Published in final edited form as:

J Speech Lang Hear Res. 1999 April ; 42(2): 345–354.

Exchange of Stuttering From Function Words to Content Words With Age

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Abstract

Dysfluencies on function words in the speech of people who stutter mainly occur when function words precede, rather than follow, content words (Au-Yeung, Howell, & Pilgrim, 1998). It is hypothesized that such function word dysfluencies occur when the plan for the subsequent content word is not ready for execution. Repetition and hesitation on the function words buys time to complete the plan for the content word. Stuttering arises when speakers abandon the use of this delaying strategy and carry on, attempting production of the subsequent, partly prepared content word. To test these hypotheses, the relationship between dysfluency on function and content words was investigated in the spontaneous speech of 51 people who stutter and 68 people who do not stutter. These participants were subdivided into the following age groups: 2–6-year-olds, 7–9-year-olds, 10–12-year-olds, teenagers (13–18 years), and adults (20–40 years). Very few dysfluencies occurred for either fluency group on function words that occupied a position after a content word. For both fluency groups, dysfluency within each phonological word occurred predominantly on either the function word preceding the content word or on the content word itself, but not both. Fluent speakers had a higher percentage of dysfluency on initial function words than content words. Whether dysfluency occurred on initial function words or content words changed over age groups for speakers who stutter. For the 2–6-year-old speakers that stutter, there was a higher percentage of dysfluencies on initial function words than content words. In subsequent age groups, dysfluency decreased on function words and increased on content words. These data are interpreted as suggesting that fluent speakers use repetition of function words to delay production of the subsequent content words, whereas people who stutter carry on and attempt a content word on the basis of an incomplete plan.

Keywords

stuttering; phonological words; function words; content words; speech plan

Brown (1945) established four basic types of words that are likely to be spoken dysfluently by adults who stutter: (1) content (rather than function) words, (2) long words, (3) words positioned early in a sentence, and (4) words starting with a consonant. This article is concerned with the mechanism behind the association of lexical word type with stuttering. Function words include pronouns, articles, prepositions, conjunctions, and auxiliary verbs. Linguistically, they are a closed class of words that do not carry full lexical meaning but have a grammatical or functional role (Hartmann & Stork, 1972; Quirk, Greenbaum, Leech, & Svartvik, 1985). Content words are nouns, main verbs, adverbs, and adjectives. Content words are an open class of words and play a crucial role in conveying semantic information. In contrast to Brown's (1945) observation about adults, Bloodstein and Gantwerk (1967) and

Bloodstein and Grossman (1981) have reported that children who stutter are more likely to be dysfluent on function words than on content words.

Wingate (1988) made two important conceptual points about the role of linguistic determinants of dysfluency: First, general underlying causes should be sought rather than making ad hoc extensions to the list of linguistic factors leading to dysfluency. Second, fluent speakers' speech errors may shed light on how linguistic determinants operate in people who stutter. The first point is illustrated by his own view that linguistic stress is the principal factor that leads to stuttered dysfluent breakdown in adults. He argued that stress could explain how the factors Brown (1945) identified operate in speakers who stutter. Brown also had recognized the need to identify an underlying cause that could explain why his "factors" led to dysfluency in adults. He argued that all four factors increased semantic difficulty. Though linguistic stress or semantic difficulty may account for stuttering in adults, they do not apply to children. In English, stress is related to word type. Function words usually are not stressed, whereas every content word carries stress. Wingate's emphasis on the role of stress is less applicable to children's speech because children who stutter are often dysfluent on function words, which they rarely stress. Similarly, Brown's argument for semantic difficulty as the underlying cause cannot explain why children have difficulty on the semantically simpler function words.

Wingate's (1988) admonition to relate observations about stuttered dysfluency to the work on fluent speakers' speech errors has particular relevance when looking at the way stuttering changes across age groups. Approaching developmental stuttering from this perspective can help identify similarities between fluent speakers and children who stutter and can help identify the processes that change when children persist in their stutter (Conture, 1990). Au-Yeung et al. (1998) adopted this approach in their investigation of why dysfluencies shift from function words to content words as speakers who stutter get older. Available research helps characterize the pattern in fluent speech. Maclay and Osgood's (1959) corpus shows that word repetition and pausing occur frequently in fluent speakers' speech. Clark and Clark (1977) suggested that such repetition and hesitation occur when the speech plan¹ for a later word is not ready for execution. Au-Yeung et al. (1998) pointed out that the words that are repeated in Maclay and Osgood's (1959) corpus are predominantly function words, whereas the words that are likely to take a long time to plan (Clark & Clark, 1977) are content words. Thus, a frequent pattern observed in fluent speech is repetition and hesitation on function words that precede the complex content words. The repetition and pausing on a simple function word allows them to delay execution of a subsequent content word until the complete speech plan for the content word is available. If, as authorities like Wingate (1988) believe, stuttered dysfluencies arise out of nonfluencies that all speakers produce, it would be expected that young speakers, whether they are diagnosed as stutterers or not, would exhibit similar nonfluencies to those just described. We hypothesize that the shift in locus of stuttered dysfluencies from function words in children to content words in adults could indicate that people who stutter abandon the delaying strategy at some point during development. If repetition of function words delays production of the subsequent content word until the plan is complete, dropping the delaying strategy would require speakers to attempt to produce content words on the basis of an incomplete plan, and this would lead to dysfluencies on the content word. Thus, stuttering on function words should decrease over age groups, and that on content words should increase.

To test predictions of this hypothesis, methods are needed to determine the position of a function word relative to a content word. The reason for this is illustrated by an utterance

¹According to Levelt (1989), speech planning includes three stages: the message generation, grammatical encoding, and phonological encoding. Therefore, a speech plan is a combination of the semantic plan, the syntactic plan, and the phonetic plan.

like “I look after my mother.” In this example, there are two function words between the content words “look” and “mother.” The question is whether one or both of the function words occurs before “mother” (and, consequently, could be used to delay its production) or whether they appear after “look” (when they could not be used to delay production of either “look,” because it is phonological word final, or “mother,” because it is not part of the phonological word containing this content word). Au-Yeung and Howell (1998) and Au-Yeung et al. (1998) have developed an analysis procedure based on Selkirk's (1984) phonological words for the purpose of establishing the position of function words. Phonological words are defined as consisting of a single content word (C) as its nucleus and any number of function words (F) that serve as prefixes or suffixes to the content word (F_nCF_m , where n and m can be zero or a positive integer). By segmenting speech into phonological words, as described in Method, it is possible to determine the position in relation to the content word of all function words. Applying this procedure to the preceding example, “after” is part of the phonological word that includes “look” and cannot be used to delay production of the content word because it occurs in final position in the phonological word. “My” is part of the phonological word that includes “mother.” In this case, because “my” appears prior to “mother,” it can be used to delay production of the content word. Au-Yeung et al. (1998) used speech segmented into phonological words to show that the majority of stuttering on function words occurs when the function word appears prior to a content word (like “my” in “my mother”) as opposed to function words that appear after a content word (“after” in “I look after”).

The fact that the likelihood of dysfluency on a function word depends to a marked extent on whether these words appear in initial position in a phonological word (Au-Yeung et al., 1998) is consistent with the view that these words are used to delay production of the content word. However, the Au-Yeung et al. (1998) study did not examine the relationship between dysfluency on function and content words within phonological words. In the current study, groups of speakers who stutter and normally fluent controls of different ages were used to test some predictions about changes in the distribution of dysfluencies over age and fluency groups derived from the preceding account. The speech was segmented into phonological words. The type of phonological words that are of particular interest are of the form F_nCF_m , where the integer subscripts take the values $n > 0$ and $m = 0$. Phonological words of this form were chosen because they have an initial function word that allows establishment of whether speakers are using the delaying tactic or not.

Four specific research questions are then tested: *Question 1:* For all age and speaker groups frequency of dysfluency on phonological word-final function words will be negligible as they take little time to plan because they are comparatively simple words and they do not play a delaying role. This hypothesis is supported, and phonological words with dysfluency on final function words are dropped from further analysis. *Question 2:* Speakers will either be dysfluent on function words or content words (depending on whether they are using the delaying strategy or not) but not both. In support of this prediction, it is shown that the frequency of dysfluency on both initial function words and the content word in the same phonological word is low. These phonological words are also dropped from subsequent analyses because the dysfluency that occurs in them cannot be exclusively associated with the content or function word. The phonological words that remain allow strategic differences in use of the delaying strategy across fluency and age groups to be established. *Question 3:* Fluent control speakers continue to use the delaying strategy across the entire age range. Consequently, repetition and hesitation on function words will be used predominantly by these speakers, and there will be no increase in dysfluencies on content words with age. They will show higher rates of dysfluency on function words than content words across age groups. *Question 4:* Because it is hypothesized that speakers who stutter gradually cease using the delaying strategy, the relationship between dysfluency on function and content

words will change over age groups. Young speakers who stutter should show a similar pattern to fluent speakers (a higher proportion of dysfluency on function words) if dysfluency arises out of normal nonfluent speech. As people who stutter get older, they abandon use of the delaying strategy. They then have to attempt to produce content words on the basis of incompletely prepared plans (Blackmer & Mitton, 1991), which leads to more errors on this type of word. Thus, as the frequency of dysfluency on initial function words decreases over age groups (dropping the delaying tactic), there will be a corresponding increase in dysfluency on content words (being attempted on the basis of an incomplete plan). The pattern over age groups should be reciprocal (the more repetition of function words decreases, the more dysfluency on content words should increase).

Method

Participants

Participants for this study included 51 individuals who were diagnosed by a speech pathologist as exhibiting stuttering behaviors. The speakers were then seen by a second speech pathologist, who independently diagnosed them as persons who stutter. The 51 speakers were recorded in conversational speech with a speech pathologist. The speakers ranged in age from 2 years 7 months to 40 years. They were divided into five different age groups: 2–6-year-olds, 7–9-year-olds, 10–12-year-olds, teenagers, and adults.² The 2–6-year-old group had 6 members, 4 boys and 2 girls (mean age was 4 years 2 months). There were 15 children in the 7–9-year-old group, with 11 boys and 4 girls (mean age, 7 years 3 months). There were 8 boys and 2 girls in the 10–12-year-old group (mean age was 11 years 4 months). There were 8 teenagers, with 7 boys and 1 girl (mean age was 15 years 8 months). There were 12 male adults, ages between 20 and 40 years (the mean age was 28 years 4 months). The speech data for the three youngest age groups is the same as that employed by Au-Yeung et al. (1998) and Howell and Au-Yeung (1995), and these also constitute part of the data employed by Kadi-Hanifi and Howell (1992).

The 68 control speakers were unpaid volunteers who reported no history of speech or hearing difficulty. They were divided into the five age groups by the same age criteria set out above for speakers who stutter. The 2–6-year-old group contained 6 speakers, with 3 boys and 3 girls (mean age was 5 years 0 month). There were 27 speakers in the 7–9-year-old group of which 17 were female and 10 were male (mean age was 7 years 6 months), and the 10–12-year-old group consisted of 15 children, with 9 boys and 6 girls (mean age was 10 years 7 months). There were 8 speakers in the teenage group, 1 of whom was male and 7 of whom were female (mean age was 17 years 8 months). There were 12 male speakers in the adult group (mean age was 29 years 5 months). Mean length of utterance (MLU) was calculated for each speaker as average number of words across all utterances (see Conti-Ramsden & Jones, 1997 for arguments for using MLU in words rather than MLU in morphemes). Age and MLU for all speakers are presented as boxplots in Figure 1(a) and (b), respectively. Age groups are indicated along the abscissa, and age and MLU (Figure 1(a) and (b), respectively) are along the ordinate. The box indicates the interquartile range of values, and the mean is indicated by the solid horizontal line. The range of measurements is shown by the whiskers. The data for the people who stutter are on the left for each age group. The main features to note in Figure 1(a) are that the age groups do not overlap and are comparable across fluency groups. In Figure 1(b), MLU shows a slight increase over age groups, and the MLU of fluent speakers is slightly longer than the controls. In Figure 1(c),

²Children up to 9 years 6 months were assigned to the 7–9-year-old group. Children assigned to the 10–12-year-old group were above 9 years 6 months. The youngest (a fluent) girl in the 10–12-year-old group is 9 years 9 months, and there is no overlap in ages between the two age groups. All other children in the 10–12-year-old group are at least 10 years of age. The group designation 10–12 is used for brevity. Kadi-Hanifi and Howell (1992) give justifications for division of age groups at these points.

the percentage of words that are dysfluent are presented for each age group for speakers who stutter presented, again, as boxplots. Mean dysfluency rates are comparable, though the 10–12 and teenage groups are more variable than the rest.

Speech Material

Recordings of speakers in spontaneous speech were used for assessment and analysis. These were made in a relaxed atmosphere and were, at minimum, two minutes in duration. The speakers who stutter were recorded when they attended the clinic before they received any treatment. At this time they also read a set text as part of their treatment assessment. The fluent controls produced just the sample of spontaneous speech. The topics for the spontaneous monologue that were suggested to the participants were family, friends, television, and so on. Speakers were able to speak continuously on these topics, and the topics were suitable for all age groups. The recordings of the participants' speech were transcribed using a broad phonetic transcription in fluent regions and a narrow system in the region of dysfluencies (see Kadi-Hanifi & Howell, 1992 for a detailed description). Transcribers estimated the durations of pauses and prolonged segments to the nearest 50 ms, and these were entered in the transcriptions. All words were classified as function or content in type. Stuttering episodes marked included word and part-word repetition and segmental or syllabic prolongations. Single word answers such as *yes* or *no* were excluded from analysis.

Segmentation of Phonological Words

To establish whether a function word is a prefix to the subsequent or suffix to the preceding content word, Au-Yeung and Howell (1998) and Au-Yeung et al. (1998) employed modifications of Selkirk's (1984) semantic sense unit rules, which she developed for intonational phrasing. Before the modifications that are necessary for applying sense unit conditions for segmenting phonological words are described, it is first shown how her rules are applied to segmentation of intonational phrases. According to Selkirk's rules, two constituents C_i and C_j form a sense unit if one of the following is true of the semantic interpretation of the utterance:

Rule a: C_i modifies C_j (a head).

Rule b: C_i is an argument of C_j (a head).

It can be seen straight away that application of these rules allows more than one content word to appear within an intonational phrase. The following example is taken from Selkirk (1984), where brackets delimit the words within different intonational phrase boundaries:

1.

(a) (Jane) (gave the book to Mary).

(b) (Jane gave the book to Mary).

There can be a large number of possible intonational phrase segmentations for a sentence (Selkirk 1984); the segmentations in Example 1 are just two out of many she gives. The segmentation of an utterance into intonational phrases is considered grammatical as long as it satisfies the two rules for semantic sense units. The first intonational phrase in 1(a) contains one content word, whereas the second contains three content words. In 1(b), the intonational phrase encompasses the whole sentence and contains four content words. The verb "gave" has three arguments: "Jane," "the book," and "to Mary." In contrast to the multiple content words that are allowed in an intonational phrase, Selkirk's phonological words allow one and only one content word per phonological word. Consider the following example (the asterisk (*) is used here to indicate illegality/ungrammaticality):

2.

- (a) Intonational phrase: (Jane) (gave) (the book) (to her).
- (b) Intonational phrase: * (Jane) (gave) (the book to her).
- (c) Phonological word: * [Jane] [gave] [the book] [to her].
- (d) Phonological word: [Jane] [gave] [the book to her].

The round brackets are used to indicate intonational phrasing, and the square brackets are used to indicate segmentation of phonological words. The sense unit rules allow intonational phrases that have no content word, as in 2(a), which would be illegal for phonological words, as in 2(c). The correct segmentation of the sentence in Example 2 into phonological words is given in 2(d). The equivalent segmentation into intonational phrases—in 2(b)—is illegal because it violates the original two semantic sense unit rules: “The book” and “to her” cannot form a sense unit. “The book” and “to her” can form a sense if and only if the word “gave” is included as well. Thus, “gave” serves as a pivot for linking the two constituents “the book” and “to her.” In order to allow the *indirect link*, the following two rules were introduced (C_k is another constituent in the same utterance):

Rule c: both C_i and C_j modify C_k (a head).

Rule d: both C_i and C_j are arguments of C_k (a head).

Another example that requires the additional rules is “[I saw] [a red] [car],” where “a” and “red” cannot form a semantic sense unit as laid out by Selkirk. A phonological word can be formed via a third part outside the phonological word “car,” where “a” is an argument and “red” is a modifier.

Because Selkirk's (1984) rules (Rules a and b) can produce a segmentation into both an intonational phrase and a phonological word, they have precedence over our additional rules (Rules c and d), which deal with cases for phonological word segmentation that cannot be handled by Rules a and b.

Reliability Measures

Interjudge reliability measures were carried out by asking a second transcriber to retranscribe speech materials from 8 speakers chosen at random. These second transcriptions were made independently (i.e., the second transcriber did not have the first transcriber's version). The agreement between the two judges on content/function word was 98%, giving a kappa coefficient of .96, which shows a high level of agreement against chance (Fleiss, 1971). Interjudge agreement of fluency was 96% on all words, giving a kappa coefficient of .92.

The speech materials were also segmented into phonological words according to the definition given above. They were also done independently by two judges. A large proportion of phonological words identified by the first judge was segmented identically by the second judge, and this was expressed in a percentage. The reverse was also true, and these were expressed as a second percentage. The agreement between the two judges for segmenting the speech material into phonological words was calculated by taking the average of the two agreement percentages and the value was 98%.

Analyses and Results

The data summarized in Table 1 assess the representativeness of the samples selected for subsequent analysis relative to the entire speech samples. The percentage of F_nCF_m phonological words relative to all types of phonological words is given in the first column of Table 1. It drops slightly below 50% for the 10–12-year-old children who stutter. Though

this type of phonological word comprises 50% of all phonological words for this one age group, it contains a high percentage of all dysfluencies, as shown in the second column (around 80%). The percentages of phonological words that have dysfluency on postcontent word function words is shown in the third column of Table 1 (Question 1). The percentages are very low (<1%) for both fluency groups and across all age groups. Phonological words that had dysfluency on postcontent word function words were excluded from subsequent analyses. As shown in Column 4 of Table 1, the percentage of words with dysfluency on both the precontent function word and the content word itself is low (<5%) across fluency and age groups (Question 2). Subsequent analyses are based on phonological words with the structure F_nCF_m , which are either spoken fluently throughout, have a dysfluency on the content word but not on the initial function word, or vice versa. Even after selection of F_nCF_m phonological words, exclusion of phonological words where dysfluency occurs on postcontent word function words and dysfluency occurs on both initial function words and content words, the selected phonological words still include the majority of dysfluencies. For the selected material, it can be established whether speakers are using the delaying strategy or not, depending whether the dysfluency occurs on the initial function word or the content word. Abandoning use of the delaying strategy over age groups would be revealed as a decline in percentage of initial function words stuttered and a corresponding increase in percentage of stuttering on content words.

Percentage dysfluency for initial function words and content words over age groups are shown for people who stutter and for fluent speakers in Figure 2. These data are adjusted for differences in stuttering rate for different individuals, using percentage of phonological words containing one or more dysfluent events. The data are given separately for function words (diamonds) and content words (triangles), and speaker groups can be identified by whether the symbols are hollow (fluent controls) or filled (people who stutter). The lines through the points are fits from a regression analysis (described below). The dotted lines are for the fluent controls, and the solid lines for the speakers who stutter.

Dysfluency rate differences between function and content words over age groups for fluent speakers were analyzed (Question 3). A two-way ANOVA was conducted with factors Word Type (function/content) and Age Group (the five age groups indicated in Figure 2). The dependent variable was the adjusted dysfluency rate of the respective word type. The effect of Word Type was significant, $F(1, 125) = 73.26, p < .001$. This indicates that significantly more dysfluency occurred on function words than content words. Age Group was not significant, but the interaction between Age Group and Word Type was, $F(4, 125) = 5.24, p < .001$. Tukey tests showed that there was a significantly higher proportion of dysfluency on function words than content words for all but the 10–12-year-old group. A polynomial regression analysis was performed separately for dysfluency rates of function and content words. The dotted lines on Figure 2 are quadratic regression fits of dysfluency rate on Age Group. The fits have been presented so comparison can be made with the fluent speakers. Note, however, that the slopes are shallow and not significant in the regression analysis. The latter observation also indicates that there is little change in dysfluency rate for function and content words for this speaker group.

The results for the people who stutter were tested in the same way as the fluent control speakers (Question 4). Word type was significant, $F(1, 91) = 30.84, p < .001$, as was the interaction between Age Group and Word Type, $F(1, 91) = 5.49, p < .001$. Once again, the effect of Age Group was not significant. The difference between word types arises because there is significantly more dysfluency on function words than on content words over all age groups. This view is qualified by the interaction with Word Type, which arises because the younger ages show markedly higher dysfluency on function words than on content words, which decreases up to age group 10–12. Looking across age groups in Figure 2, it is seen

that dysfluency on function words decreases, whereas that on content words increases. Similar regression analyses to those performed on the fluent speakers were conducted on these data. The regression, including linear and quadratic components, was significant for both function, $F(2, 4) = 133.9, p < .01$, and content, $F(2, 4) = 34.4, p < .05$, words. The fitted regression lines are shown as the solid lines in Figure 2.

In the preceding analyses, the same effects were significant for each age group (age and word type by age group interaction). Inspection of the data in Figure 2, however, shows that the patterns are dissimilar. This occurs mainly in the interaction effect between word type and group. The data of the fluent speakers show that the difference between dysfluency rate on content and function words remained approximately constant across age groups. The data on the people who stutter are characterized as function word dysfluency exchanging for content word dysfluency (i.e., as stuttering on function words decreases over age groups, that on content words increases). To highlight these different patterns between speaker groups, a three-way ANOVA was performed with factors Fluency Group, Age Group, and Word Type. The dependent variables were adjusted dysfluency rates from the preceding analyses of the respective word type. The effect of particular importance indicating the different patterns between fluency groups is the three-way interaction between Fluency Group, Age Group, and Word Type, $F(4, 218) = 4.86, p < .001$.

Discussion

The theory outlined in the introduction proposed that dysfluencies arise when the plan for a content word is not available. When this situation arises, speakers can deal with it in one of two ways. The first way is to delay production of the content word by repeating function words that precede it to buy time for the content-word plan to become available. Alternatively, they can attempt the content word on the basis of the partly available plan and gamble that the remainder of the plan will arrive while the content word is being executed (Blackmer & Mitton, 1991). The latter strategy differs from the pattern Clark and Clark (1977) described as characteristic of fluent speakers. On the assumption that early stuttering has similarities to childhood nonfluency, it was proposed that young people who stutter would predominantly exhibit the function word repetition strategy. On the basis of the shift of dysfluency from function words to content words surmised to occur when dysfluency persists (as stuttering) into adulthood, it was predicted that people who persist in their stutter do not use the delaying tactic that they formerly had available, but continue the utterance and attempt production of the subsequent, incompletely prepared content word.

Phonological words of the form F_nCF_m (where the integers $n > 0$ and $m = 0$) were selected so that the relationship between dysfluency on phonological word-initial function words and content words could be investigated. Note that, though this selection is made, the preceding account does not restrict dysfluency on content words to this designated type of phonological word. The plan for a content word may not be available in phonological words consisting of a content word alone (C) or in ones that start with a content word and have subsequent function words (CF_m , where the integer $m > 0$). In these cases, fluent speakers may gain time by introducing a pause prior to the content word. Adults who stutter may not pause but instead go on and attempt the content words in this context, as is hypothesized to occur in phonological words of the F_nCF_m form. There is no evidence about this at present. This is not addressed here because these other types of phonological words are not pertinent for establishing whether a delaying tactic on function words occurs and whether and how this varies across age and fluency groups. The F_nCF_m type of phonological word is not a rarity as it constitutes, at minimum, around 50% of all phonological words across age groups. The percentage of the selected type of phonological word does get slightly less

frequent over age groups, for both fluency groups, which may indicate some underlying process in long-term language use.

Though these phonological words can comprise slightly less than half of all phonological words, they have a greater chance of being stuttered than the remaining phonological words. For the youngest speakers in both fluency groups, in particular, they contain between 85.7% and 93.8% of dysfluencies in people who stutter and fluent controls, respectively (Table 1). The proportion of dysfluencies in this type of phonological word decreases during childhood for people who stutter dropping to between 77.8% (10–12-year-olds) and 79.5% (adults). No such decrease over age groups occurs in fluent controls (e.g., in adults, 96.4% of all dysfluencies occur in phonological words of this form compared with the 93.8% in 2–6-year-old children).

The next analysis (Question 1) on the selected phonological words showed that dysfluency on function words that occurred after the content word was very low. This has been reported previously (Au-Yeung et al., 1998) for people who stutter. According to the hypothesis, only function words that appear before a content word can delay its production.

Another consequence of function words in initial position serving the role of delaying production of the content word in phonological words was tested in Question 2. Speakers would only use repetition and hesitation on function words to delay execution of a content word if the content word could then be produced fluently. Conversely, if speakers did not use delaying when they lacked a plan for the content word, there was an increased chance of dysfluency on the content word. These observations suggest that dysfluency on F_nCF_m phonological words will tend to occur either on the initial function words or content words, not both. In support of this prediction, it was found that over all age and fluency groups, less than 5% of cases where there was dysfluency in F_nCF_m phonological words involved dysfluency on both the initial function word and the content word.

The way dysfluencies are apportioned between function and content words and whether and how this varies across age groups was investigated in fluent speakers to test Question 3. In the final two analyses, the small number of cases in which dysfluency occurred on both initial function and content word were omitted. Figure 2 shows that function words were more likely to be dysfluent than content words for all fluent age groups. The significant interaction between the word type the dysfluency occurred on (function versus content) and age groups was due to a smaller difference in dysfluency rate across word types for 10–12-year-old children. This may arise from a tendency for fluent speakers of this age to experience more of a problem on content words than other ones. The predominance of dysfluencies on function words in fluent speakers suggests that they usually use the delaying strategy.

In the final analysis (Question 4), the pattern of dysfluency on function and content words was investigated in people who stutter, as it had been in the fluent controls in the preceding analysis. Children who stutter, like the fluent controls, show a high proportion of dysfluency on initial function words and a low proportion on content words up to teenage. The dysfluency rates, however, are not constant over this range. Dysfluency on function words drops progressively, and that on content words increases. This shows that when this type of phonological word contains one dysfluency, it is more likely to be on the initial function word during early childhood but on a content word at ages beyond 12. The speakers start by producing a pattern similar to fluent speakers (more dysfluencies on function words) but shift over this age range to producing dysfluencies on content words. Because the analysis is conducted on F_nCF_m phonological words where the dysfluency occurs on the initial function word, this change in pattern indicates an advance from the function words at the start to the

later content word. The interpretation offered for this is that these speakers have abandoned the delaying strategy that they previously used to defer execution of the content word. This transition appears to be complete at an age beyond 10–12. Children in this age range may be particularly vulnerable to advancing to content words because, as was noted in the corresponding analysis of fluent children at this age, the dysfluency rate on function words was not significantly higher than that on content words, unlike other age groups. If speakers abandon delaying repetition of function words, as the people who stutter into teenage and beyond do, they are likely to experience problems on the following content words.

Acknowledgments

This research was supported by a grant from the Wellcome Trust.

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Figure 1.

Parts (a) and (b) present age and MLU data for all speakers as boxplots. Part (a) indicates age group along the abscissa and age along the ordinate. The box indicates the interquartile range of values; the mean is indicated by the solid horizontal line; and the range of measurements is shown by the whiskers. The data for the people who stutter are on the left for each age group. Part (b) presents the MLU data (ordinate) in the same format. In Part (c), the percentage of words that are dysfluent are presented for each age group for speakers who stutter presented again as boxplots. Throughout, *N* indicates the number of subjects in each age group.

Figure 2.

The mean dysfluency rate of function and content words for people who stutter (PWS) and fluent control speakers (CONTROL) adjusted for the overall dysfluency rate of phonological words across the five age groups. The data points are given separately for function words (diamonds) and content words (triangles). The symbol is filled for people who stutter and open for fluent controls. Polynomial regression fits for both function and content words are plotted. The plots for people who stutter are the solid lines, and those for the fluent controls are the broken lines.

Table 1

Details of type of phonological words (PWs) for fluency and age groups. Column 1 contains the percentage of words of F_nCF_m type, where the integer subscripts $n > 0$ and $m = 0$. The percentage of all dysfluencies occurring in phonological words of this type is shown in Column 2. Column 3 gives the percentage of phonological words of this type with stuttering on the postcontent function word. Column 4 contains the percentage of phonological words that had dysfluency on both the initial function word and the content word.

	% of PW of the form F_nCF_m	% of total dysfluencies in F_nCF_m PWs	% of F_nCF_m PW with stuttering on postcontent function words	% of F_nCF_m PW with stuttering on both the initial function word and content word
People who stutter				
2–6-year-olds	61.14	85.7	0.00	2.85
7–9-year-olds	62.33	82.4	0.07	2.70
10–12-year-olds	49.22	77.8	0.06	4.61
Teenager	60.94	78.0	0.13	4.32
Adult	53.69	79.5	0.28	3.01
Fluent controls				
2–6-year-olds	70.00	93.8	0.00	0.20
7–9-year-olds	83.61	92.3	0.01	0.89
10–12-year-olds	65.29	87.3	0.01	0.77
Teenager	70.23	94.1	0.00	0.39
Adult	58.84	96.4	0.01	0.22