.
2. Apply the above semantic sense unit rules to determine the membership of a function word to the nearest preceding or following content word.

Results

The results are reported in two main sections. First, separate analyses are reported (a) for position category of function words before and after the content word and (b) for ordinal position in a PW, analyzed separately for function and content words. These analyses are similar to those reported for English by Au-Yeung et al. (1998). Second, exchange of disfluency from function to content words across age groups is examined. This analysis corresponds to that reported for English by Howell et al. (1999). All analyses involved ANCOVA using disfluency rate associated with the selected factor as the dependent variable. In all these analyses, disfluency rate (percentage of words disfluent out of all words in the selected sample) was obtained for each speaker for each of the samples where the sample selected depended on which factor from the ANCOVA was being considered. These disfluency rates were calculated by dividing the number of disfluent words in that category (e.g., total number of function words) by the total number of words in that category (all function words in the sample) and multiplying by 100 to convert to percentages (to give function word disfluency rate in this case). Overall disfluency rate (i.e., disfluency rate out of all words) of each participant (listed in Table 1) was used as the covariate in all ANCOVAs so that comparisons could be made across the speakers, given the wide variation in disfluency rates. As indicated in the *Method* section, when overall disfluency rate is used as the covariate in an ANCOVA, the ANCOVA gives the adjusted mean disfluency rate after the effects of the covariate have been taken out. Note that the current study did not include word position within a sentence (or utterance) as a factor in the analyses, as Au-Yeung et al. (1998) found no effect of this factor in any age group in their English data set.

Disfluencies of Function Words at Precontent and Postcontent Word Positions

Each word in a PW was classified as a precontent function word (Pre-F), content word (Content), or postcontent function word (Post-F). A two-way ANCOVA was performed with the factors age group (five groups, G1–G5) and word type (Pre-F, Content, and Post-F). The effect of word type was significant, $F(2, 104) = 43.31$, $p < .001$. Post hoc Tukey tests showed that Pre-F had a significantly higher disfluency rate than Content ($T = 6.604$, $p = .0000$), which in turn had a significantly higher rate than Post-F ($T = 3.293$, $p = .0039$). There was no significant effect of age group on disfluency rate, $F(4, 104) = .17$, $p = .953$, but the interaction between age group and word type was significant, $F(8, 104) = 2.66$, $p < .05$, showing that the splitting of disfluencies between Pre-F, Content, and Post-F changed across ages. Post hoc Tukey tests showed that for participants in G1 and G2, Pre-F had a significantly higher disfluency rate than did Content (G1, $T = 6.1343$, $p = .0000$; G2, $T = 3.624$, $p = .0322$) and Post-F (G1, $T = 5.219$, $p = .0001$; G2, $T = 4.407$, $p = .0023$). For G5,

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Pre-F had a significantly higher rate than did Post-F ($T = 4.768$, $p = .0006$). No significant effects were found for the other age groups. The mean percentages of disfluent words (adjusted by the ANCOVA) are shown in Figure 1.

Disfluencies of Function and Content Words Versus Their Ordinal Position in PW

Content words and function words were next classified by the position they occupied in PWs. Separate two-way ANCOVAs were performed for content words and function words. For the function word analysis, the factors were age group (five groups) and word position (first, second, or third word within the PW; data at positions beyond position 3 were sparse, and they were dropped from the analysis). The main effect of word position was significant, $F(2, 117) = 32.55$, $p < .001$. Post hoc Tukey tests showed that there was a significantly higher disfluency rate for function words that occurred in the first word position in a PW than in positions 2 ($T = 6.730$, $p = .0000$) and 3 ($T = 7.104$, $p = .0000$). The effect of age group was not significant, but the interaction of age group and position was, $F(8, 117) = 3.44$, $p < .005$, showing that disfluencies were spread among word positions in different ways over age groups. Post hoc Tukey tests showed that for G1, the first function words in PWs had a higher disfluency rate than those located at position 2 ($T = 6.386$, $p = .0000$) or position 3 ($T = 6.087$, $p = .0000$). The mean adjusted disfluency rate for each age group by function word position is plotted in Figure 2.

Position of the content word in the PW was examined next in a way similar to that used for function words. For the content word analysis, the factors were age group (five groups) and word position (each of the first four positions within the PW; data at positions beyond four were sparse and were dropped from the analysis). The main effect of age group was significant, $F(4, 144) = 3.28$, $p < .05$. Post hoc Tukey tests showed that there was a significantly higher proportion of disfluencies on content words by participants in G5 than by those in G1 ($T = 3.139$, $p = .0173$). The effect of position was not significant, and neither was the interaction of age group and position. The absence of an interaction between age group and position suggests that disfluency rate does not depend on a content word's position in different ways over age groups. The mean percentage disfluency rate (adjusted) for each age group and for each content word position is plotted in Figure 3.

Exchange of Disfluencies From Function to Content Words

The next analysis looked at whether Spanish participants change the locus of disfluency from function to content words as reported by Howell et al. (1999). Following Howell et al., PWs where there was no precontent function word, or where both the precontent function word and the content word were disfluent, were excluded from analysis. This was performed because both initial function words and the content word have to be present to assess the chance of disfluency on either. This would not be possible in a PW with no precontent function word. Also, when a participant repeated a preceding function word to delay producing the content word, disfluency is not likely to occur on the content word, and disfluency on the content word should occur when there has been no delaying on the function word. This prediction is supported by the fact that disfluency on postcontent function words was rare (less than 0.5%, shown in column 4 of Table 2); postcontent words were omitted in subsequent analyses. Although only 54–63% of the PWs (see column 2 of Table 2) were included when both these criteria were applied, the PWs that were left included over 93% (column 3 of Table 2) of all the disfluencies in the sample. (Howell et al., 1999, also reported for English that such PWs contained nearly all instances of disfluency.)

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Exchange Analysis

A two-way ANCOVA was performed with factors word type (two types: Pre-F/Content) and age group (five groups). The main effect of word type was significant, $F(1, 81) = 74.55$, $p < .001$. A post hoc Tukey test showed that the disfluency rate on function words was higher than that on content words ($T = 8.634$, $p = .0000$). Age group was not significant, but the interaction of age group and word type was, $F(4, 81) = 9.14$, $p < .001$. This shows that the splitting of disfluencies between function and content words changed over ages (an exchange relation). A post hoc Tukey test showed that for content words, the disfluency rate was significantly lower for participants in G1 than for participants in G3 ($T = 3.897$, $p = .0073$), G4 ($T = 3.787$, $p = .0103$), and G5 ($T = 3.847$, $p = .0085$). For participants in G1 and G2, the disfluency rate of function words was significantly higher than that for content words (G1, $T = 8.247$, $p = .0000$; G2, $T = 4.923$, $p = .0002$). Note that for G1, a significantly higher disfluency rate on function words than occurred with the other age groups is associated with a significantly lower disfluency rate on content words than occurred with the other age groups. The mean adjusted disfluency rates are shown in Figure 4. The adjusted disfluency rate is less than zero for content words for the youngest group because the ANCOVA has taken out the effect of differences in individual disfluency rates.

Discussion

The speech data from Spanish speakers who stutter were segmented into PWs according to the scheme proposed by Au-Yeung et al. (1998) for English. By using PWs, it was shown that there was a high level of disfluency in precontent function words and a low level in postcontent function words (see Figure 1). The difference in disfluency rate across these positions was significant for three of the five age groups (G1, G2, and G3) and replicates that of Au-Yeung et al. on English speakers who stutter. One minor difference between Au-Yeung et al. (1998) and this analysis is that Au-Yeung et al. found significant effects for all age groups.

The next analysis showed there was a significantly higher rate of disfluency on PW-initial function words, as found by Au-Yeung et al. (1998) for speech data from English speakers who stutter. As expected on the basis of Au-Yeung et al. (1998), there was no effect of ordinal position on disfluency rate for content words in a PW.

The speech data were then analyzed to see whether speakers were disfluent on the function words or on the content word itself when there was the opportunity for disfluency at each of these locations. Young speakers had high rates on precontent function words and low rates on the content word. Disfluency on the function words dropped off with age and, as it did so, disfluency on the content words increased. These data are similar to those in English found by Howell et al. (1999) (i.e., an exchange relation).

There are some other interesting incidental findings noted when preparing material for the exchange analysis. The selection procedure for obtaining PW for the exchange analysis suggests that Spanish is highly constrained in the form of PW that leads to disfluency in people who stutter. Less than 3% of disfluencies were lost when PWs in which disfluency occurred on both the initial function words and the content word were eliminated (column 5 of Table 2). Three percent is at a similar level to the amount lost when this procedure was applied to Howell et al.'s (1999) English data (average across age groups of 3.5%). PWs that started with a content word (had no initial function word) were also eliminated, and together with the earlier exclusion, between 54% and 63% of all PWs were left across the different age groups (column 2 of Table 2). Though a significant proportion of the PWs were lost, 93% of disfluencies (column 3 of Table 2) were retained. This is substantially higher than the percentage in Howell et al.'s (1999) data for English speakers who stutter (average across

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age groups of 78%). Indeed, the Spanish rate is comparable with Howell et al.'s data on English speakers who do not stutter (average across age groups of 93%). This difference suggests that English speakers who stutter are more likely to be disfluent in PWs that start with a content word than are Spanish speakers who stutter.

Howell, Au-Yeung, and Sackin (2000) reported that English content words with consonant clusters at the initial position had the highest chance of being produced disfluently. It is plausible that stand-alone content words in English attract more disfluency than those in Spanish due to the higher phonological complexity of the English words. In Spanish, consonant clusters are both fewer and less complex than those in English (Stockwell & Bowen, 1965, p. 70). Motorically complex sequences in English such as /s/+C+C (where C signifies a consonant) do not occur in Spanish (three-element strings in Spanish are relatively easier and have stop+liquid+semivowel structure). The relationship of phonological complexity of Spanish and English are currently under investigation and outside the scope of the current article. Apart from the indication that Spanish speakers show little disfluency on content words that exemplify the lower phonological difficulty of Spanish words, the general pattern of results is very similar to that found in English (Au-Yeung et al., 1998; Howell et al., 1999).

Two accounts for the patterns of disfluency on function and content words that occur in English and Spanish are considered. The first is the covert repair hypothesis (CRH), which maintains speakers who stutter have a phonological deficit that leads to errors in the speech plan and that these errors result in disfluency (Kolk & Postma, 1997; Postma & Kolk, 1993). The second is the EXPLAN account in which speakers who stutter take more time to prepare a correct plan than fluent speakers (Howell, 2002; Howell & Au-Yeung, 2002). The difference between these two points of view is in whether they regard errors as being implicated in stuttering or not. Errors refer to when a phone or phones appear in a position that some alternative phone(s) should occupy or where a phone or phones is(are) omitted from an intended word. A speaker who needs more time to produce the plan for a word may produce the first phones in the correct order (which are then not in error according to the preceding definition) but may run out of planned phones during that word's execution. Thus, a speaker who produces “mystery” for “history” has produced an error. A speaker who needs more time to generate a plan may produce “hhhhistory.” In this example, the prolonged /h/ is in the correct position and not in error. Also, the eventual production had all subsequent phones in the correct position for the intended word and so, again, does not constitute an error.

The CRH (Kolk & Postma, 1997; Postma & Kolk, 1993) proposes that the activation of phonological targets takes a long time in speakers who stutter. Kolk and Postma (1997) used Dell and O'Seaghdha's (1991) connectionist model to explain how a slow phonological system results in speech errors (consistent with the above definition). According to this model, when a speaker intends to say the word “cat” (the target unit), phonologically related competing units are also activated (e.g., “rat”). The buildup of activation for the target and competing units follows similar trajectories in early epochs, but later in time they asymptote at different levels. At asymptote, the target unit has a higher activation level that generates this (the appropriate) word as response. Operating under time pressure (such as when speech has to be produced rapidly) requires a speaker to generate words in the period where activation is still being built up. The word that is generated is again the one with highest activation but, as the target and competing options have similar activation trajectories during build-up, by chance one of the competing options may have highest activation and be triggered (resulting in a speech error) if word selection is made in this time region. Also, a slow phonological system will involve an extended time in the build-up phase. If a speaker with a slow phonological system is operating under time pressure (obliging the speaker to generate a word in the extended build-up phase) there is again a heightened chance of a speech error arising.

When the wrong word unit is generated, it may be produced overtly (e.g., “rat” for “cat”), and these errors usually occur on content words. According to CRH, the speech errors that arise can also be repaired internally before the speech is output (covertly) and are evident when the surface form of speech is disrupted but does not contain an overt error. From this stance, (a) prolongation and repetition of part of a content word and (b) disfluencies on and around function words that involve interruptions (filled and unfilled pauses) or word and phrase repetitions could both reflect covert repair activity (Howell, Kadi-Hanifi, & Young, 1991). As covert repair can take place on words that precede the error, CRH could explain why function word repetition and hesitation occur most frequently on precontent function words (where the content word is assumed to be the word that has generated the error). To account for the exchange relationship between function and content word disfluencies (if both are a result of covert repair processes), it would be necessary to assume (a) that the incidence of covert repairs on function words is highest in childhood, (b) that covert repairs on function words are complementary to covert repairs on content words, and (c) that the incidence of the covert repair options in (b) depends on the speaker's age. There does not appear to be any reason for these assumptions apart from the view that (to use CRH terms) covert repairs on function words are complementary to covert repairs on content words. Support for this is that disfluencies on both function and content words in a PW (each of which could reflect covert repairs according to CRH) is less than 3% (column 5 of Table 2). Another argument against CRH's assumption that stuttering reflects covert repairs to underlying errors is that recent reviews of the literature on whether children who stutter produce more phonological errors than fluent speakers has not found any clear relationship (Nippold, 1990, 2001).

The EXPLAN model regards function and content word disfluencies as two alternative ways of dealing with situations where the content word's plan is correct but not completely ready for output immediately after the preceding word was first produced (Howell, 2002; Howell & Au-Yeung, 2002). Function words are repeated for the sole purpose of gaining more time for completing the plan of the content word. According to EXPLAN, only the first part of a content word is produced, as this is the only part for which the plan is complete. When the plan runs out, the part that is available may be prolonged or repeated until the remainder of the plan is ready. In this account, disfluencies on function and content words are in complementary distribution (repeating function words prevents content word disfluencies, and content word disfluencies ensue when speakers do not repeat function words at points they could have). This accounts for the exchange relation originally found in English (Howell et al., 1999) and found here to apply to Spanish. Also, function word repetition and hesitation around function words are given a different role in EXPLAN (to gain time) than in CRH (as indications of a covert repair taking place). The EXPLAN model appears to account for the developmental exchange relationship, whereas the tenets of the CRH would appear to provide no ready explanation for this exchange.

The EXPLAN account of developmental stuttering can also be framed in the “Demands and Capacities” model (DCM; cf. Starkweather, 1987; Starkweather, Gottwald, & Halfond, 1990) in terms of *phonological encoding capacity* and *speech execution demand*. The DCM is not a theory of stuttering but a multifactorial model for clinicians to manage disfluent behavior. There is a recent debate by leading researchers in the field on this model in a special issue of the Journal of Fluency Disorders (Bernstein Ratner, 2000; Curlee, 2000; Kelly, 2000; Manning 2000a, 2000b; Siegel, 2000; Starkweather & Gottwald, 2000; Yaruss, 2000). Readers are referred to the debate for detailed discussion of DCM. Capacities in DCM include speech motor control, language formulation, social–emotional maturity, and cognitive skills. Our current suggestion, however, pinpoints the capacity of the phonological encoding system and the demands of the speech execution system (for instance, when speech rate is high).

The “speech execution demand” exceeding “phonological encoding capacity” explanation can be extended to explain features of developmental stuttering. If at a particular point in language development a child is in a stage where the execution demand exceeds the capacity of phonetic planning, a high level of disfluency could ensue. The child can cope with this by repeating function words. At a later stage when either the phonological encoding capacity catches up with the execution demands or execution demand is decreased by slowing speech rate, the function word disfluencies disappear and the speaker has recovered from these early types of disfluency. For a child who does not experience a disfluent period, his or her phonological encoding capacity and execution demand maintain a balance throughout language development. A child who does not recover has either adopted a different way of coping with the problem situation that then makes recovery difficult (Howell & Au-Yeung, 2002) or has a genuine deficit in the phonological encoding process where slowing of execution to a normal speech rate would still not regain the balance. According to Howell and Au-Yeung, the maladaptive way of coping is to attempt the content word before its plan is completed rather than repeat or hesitate on the preceding function word or words.

According to the argument so far, children who stutter do not necessarily have an inferior phonological system that produces more errors than their counterparts who do not stutter. They may simply be producing phonetic plans out of synchrony for the motor system to articulate. A normal system under a high demand will break down, and so will an inferior system under normal demand. On the other hand, an inferior system under low demand may not result in disfluent speech. An inferior phonological system that produces many errors is not a prerequisite of developmental stuttering. But obviously, an inferior phonological system that produces many errors would not contribute positively to speech fluency. The current authors' speculation is that people who stutter may not have an inferior phonological encoding system in the sense of producing more errors but in the sense of having a relatively slower phonological encoding system when compared to people who do not stutter. Different ways of assessing a child's phonological ability are needed to assess this. The assessment will need to tap the levels of phonological error produced, the speed of phonological planning (in more detail than that provided in picture-naming tasks), and the synchronization of the phonological encoding system and the motor execution system.

Further work is needed both on the patterns of stuttering described in this article (serial position functions and exchange relations) and on the properties that lead words to be produced incorrectly (CRH) or to take a long time to generate (EXPLAN). The patterns in the data of the English speakers (Howell et al., 1999) and the current Spanish speakers are cross-subject analyses. Longitudinal studies on speakers who stutter are required to confirm whether the shift from function word to content word disfluency occurs across ages for individual speakers who stutter. Content words in English and Spanish appear to operate equivalently insofar as they give an exchange relation. Some properties of content words remain roughly constant between the two languages (e.g., word frequency differences, their role in syntactic constructions). Other properties differ (e.g., phonological structure of Spanish content words is simpler than that in English, stress is carried mainly by content words in English whereas function words can be stressed in Spanish). This leads to a question: Does the similarity in the exchange pattern across the two languages mean that stuttering in Spanish is governed by those factors that are in common with English, or do the factors that operate differently also exert an influence?

In conclusion, people who stutter from both English- and Spanish-speaking populations exhibit almost identical patterns of disfluency. In both languages, young speakers who stutter are predominantly disfluent on function words. There is an exchange of disfluencies from function to content words as speakers get older for both languages. These exchange findings are explained by the EXPLAN model but not so readily by CRH. It is suggested that EXPLAN may be more appropriate for developmental stuttering and CRH when there are associated phonological disorders.

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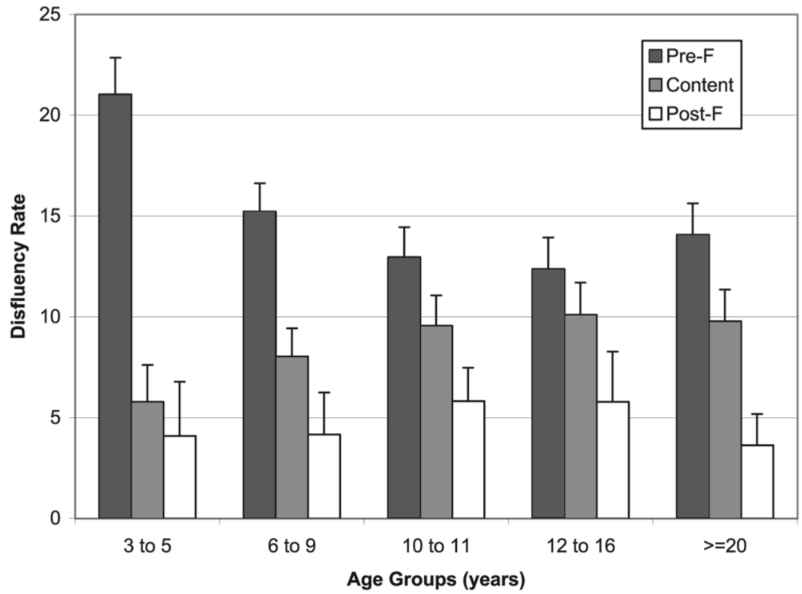

Figure 1.
The mean percentage of disfluent words (adjusted) of the precontent function words (Pre-F), content words (Content), and postcontent function words (Post-F), for the five age groups.

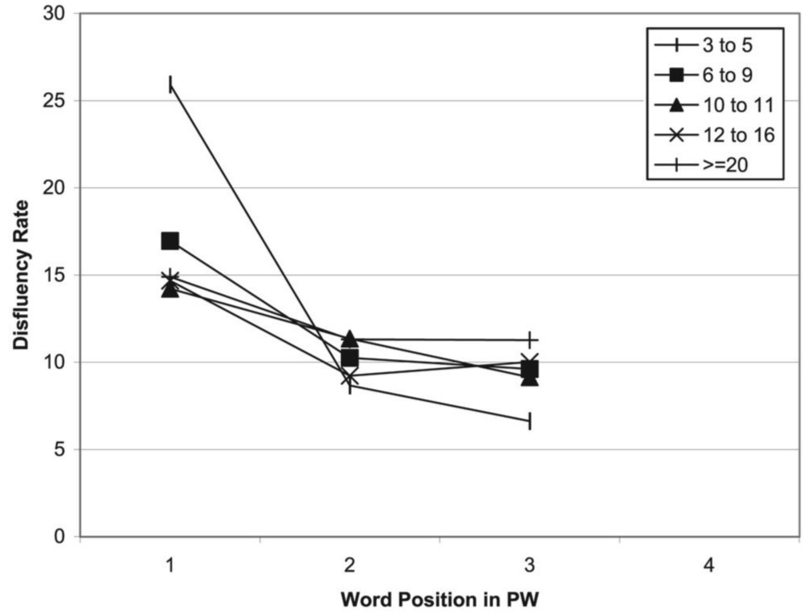

Figure 2.
The mean percentage of disfluent words (adjusted) of the function words across PW positions for the five age groups.

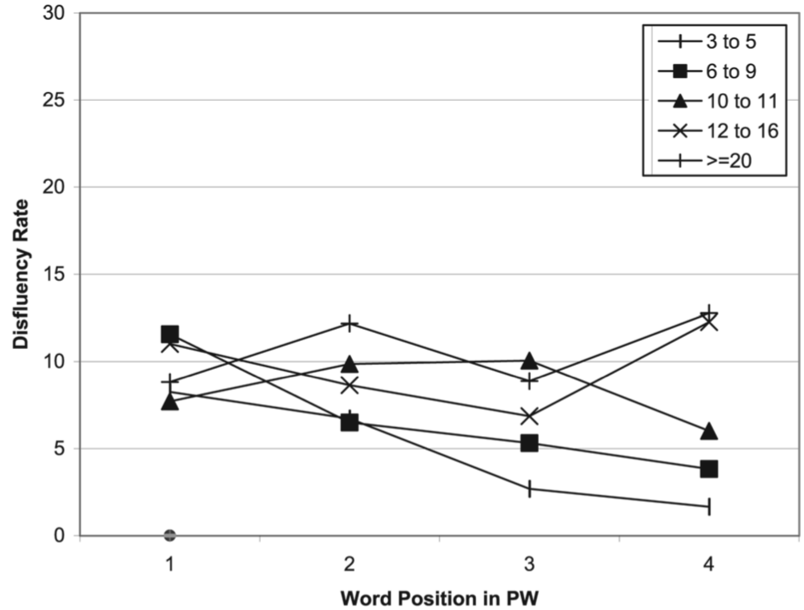

Figure 3.
The mean percentage of disfluent words (adjusted) of the content words across PW positions for the five age groups.

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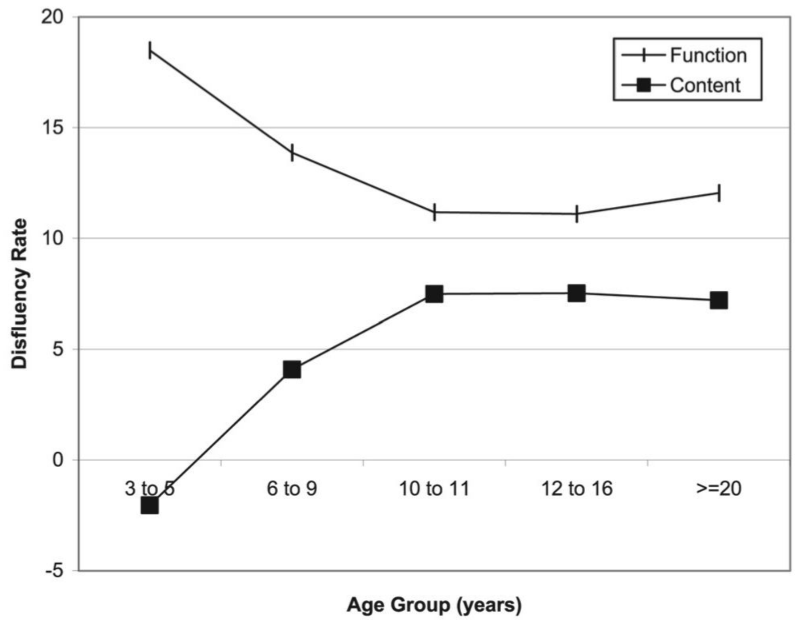

Figure 4.
The mean percentage of disfluent function and content words for people who stutter for the five age groups. The disfluency rates are adjusted for overall disfluency rate by the ANCOVA. The data points for function words are indicated by ticks and content words by squares.

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Table 1

Details of speakers (column 1), including age (column 2), gender (column 3), age group (column 4), disfluency rate in the sample (column 5), residence location (column 6), recording setting (column 7), and the number of words present in the speech sample (column 8).

Speaker	Age (years)	Gender	Age group	Disfluency rate	Location	Setting	Number of words in sample
S1	3	M	G1	22.53	Madrid	Clinic	275
S2	4	F	G1	26.25	Madrid	Clinic	132
S3	4	F	G1	9.35	Madrid	Clinic	159
S4	5	M	G1	11.60	Madrid	Clinic	640
S5	5	M	G1	3.81	Madrid	Clinic	967
S6	5	F	G1	15.00	Granada	Clinic	487
S7	5	F	G1	27.27	Madrid	Clinic	138
S8	6	F	G2	4.91	Granada	Clinic	210
S9	6	M	G2	20.31	Madrid	Clinic	294
S10	6	M	G2	5.15	Cordoba	Clinic	234
S11	6	M	G2	15.73	Madrid	Clinic	650
S12	6	M	G2	11.68	Mallorca	Clinic	554
S13	7	M	G2	5.65	Almeria	Clinic	486
S14	7	M	G2	15.51	Mallorca	Clinic	253
S15	7	F	G2	8.13	Mallorca	Clinic	687
S16	9	M	G2	4.39	Almeria	Clinic	1017
S17	9	M	G2	14.88	Madrid	Clinic	259
S18	9	F	G2	10.45	Almeria	Clinic	480
S19	10	M	G3	1.43	Almeria	Clinic	348
S20	10	M	G3	4.76	Almeria	Clinic	651
S21	10	M	G3	18.38	Madrid	Clinic	241
S22	10	M	G3	12.46	Madrid	Clinic	373
S23	10	M	G3	11.24	Madrid	Clinic	500
S24	10	F	G3	11.52	Cordoba	Home	615
S25	11	M	G3	2.56	Almeria	Clinic	920
S26	11	M	G3	5.81	Almeria	Clinic	991
S27	11	M	G3	2.43	Almeria	Clinic	804

Speaker	Age (years)	Gender	Age group	Disfluency rate	Location	Setting	Number of words in sample
S28	11	M	G3	1.75	Almeria	Clinic	1308
S29	12	M	G4	8.60	Almeria	Clinic	398
S30	12	M	G4	2.86	Cordoba	Clinic	87
S31	12	M	G4	5.44	Granada	Clinic	761
S32	13	M	G4	4.03	Madrid	Clinic	353
S33	13	M	G4	6.85	Almeria	Clinic	561
S34	14	M	G4	12.74	Almeria	Clinic	476
S35	15	M	G4	1.14	Granada	Clinic	317
S36	17	M	G4	12.27	Madrid	Clinic	198
S37	16	M	G4	2.61	Almeria	Clinic	1165
S38	20	M	G5	11.34	Madrid	Clinic	340
S39	25	M	G5	12.20	Santiago	Clinic	508
S40	25	M	G5	8.56	Madrid	Clinic	286
S41	36	M	G5	16.74	Granada	Home	792
S42	38	M	G5	13.32	Cordoba	Home	2037
S43	40	M	G5	11.26	Cordoba	Home	1489
S44	50	M	G5	12.36	Santiago	Clinic	1406
S45	52	F	G5	7.47	Cordoba	Home	1939
S46	68	F	G5	5.05	Cordoba	Home	2909

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Table 2

Properties of PWs across age groups.

Age group and range (in years)	% PWs in F_nCF_m form	% overall disfluencies in F_nCF_m PWs	% PWs with disfluencies on post-F	% PWs with disfluencies on both F and C	Mean age of the group (in years)
G1 (3–5)	54.11	95.01	0.41	2.83	4.4
G2 (6–9)	59.77	97.85	0.00	2.27	8.7
G3 (10–11)	63.16	95.98	0.03	2.38	10.4
G4 (12–16)	62.39	96.30	0.09	2.93	13.8
G5 (20–68)	59.74	93.05	0.17	2.31	39.3

Note. Column 1: age group and the corresponding age range. Column 2: the percentage of PW that had initial and final function words. Column 3: the percentage of the overall disfluencies included in the PWs given in column 2. Columns 4 and 5: the percentages of PW that were dropped due to the two exclusion criteria (the column 4 exclusion criterion is a disfluency on a function word that followed the content word; the column 5 exclusion criterion is disfluency on both an initial function word and the content word. Column 6: the mean age (in years) of the group.