DIFFERENTIATING SPEECH REPAIRS FROM REPETITIONS AND CONJUNCTIONS
USING PROSODIC CUES

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1. INTRODUCTION

When we listen to speech it is not usually difficult to determine
speakers' intentions, even when they make alterations or start a
sentence, break off, and recommence. These processes are termed
"speech repair" [1]. An example of a repair is "Go left at the, I
mean, go right at the crossroads". There are typically three
identifiable parts in a repair - the original utterance (OU), the
editing phase and the repair proper. In the example, "Go left at
the" is the OU, and "go right at the" is the repair. The OU
contains the word or words to be repaired, termed the reparandum,
("left" here). The speaker has gone past the word which is in
error, and so the repair is said to have an overshoot. The editing
phase here is "I mean". Levelt counts "er" as an editing term, but
it is considered here as a form of pause. With "er" excluded, the
editing phase is rare in our corpus of repairs from unrestricted
speech (4.2%) and is not discussed further. The final phase is the
repair which includes the alteration (here the word "right"). Note
also that the speaker has backed up to a point prior to where s/he
wants to make the alteration and, so, the repair contains a
retrace.

Levelt [1] has identified several categories of repair, for
example, error repairs in which erroneous information has been
altered. Though these may be sub-divided into repairs which occur
on different grammatical units, the analysis reported here applies
to all categories of error repair. The only obligatory parts of
error repairs are the alteration and reparandum.

In order that listeners can follow the message, speakers need to
make it clear (1) that a repair is being made (the forward flow of
speech stops) and (2) what erroneous information is being altered.
Prosody might have a role in each of these.

Schemes for transcribing prosody allow the patterning of stresses,
pauses and pitch movement, as well as rate variation, nasalization
of stretches of speech etc., to be represented in groups of words.
Pauses and pitch movement are self explanatory: Stress refers to
an increase in prominence usually due to an increase in loudness

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of a particular syllable [2].

Levelt and Cutler [1] investigated prosodic alterations in lexical error repairs to see how these might indicate to a listener that a repair was being made. They looked at the frequency with which the corrections were 'marked'; by marked they meant when the alteration differed prosodically from the reparandum [1, p.212]. They found a high incidence of marking on lexical error repairs compared with appropriateness repairs.

Prosody can be used both to indicate that the flow of speech has stopped and in order to make the alteration in such a way that it is intelligible to a listener. Firstly, there is often a pause when speakers interrupt the flow of speech, which may indicate where the repair starts. The position of such pauses relative to the alteration would depend upon whether a retrace occurs or not. Thus, when a retrace occurs, a pause should occur prior to it whilst when there is no retrace the pause should occur prior to the first word of the alteration. Secondly, speakers may mark the start of the alteration as the work of Levelt and Cutler [1] shows for the case of lexical error repairs. Here we examine whether stress is used to indicate the start of an alteration, in a set of repairs drawn from unrestricted speech. It is predicted that in all cases there will be a tendency for the first word of the alteration to be stressed. An analysis is conducted on the highest stress on the alteration and reparandum to establish whether there is an increase or decrease in stress.

In the cases where there is no retrace, the alteration will occur immediately after the pause. In the cases where there is a retrace the pause will be separated from the alteration by this retrace. Here, analysis of pauses from the corpus of repairs drawn from unrestricted speech is reported. Pauses which are added at the beginning of a retraced section when none occurred in the corresponding part of speech in the original utterance are compared with the incidence of pauses dropped before the retrace.

The next question that arises concerns whether the prosodic pattern in repairs is a reliable identifying feature. Here, two types of structure which are closely related to repairs are analyzed, repetitions and phrases connected with conjunctions. Repetitions include word and phrase repetitions; the repeated sections can be analyzed in the same way as retraces to ascertain whether a pause signifies the speaker's intention to restart the message.

The inclusion of conjunctions in the analysis depends upon a rule described by Levelt for ascertaining whether a repair is well-

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formed or not (WFR). Levelt's WFR suggests that the two main parts of a repair (original utterance and repair proper) are related in the same manner as the two constituents of a coordination. According to Levelt "An original utterance plus repair <OR> is well formed if and only if there is a string C such that the string <OC or R> is well formed, where C is a completion of the constituent directly dominating the last element of O (or is to be deleted if that last element is a connective such as "or" or "and")." [1, p.486]. Thus, in "There you can park at the left-hand side of the, the right-hand side of the road," the original utterance is "park at the left-hand side of the". The VP "park at the left-hand side of the" can be completed with "road" (=C).

The repair (R) is "park at the right-hand side of the road". The coordination thus becomes: "There you can park at the left-hand side of the road or park at the right-hand side of the road."

Given a co-ordination, this process can be reversed. Thus the co-ordination "a comparative graphology paper or a historical graphology paper", an example taken from [3], could have been the repair "a comparative graphology, a historical graphology paper". Levelt has pointed to the syntactic relationship between co-ordinations and repairs, so it might validly be asked whether this extends as far as the two structures having similar prosodic properties. Using Levelt's WFR, the retrace in a co-ordination starts after the conjunction and the first non-matching word constitutes the alteration ("historical" in the example, which is to be compared with "comparative").

2. EXPERIMENT

2.1 Prosody

The data from the Survey of English Usage [3] are in orthographic form with prosody marked following Crystal's [4] scheme. The repairs were phonemically transcribed into a machine-readable form using a convention based upon that used by the Joint Speech Research Unit (JSRU). The convention allows for primary and secondary stress and pauses of specified duration. The prosodic transcriptions were mapped from those given in the Survey of English Usage [3] to the JSRU convention directly. Kinetic pitch movements, which are marked in [3], include an obligatory increase in intensity which is equivalent to an increase in stress [4, p.143]. Therefore, all pitch glides which occurred in the data were converted to primary stresses. An example of the prepared transcription of the repair "about six months later three months later" is:

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/a-bout :siks :munths :"lai-ta ⁻= :"three :munths :"lai-ta ⁻=

The double quotation mark denotes primary stress (a secondary stress would have been indicated by a single quote). Syllabification within word is shown explicitly by the hyphen unless a primary or secondary stress occurs. An oblique (/) before a word indicates that it is a function word and a colon (:) that it is a content word. Tone unit boundaries are indicated either by punctuation (none in the above example) or by the symbols ⁻=.

A total of 284 repairs, 364 word repetitions and 168 phrase repetitions, and 244 phrases around conjunctions were collected from [3]. The latter were single words or phrases which were joined by any conjunction. The constraints placed upon conjunction selection was that the word or phrase before the conjunction started at a constituent boundary and that there was a constituent boundary after the word or phrase following the conjunction. Also, the grammatical category of the word or phrase before the conjunction had to match the grammatical class of the word after the conjunction. No other constraints were applied. As illustrated in the 'comparative graphology' example, this generated material which had sections with retraces and "reparandum/alteration" equivalent pairs, and analysis proceeded as described for the repairs.

2.2 Results and Discussion
For the repairs, symbols were added to the transcriptions which were designed to mark the various components of repairs described earlier. The parsing decomposed each repair into the retraced section and the first occurrence of this section of speech, the overshoot and its repeat, and the reparadum and alteration.

In the introduction, it was predicted that pauses would be added at the beginning of the retrace section relative to the occurrence of pauses at this position in the original utterance. No systematic changes in stress pattern (measures by comparison of the first word of the retrace with the corresponding word in the original utterance) would be expected, since no alterations have been made in the retrace section.

The first and second occurrence of the retraced section were aligned syllable by syllable. All prosodic alterations were measured relative to the original utterance (containing the reparandum) e.g., when no pause (or stress) occurred at a corresponding position in the repaired speech, the pause (or stress) was said to be dropped; if a pause (or stress) only occurred in the repaired speech it was said to be added.

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Comparisons were made of corresponding syllables with respect to whether stress was added or dropped or a pause inserted or removed.

The results for pauses and stresses added before the first word of the retrace and on the first word of the retrace (for pauses and stresses respectively) are shown in Table 1. The first three rows of the table give the results for pauses, and these are (in order) the number of repairs where pauses were added or dropped before the first word of the retrace and the total number of repairs (N).

Table 1. Analysis of pauses and stresses on retraced sections

Pauses	Added	27
	Dropped	2
	N	110
Stresses	Added	1
	Dropped	2
	N	110

The data show clearly that, as predicted, there was a marked tendency to add pauses before the first word of the retraced portion. A one-tail sign test shows that there are significantly more added pauses than dropped pauses ($p < 0.001$). The corresponding data on stresses are shown in the next three rows. These show that there is no systematic tendency to add stresses ($p > 0.05$). Thus, it appears that pauses are used by speakers to indicate the point where the repair starts; stress is not used for this purpose.

It was not possible to classify the type of repair because much depends on a prediction of what the speaker would have continued to say, especially where the moment of interruption occurs within a word. In a constrained task such as Levelt [1] used, prediction may be possible. In our data, however, it would have involved far too many guesses. Because of this difficulty in assessing the exact relationship of the alterations to the reparanda, and because syntactic structures and number of words often differed in the two, we decided only to examine changes in prosody between the first word following a retrace (or, where no retrace was present, the first word of the repair) and the first word of the reparanda.

To carry out this analysis, it was necessary to exclude data. Where the "repair" consisted of the insertion of a word or short phrase (N=17, 4.3%), alteration/ reparandum comparisons were not made (although the retrace comparisons, reported above, were, where

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applicable). The reason that these data were excluded is that it could be argued that the inserted word does not replace anything.

Because the words to be compared frequently had a differing number of syllables, syllable-alignment as done with retraced sections, was not possible. The pause comparison was therefore made on the pauses before the first syllable of each word, and the stress comparison on the highest stress on any syllable of each word.

The data for the first word of the alteration are presented in Table 2 in a similar way to the retrace data (Table 1). Here though, the data are also displayed depending on whether there had been a retrace prior to the alteration or not.

Table 2. Analysis of pauses and stresses on the first word of the reparandum and alteration

		Had no retrace	Had retrace
Pauses	Added	38	5
	Dropped	5	4
	N	149	106
Stresses	Added	41	19
	Dropped	7	4
	N	149	106

For the cases which had no retrace (and had no editing term), there was a significant tendency to add rather than drop pauses before the alteration ($p < 0.01$ by sign test), but no such tendency when there had been a retrace ($p > 0.05$). In the former case the pause is occurring at the point where the repair is starting, but this point is not the start of the repair in the latter. Thus, as with the data on retraces, it appears that a pause serves the function of indicating that a repair is being made.

It can be seen in Table 2 that stresses were added on the alteration whether or not a retrace had occurred. In both cases significantly more stress were added than dropped on the first word ($p < 0.001$ by sign test in each case)> Moreover, the tendency to add stresses is particularly marked when a retrace occurs. The addition of stress on the first word of the alteration indicates that this factor is used by speakers to show that the speech being altered has started.

The results of the analysis of repetitions are shown in Table 3.

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Table 3. Analysis of pauses and stresses in repetitions

		Word repetitions	Phrase repetitions
Pauses	Added	107	56
	Dropped	21	4
	N	364	168
		sig.	sig.
Stresses	Added	19	12
	Dropped	13	15
	N	364	168
		ns.	ns.

Basically, the table shows that speakers introduce pauses before the first word of a repetition, but there is no increase in stress. This parallels the findings with retraced sections of repairs and offers some support for terming these "covert repairs" [1].

Table 4. Analysis of prosodic factors around conjunctions

a) Pauses and stresses on the first word of the "reparandum/alteration" equivalent

		Had no retrace	Had retrace
Pauses	Added	10	2
	Dropped	2	4
	N	198	46
		sig.	ns.
Stresses	Added	61	20
	Dropped	50	4
	N	198	46
		ns.	sig.

b) Pauses and stresses on retraced sections

Pauses	Added	1
	Dropped	2
	N	46
		ns.
Stresses	Added	1
	Dropped	4
	N	46
		ns.

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Table 4 shows that the prosody around conjunctions differs from that around repairs. For the conjunctions that had a retrace, there is a significant tendency to stress the "alteration", as with repairs, but no significant tendency to add pauses prior to the "retrace", unlike with repairs. For the conjunctions that did not have a retrace, there is a significant tendency to add pauses, as with repairs, but no significant tendency to add stresses, unlike with repairs. Thus, it appears that the different types of constructions, though syntactically related, are prosodically dissimilar. The prosody in repairs is dissimilar to that in related grammatical structures such as around conjunction.

3. CONCLUSION

The data show that the prosody around repairs conveys information about the speaker's intent. There is a pause at the point where the speaker stops his/her forward flow. This point is prior to the retrace when one occurs or prior to the alteration when there is none. Repetitions operate like isolated retraces. The first word of an alteration in a repair is more likely to carry higher stress than the reparandum. Analysis of phrases connected by conjunctions show that no such stress effects occur in them. Therefore, it appears that although there are theoretical reasons for supposing phrases connected by conjunctions are related to repairs, this does not extend as far as their prosody. To put this another way, the prosody of repairs differs from related syntactic structures.

4. REFERENCES

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