Published article:

Plug, L (2011) *Phonetic reduction and informational redundancy in self-initiated self-repair in Dutch.* Journal of Phonetics, 39 (3). 289 - 297. ISSN 0095-4470

http://dx.doi.org/10.1016/j.wocn.2010.08.001

Phonetic reduction and informational redundancy in self-initiated self-repair in Dutch*

Leendert Plug

1 Introduction

At least since Lindblom (1990) it has been widely acknowledged that articulatory plannning is sensitive to informational redundancy, in that 'Parts of the speech stream that carry little information are realized with less articulatory effort than more informative parts' (Pluymaekers et al. 2005a: 157). A number of studies (Jurafsky et al. 2001, Bell et al. 2003, Pluymaekers et al. 2005a, Aylett and Turk 2006) have assessed the correlation between a measure of informational redundancy and a measure of phonetic reduction — for example the number of absent segments or syllables relative to the word's canonical realisation — and found it to be significant. These studies have two common features. First, their measures of informational redundancy tend to be based on frequency measures, such as overall rate of occurrence in a corpus of speech or contextual predictability. Second, they apply their measures to samples from a large corpus of speech, across a range of discourse contexts. While not denying that specific contexts may be associated with specific pragmatically motivated constraints on speech production, the studies are based on the assumption that random sampling should prevent any skewing effect such constraints may have (e.g. Pluymaekers et al. 2005a: 149).

This paper takes a different approach to the issue of the relationship between informational redundancy, phonetic reduction and communicative context. First, it explores the influence of informational redundancy on temporal and articulatory reduction in a single, narrowly defined discourse context. Second, it takes a qualitative approach to the measurement of informational redundancy by comparing two sets of utterances in this context which differ in the extent to which they introduce new information into the discourse. On the face of it, it would seem reasonable to assume that with variation in

*I am very grateful to Barry Heselwood, Hannah Sowden and Mike Woolridge for their contributions to this research, and to Sieb Nooteboom and Anne Cutler for comments following oral presentations at the University of Edinburgh and the Max Planck Institute for Psycholinguistics, Nijmegen. I am also grateful to the editors of this issue and various reviewers for their constructive criticism of versions of this paper.

discourse context controlled for, and with informational redundancy defined in functional terms, its influence of informational redundancy on phonetic reduction should be clearly observable. This paper addresses this assumption. The context on which it focuses is that of self-initiated self-repair, as defined in the conversation-analytic and psycholinguistic literature (see Schegloff et al. 1977 and Levelt 1983, among others). In self-initiated self-repair, a speaker interrupts the flow of talk to correct or modify something he or she has said before. The stretch of speech to be corrected or modified can be called the 'reparandum'; the correction or modification itself the 'repair'. Two examples are given in (1) and (2), with the sequence of reparandum and repair underlined and the two constituents divided by '//'.

```
(1) dat  dat  dan  eh: toch weer minder // toch weer meer is
    that that then er  still     less       still     more is
```
that that then er is still less – still more

```
(2) die  gozer kan zo: // die  kerel  kan zo goed spelen
    that guy   can so     that fellow can so well play
```
that guy can – that fellow can play so well

In (1), the speaker retroactively replaces *minder* 'less' by *meer* 'more'; in (2), the speaker repairs *gozer* 'guy' to *kerel* 'fellow'. Repairs of this type are often accompanied by the repetition of items that precede or follow the reparandum; in these cases *toch weer* 'still' and *die ... kan zo* 'that ... can so' are repeated.

Previous research on the phonetics of self-repair has focused mainly on the various types of disfluency associated with the identification of a reparandum and the 'initiation' of repair, such as the lengthening of pre-repair segments (Fox Tree and Clark 1997, Shriberg 2001) or the abrupt, often glottally reinforced 'cut-off' of pre-repair lexical items (Jasperson 2002, Benkenstein and Simpson 2003). This study rather focuses on the phonetic characteristics of the repair proper — in particular as compared with those of the reparandum. With regards to informational redundancy and phonetic reduction, the following initial observations can be made. First, self-repair introduces new information, and the introduction of this information is important enough for the speaker to sacrifice fluency. This would suggest that the repair component has a high level of 'informativeness', and is therefore unlikely to be associated with phonetic reduction relative to the reparandum. Second, self-repair often involves the use of 'editing terms' (Levelt 1983) such as *or* or *I mean*, as well as repetition, as seen in (1) and (2). Given that editing terms and repeated items are informationally highly redundant, we may expect repair stretches that contain editing terms and repeated material to show internal variation between phonetically reduced and phonetically unreduced speech.

Third, since Levelt (1983) it has been customary to distinguish between 'error repairs', in which a speaker corrects an erroneous formulation, and 'appropriateness repairs', in which a speaker refines, elaborates or clarifies a prior formulation. Of the examples given above, (1) is an error repair, while (2) is an appropriateness repair: *kerel* and *gozer* have the same denotation, but the speaker may consider *kerel* pragmatically more appropriate than *gozer*. The distinction would seem to be highly relevant for the relationship between informational redundancy and phonetic reduction. Error repairs introduce information that is crucial to the listener's correct interpretation of the utterance, while in appropriateness repairs, the new information refines or elaborates rather than corrects. In other words, error repairs are more highly informative than appropriateness repairs; therefore, we can hypothesise that they are less likely to be associated with phonetic reduction in the repair stretch. In fact, Levelt and Cutler (1983) observe in a corpus of Dutch self-repairs that while a majority of error repairs is 'prosodically marked' — that is, marked by a pitch accent on the repair stretch — a majority of appropriateness repairs is unmarked. At first sight, this is consistent with the present hypothesis: in Lindblom's (1990) terms, error repairs are more likely than appropriateness repairs to be associated with local 'hyperspeech'.

2 Data and method

2.1 Data

Instances of self-initiated self-repair were selected from approximately 15 hours of unscripted speech by 10 pairs of male speakers of Standard Dutch, recorded by Mirjam Ernestus in 1995 and 1996 (Ernestus 2000). The material comprises informal interviews which Ernestus undertook with each pair, one-to-one conversations between the members of each pair on a range of topics, and unscripted negotiations undertaken by each pair following a set of instructions. During the informal interviews, Ernestus asked a small number of questions with a view to generating talk by the two participants, and minimised her own verbal participation in the ensuing interactions. Most pairs spent little time on the negotiation task, so that across the corpus, a total of over 12 hours involves free conversation by the participants. The participants were friends or colleagues who knew each other well before participating in the recordings. In most cases they had similar ages, with an overall range of 21 to 55, and similar social and educational backgrounds. Gross measures of syllable and segmental deletions across the corpus suggest that it is similar to other spontaneous speech corpora, including that of Johnson (2004), as far as the prevalence of phonetic reduction is concerned (Schüppler et al. 2008).

The material contains 83 instances of self-initiated self-repair of the type described above. All instances involve the overt correction or reformulation of immediately prior speech. Instances of 'covert repair' such as hesitations, repetitions and restarts (Levelt 1983, Postma and Kolk 1993, Fox Tree and Clark 1997, Nooteboom 2005) were not included. It should be noted that the material used for this study is rather different from that used in some of the earlier studies of self-repair referred to above — in particular Levelt (1983) and Levelt and Cutler (1983). Their findings are mostly based on analysis of task-oriented speech, in which much of the interaction involves the participants giving each other instructions. It may well be that different types of interaction are associated with different strategies for dealing with error and repair; therefore, it cannot simply be taken for granted that findings on the phonetics of self-repair generalise across studies. We will return to this issue below.

2.2 Classification of repairs

All instances were classified as error or appropriateness repair using the criteria set out by Levelt (1983) and, more recently, Kormos (1999). Kormos' illustrated taxonomy of repairs, reproduced with minor terminological changes in Table 1, provided a useful point of reference in the present study. Following Levelt and Cutler (1983), so-called 'different repairs', which involve the abrupt abandonment of a well-formed utterance followed by an equally well-formed repair, were treated as appropriateness repairs rather than as a third category.

The classification was done by two independent raters: the author and an additional rater familiar with the relevant literature. Unlike the author, the additional rater was not a native speaker of Dutch. Therefore, the author prepared glosses and translations for all instances, with additional contextual information where this was crucial to the understanding of the repair. All glosses, translations and clarifications were checked and corrected by an independent specialist in Dutch–English translation who was unaware of the classification scheme, to ensure accuracy and avoid the author's own interpretation of the repairs biasing the provided information where other interpretations were possible.

On the basis of the resulting material, the author and additional rater independently classified 72 out of 83 instances identically (Cohen's Kappa 0.78, $p<0.001$). The 11 instances where initial judgements were different were then reconsidered independently by both raters, with a closer consideration of the context in which the repair occurred. Following this reconsideration, the raters reached agreement on 8. The remaining 3 instances were excluded from the analyses presented below. The resulting data set of 80 repairs contains 41 error repairs (51%) and 39 appropriateness repairs (49%). Further examples are given in (3) to (5). (3) and (4) were classified as error repairs; (5) as an appropriateness repair.

(3)
```
wat  er    met  deze  opnames    gaan gebeuren ma- // gaat gebeuren
what there with these recordings go   happen   but    goes happen
```
what will[SG] happen with these recordings bu- what will[PL] happen

Table 1: Taxonomy of repairs (adapted from Kormos 1999: 318, Table 1)

Different repairs	*We gaan rechtdoor offe ... We komen binnen via rood, gaan dan rechtdoor naar groen* 'We go straight on or ... We come in via red, go then straight to green.' (Levelt 1983: 51)
Appropriateness repairs	
Ambiguity	*We beginnen in het midden met ... in het midden van het papier met een blauw rondje* 'We start in the middle with ... in the middle of the paper with a blue disc' (Levelt 1983: 52)
Appropriate level	*met een blauw vlakje, een blauw rondje aan de bovenkant* 'with a blue spot, a blue disc at the upper end' (Levelt 1983: 52)
Coherence	*Ga je een naar boven, is uh ... kom je bij geel* 'Go you one up, is uh ... come you to yellow' (Levelt 1983: 53)
Good language	*C'est qu'un con, un idiot pardon* 'He's nothing but a damn fool, an idiot sorry.' (Brédart 1991: 127)
Error repairs	
Lexical	*Rechtdoor rood, of sorry, rechtdoor zwart* 'Straight on red, or sorry, straight on black' (Levelt 1983: 53)
Morphosyntactic	*En zwart ... van zwart naar rechts naar rood* 'And black ... from black to right to red' (Levelt 1983: 54)
Phonological	*Een eenheed, eenheid vanuit de gele stip.* 'A unut, unit from the yellow dot.' (Levelt 1983: 54)

(4) `het dons ligt nu hoog` <u>`opgeschaveld // gestapeld`</u> `in de magazijnen`
`the down lies now high NON-WORD stacked in the warehouses`
the down is now stapped up – stacked up high in the warehouses

(5) <u>`dat weet je // althans ik weet dat`</u> `ook inderdaad`
`that know you at-least I know that too indeed`
you know that – at least I know that too, that's right

Finally, instances classified as error repair were further classified as lexical, morphosyntactic or phonological according to the nature of the error addressed by the repair. This was done by the author only. (1) above is an example of a lexical error repair. (3) is a morphosyntactic error repair: it addresses the erroneous number marking on the auxiliary verb *gaan*. (4) is a phonological error repair, addressing the initial mispronunciation of *opgestapeld* 'stacked up'. Of the 41 error repairs, 31 (76%) are lexical error repairs, 7 (17%) are morphosyntactic repairs, and 3 (7%) are phonological repairs. This means that a meaningful comparison between subtypes of error repair is not feasible.[1] It also means that the majority of error repairs are similar to the appropriateness repairs in the data set in that they involve the correction of the selection of one or more lexical items.

2.3 Temporal analysis

Duration measurements were taken for the reparandum and the repair stretch as a whole as well as for various components that make up the repair stretch, which are specified further below. Segment boundaries were placed at waveform zero-crossings nearest to visual discontinuities that corresponded to the audible start or end of the component involved, following the general method described by Rietveld and Van Heuven (1997). In cases where placement was difficult, care was taken to apply a single method to both reparandum and repair. For example, in cases where both reparandum and repair started with a voiceless plosive and the onset of the plosive hold phase was difficult to identify in either component, boundaries were placed at the plosive release for both. This is illustrated in Figure 1, which shows a segmented waveform for the repair in (1) above.

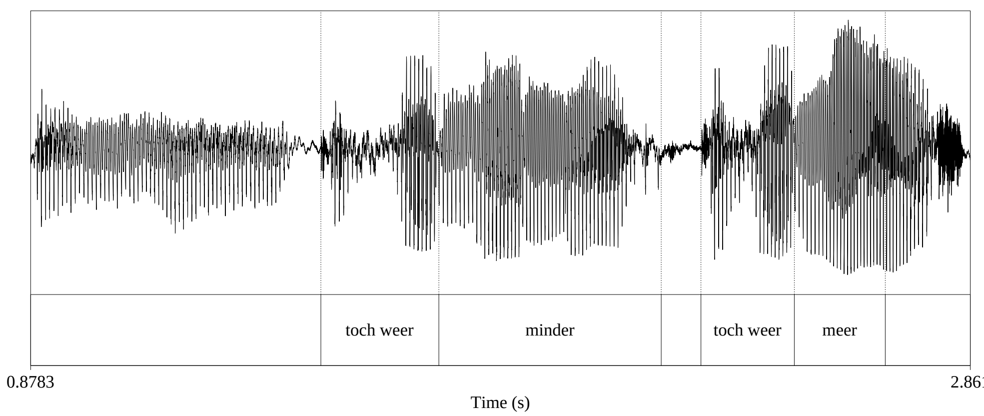

Figure 1: Segmented waveform for the repair sequence in (1); boundaries mark the beginning and end of the reparandum and repair, as well as the beginning and end of repeated lexical items that accompany the repair

To ensure comparability across stretches with different numbers of syllables, duration measurements were converted into speech rate values. The conversion was done by dividing the canonical number of syllables of a given stretch by its duration. To facilitate comparison of the speech rate of a repair stretch, or one of its components, to that of the corresponding reparandum, the former was expressed as a proportion of the latter. For example, in the case of (1) the speech rate across the repair stretch *toch weer meer* is 7.1

[1]Cutler (1983) and Shattuck-Hufnagel and Cutler (1999) report a phonetic difference between phonological repairs on the one hand and lexical repairs on the other, in that the former are less frequently prosodically marked.

sylls/sec, as compared with 5.3 sylls/sec across the reparandum *toch weer minder*. The resulting proportional value is 1.34.

In what follows, proportional values will be presented in three ranges. Research on the perception of tempo variation has repeatedly found a Just Noticeable Difference for tempo variation of approximately 5% (Eefting and Rietveld 1989, Quené 2007). In terms of the proportional values, this would mean that a value between 0.95 and 1.05 can be taken to characterise a repair whose repair stretch is not noticeably faster or slower than the reparandum, while values below 0.95 and above 1.05 characterise repairs in which the repair stretch *is* temporally 'marked'. In order not to overestimate the proportion of such marked repairs, this study adopts the wider 'equivalence range' of 0.90–1.10 — that is, a range of tempo variation of up to 10%. Instances with values in this range will be presented as not *clearly* having a temporally expanded or reduced repair stretch. Values below 0.90 represent expansion of the repair relative to the reparandum; values above 1.10 reduction.

2.4 Segmental analysis

In addition to the temporal analysis, all instances of self-repair were transcribed phonetically by the author as well as an additional transcriber with no particular knowledge of the phonetics and phonology of Dutch and no particular intuitions regarding the phonetics of self-repair. The latter transcriber was provided with a canonical transcription of each utterance for reference, taken from Heemskerk and Zonneveld (2000). Transcription was conducted independently, on the basis of auditory analysis and concurrent inspection of spectrograms and waveforms, and followed the conventions of the International Phonetic Association (IPA 1999) for narrow segmental transcription. Example transcriptions for the repair in (1), prepared by the author,[2] are given in Table 2.

Table 2: Segmental transcription of the repair in (1)

	Reparandum	Repair
	toch weer minder	*toch weer meer*
Canonical form	tɔx ʋer mɪndər	tɔx ʋer mer
Attested form	tɔʁ ʋ̞ɪ mɪndəɾ	tɔ ʋɪ mɪɾ

Degree of segmental reduction was quantified in terms of the absence of segments relative to a canonical realisation (Johnson 2004, Binnenpoorte et al. 2005). Of course this measure does not cover all types of articulatory reduction and cannot be seen as anything more than a crude approximation of a 'reduction quotient' (Kohler 1991, 2000).

[2]While the two transcribers did not produce identical transcriptions in this instance, their transcriptions matched in terms of the number of observed segmental deletions: see below.

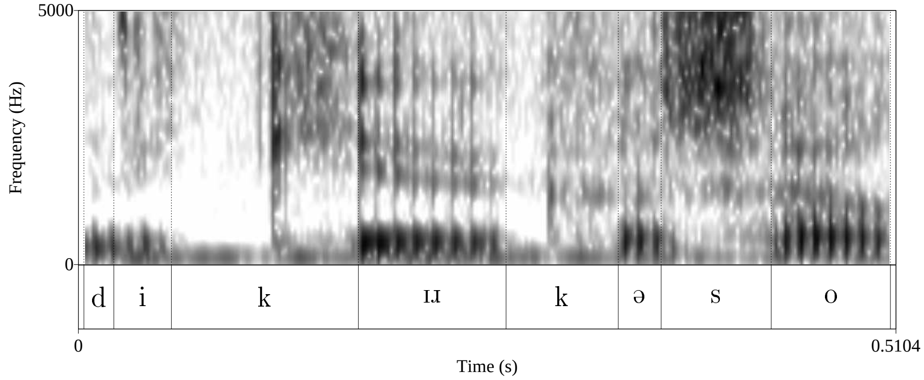

Figure 2: Segmented spectrogram for the repair *die kerel kan zo* /di kerəl kɑn zo/ in (2), in which /əl/ and /n/ were deemed absent

Nevertheless, the measure was deemed useful as a complement to the temporal measures described above. Counting reparanda and repairs as separate utterances, the transcribers provided transcriptions that matched in terms of the number of absent or non-segmentally realised canonical segments for 114 out of 160 utterances (71%). Most cases of divergence reflect the fact that segmental reduction is a gradient phenomenon, and the line between a weakly articulated segment and the absence of a segmental realisation is a fine one (see Cucchiarini 1996, Ball 2001). Rather than discarding all non-matching transcriptions, the author reconsidered the relevant audio files, paying particular attention to the spectral properties of the utterance. If a spectral discontinuity or the absence thereof favoured one of the two transcriptions, that transcription was taken as representative. For example, in the case of the repair in (2) above, the transcribers disagreed on whether the initial /d/ in the repair component *die kerel kan zo* is realised segmentally. The spectrogram in Figure 2 shows a spectral discontinuity that suggests it is, although there is no evidence of a canonical plosive release.[3] It was possible to make such an informed decision in 38 out of 46 cases. For the remaining 8 instances, for which the inspection of spectral records did not motivate a choice between transcriptions, the transcription produced by the non-native transcriber was taken as representative, given that it is less likely to have been biased by expectations as to the segmental make-up of the utterance.

The agreed counts were then used for a comparison between reparandum and repair stretch along the lines of the temporal analysis outlined above. To ensure comparability across stretches of different lengths, numbers of observed segments were expressed as a percentage of the corresponding number of canonical segments. An outcome of 100% means no segmental deletions were observed, and the higher the proportion of canonical segments deemed absent, the lower the resulting value. To compare the percentages across

[3] On the other hand, the sequence [ɪɹ] is difficult to segment, but both transcribers agreed that rhoticity can be observed.

reparandum and repair, the latter was subtracted from the former. A positive result means the repair has more segmental deletion than the reparandum, while a negative result means the reverse and zero means equivalence in terms of relative segment counts. In the case of (1), the reparandum as a whole has a proportion of realised segments of 92%, while the repair has 77%; the resulting value of 15 is consistent with reduction of the repair relative to the reparandum.

2.5 Editing terms and repetition

As suggested above, repairs of the type considered here are recurrently accompanied by editing terms and the repetition of lexical material. We have already seen several examples of lexical repetition. For an example of a repair with an editing term, see (5) above, in which the repair is prefaced by *althans* 'at least'. Across the data set, 27 instances (24%) contain editing terms, and 55 instances (69%) involve lexical repetition.

In addition to calculating the temporal and segmental values specified above over the entire reparandum and repair stretch, values were calculated excluding any editing terms and repeated items, as well as for the repeated items alone.[4] Previous research on the Dutch editing term *eigenlijk* 'actually' (Plug 2005) suggests that it is recurrently highly reduced, while most previous research on the phonetics of repetition has observed phonetic reduction rather than expansion, too, across a range of contexts (e.g. Fowler 1988, Bard et al. 2000). While the function of these repair components is different (see Levelt 1983), neither adds new propositional information, and it is only in the component of the repair that does this that any difference between error and appropriateness repairs due to a difference in informational redundancy might be observed.

2.6 Reparandum type and lexical frequency

It has been observed that disfluencies are regularly anticipated by 'a lengthening of rhymes or syllables preceding the interruption point' (Shriberg 2001: 161). We have already seen that this 'pre-repair lengthening' occurs in the data set: in example (2), a noticeably long duration of the pre-repair segment is marked by a colon. The occurrence of pre-repair lengthening in the data raises the possibility that a measurement result indicative of relative reduction in the repair stretch for a given instance may be due more to the temporal expansion of isolated segments or syllables in the reparandum than to reduction across the repair stretch due to a change in degree of informational redundancy. Therefore, reparandum type was treated as a possible explanatory factor in the analyses reported

[4]The data set contains four 'expansion repairs', which involve the retroactive addition of a lexical item or items to a reparandum phrase, which is repeated in the repair. In these cases, excluding repeated material leaves no reparandum to compare the repair to. Therefore the number of instances for the analyses excluding editing terms and repeated material is 76 rather than 80.

below. Three types were distinguished: lengthened, cut-off and neutral. A reparandum was classified as lengthened if one or both of the independent phonetic transcribers involved in this research transcribed a long reparandum-final segment. This method was chosen so as not to underestimate the size of this subset. A reparandum was classified as cut-off if it involved a premature cessation of the production of a lexical item, as in (3) above. Only clearly incomplete productions were considered. All remaining instances were classified as neutral in terms of reparandum type.

Finally, an preliminary attempt was made to assess the influence of lexical frequency on degree of reduction in the repair. Given that more frequent words are more likely to undergo phonetic reduction (Bybee 2001, Pluymaekers et al. 2005b), a repair which corrects a less frequent word or phrase in favour of a more frequent one is arguably less likely to be associated with local hyperarticulation than a repair which replaces a frequent word or phrase with a less frequent one. In the present study, all instances involving the repair of a single lexical item or short phrase without additional reformulation (N=45) were subjected to frequency analysis. For each word or phrase a frequency count was taken from the Corpus Spoken Dutch, a 10 million-word corpus of Dutch speech (Oostdijk and Broeder 2003, Schuurman et al. 2003). For example, in the case of (2) counts were taken for *gozer* and *kerel*, and for (3) counts were taken for *gaan gebeuren* and *gaat gebeuren*. In each case the count for the repair was expressed as a proportion of the count for the reparandum. To reduce the effects of extreme values, all values were logarithmically transformed before their correlation with the measures of phonetic reduction specified above was evaluated.

3 Results

3.1 Overall comparison

Table 3 shows the results of a comparison in speech rate between the repair stretch and the reparandum for all instances in the data set. A clear majority of proportional values (68%) is above 1.10: that is, there appears to be an overall tendency towards temporal reduction of the repair stretch. A relatively small number of instances has a value in the 'equivalence' or 'expansion' ranges (23% and 10% respectively). As for the two subtypes of repair, distinguishing error repairs from appropriateness repairs does little to explain the variation in values. Both subtypes have similar ranges of values, and there is no significant difference in mean (unpaired t-test: $t(78)=-0.38$, $p=0.70$) or in the distribution of instances across the three ranges of values (Fisher's exact probability test, $p>0.05$).

Table 4 shows the effect of reparandum type on proportional values for the two subtypes of repair. It can be seen that within both error and appropriateness repairs, instances with pre-repair lengthening have the highest mean proportional value, and in-

Table 3: Speech rate of the repair stretch (excluding any editing terms and repeated lexical items) as a proportion of that of the reparandum: descriptive statistics and numbers of values in three ranges

		All (N=80)	Error (N=41)	Appropriateness (N=39)
Range		0.69–3.17	0.70–3.17	0.69–3.04
Mean (SD)		1.39 (0.56)	1.37 (0.58)	1.42 (0.54)
Reduction	(> 1.10)	54 (68%)	28 (68%)	26 (67%)
Equivalence	(0.90–1.10)	18 (23%)	8 (20%)	10 (26%)
Expansion	(< 0.90)	8 (10%)	5 (12%)	3 (8%)

stances with a cut-off reparandum the lowest. Error and appropriateness have similar proportions of instances with the three types of reparandum, and a factorial Analysis of Variance confirms that while the effect of reparandum type is statistically significant ($F(2)$=7.78, p=0.001), due to a significant difference between repairs with pre-repair lengthening on the one hand and those with a neutral or cut-off reparandum on the other (Tukey HSD, p<0.001), there is no significant interaction between repair type and reparandum type ($F(2)$=0.003, p=0.99). In other words, controlling for reparandum type does not result in the emergence of a difference between error and appropriateness repairs; rather, it shows that they are similar in terms of the nature of the disfluency that 'initiates' repair as well as the temporal relationship between reparandum and repair.

Table 4: Influence of reparandum type on proportional values in temporal analysis: descriptive statistics across repair types

		Mean (SD)	N
Error	Neutral	1.36 (0.59)	23
	Cut-off	1.18 (0.30)	13
	Lengthened	1.90 (0.84)	5
Appropriateness	Neutral	1.37 (0.49)	20
	Cut-off	1.20 (0.30)	12
	Lengthened	1.93 (0.71)	7

Finally, Table 5 shows the results of a comparison between repair stretch and reparandum in the proportion of realised canonical segments. It can be seen that this measurement, too, indicates that in a majority of cases (here 59% overall) the repair is reduced relative to the reparandum.[5] Again, there is no significant difference between error and

[5]The larger proportion of values in the 'expansion' range in comparison with the temporal measurements (29% *vs* 10%) suggests that it is possible for a repair stretch to be temporally reduced relative to the reparandum, while exhibiting fewer segmental deletions.

appropriateness repairs in means ($t(78)=-0.32$, $p=0.75$) or in distribution across the three ranges of values (Fisher's, $p>0.05$).

Table 5: Proportion of realised canonical segments for the repair stretch subtracted from the proportion for the reparandum: descriptive statistics and numbers of values in three ranges

		All (N=80)	Error (N=41)	Appropriateness (N=39)
Range		–23.00 – 45.00	–20.00 – 36.00	–23.00 – 45.00
Mean (SD)		6.63 (12.88)	6.17 (12.00)	7.10 (13.89)
Reduction	(> 0)	47 (59%)	23 (56%)	24 (62%)
Equivalence	(0)	10 (13%)	7 (17%)	3 (1%)
Expansion	(< 0)	23 (29%)	11 (27%)	12 (31%)

3.2 Editing terms

As indicated above, 27 instances of repair in the data set contain an initial editing term or combination of editing terms. Many of these show considerable phonetic reduction, both temporally and articulatorily. Speech rate figures range from 4.3 sylls/sec to 26.7 sylls/sec, with a median of 10.0 sylls/sec.[6] In terms of articulation, 13 out of 27 editing expressions show at least one instance of segmental deletion, with a mean proportion of canonical segments realised of 81%. The transcriptions in Table 6 illustrate that articulatory reduction is commonly observed.[7] For example, *of* recurrently lacks a vowel portion, and when it does have a vowel, it is recurrently central rather than back. It can also be seen that *eigenlijk* occurs in its highly reduced, monosyllabic form, as previously described by Ernestus (2000), Keune et al. (2005) and Plug (2005).

With reference to the two subtypes of repair, of the 27 instances with editing terms, 15 are error repairs and 12 are appropriateness repairs. The two subgroups of editing terms are not significantly different in terms of speech rate (11.8 *vs* 9.0, $t(25)=1.62$, $p=0.12$) or proportion of canonical segments realised (85% *vs* 76%, $t(25)=1.68$, $p=0.11$). Therefore, excluding editing terms from measurement is likely to affect both subgroups of repair to a similar extent.

[6]26.7 sylls/sec is an outlier, measured for a highly contracted form of *of eigenlijk* 'or actually'. Excluding this outlier, the mean speech rate across the remaining editing terms is 9.9 sylls/sec.

[7]As in the case of Table 1, the transcriptions presented here are the author's. Both transcribers agreed on the number of realised segments in each instance. The same is the case for Tables 7 and 10 below.

Table 6: Transcriptions of the editing terms in the data set

Editing expression	N	Canonical form	Observed form(s)
of ‘or’	17	ɔf	ɔf, əf, ɜʊ, f
althans ‘that is’	2	ɑltɑns	ɑtəs, ɑl̞t̞ɐz
of eigenlijk ‘or actually’	2	ɔf ɛixələk	əvɛ̞e̞g̚
ik bedoel ‘I mean’	1	ɪk bədul	b͡dul̞
nou ‘well’	1	nɑu	nɑ̟
nee ‘no’	2	ne	ne
even kijken ‘let’s see’	1	evə kɛikə	əfkɛ̠e̠
of tenminste ‘or at least’	1	ɔf təmɪnstə	ə̥ftəmĩs̞ə

3.3 Repeated lexical items

Table 7 shows that the temporal proportional values for repeated lexical items are very similar to those reported in Table 3. The repeated items are not invariably temporally reduced relative to the first mention, and the mean proportional value of 1.38 is almost identical to the mean proportional value calculated over the repairs as a whole. Proportional values for repeated lexical material are similar across the subgroups of error and appropriateness repairs; the difference in mean (1.35 *vs* 1.41) is not statistically significant ($t(53)$=–0.35, p=0.73), and neither is the distribution of instances across the three ranges of values (Fisher’s, $p>0.05$).

Table 7: Speech rate of the repair stretch (repeated lexical items only) as a proportion of that of the reparandum: descriptive statistics and numbers of values in three ranges

		All (N=55)	Error (N=28)	Appropriateness (N=27)
Range		0.59–4.14	0.59–4.14	0.65–2.28
Mean (SD)		1.38 (0.65)	1.35 (0.78)	1.41 (0.51)
Reduction	(> 1.10)	33 (60%)	19 (68%)	14 (52%)
Equivalence	(0.90–1.10)	14 (25%)	5 (18%)	9 (33%)
Expansion	(< 0.90)	8 (15%)	4 (14%)	4 (15%)

In terms of articulation, 17 out of 55 instances have a lower proportion of realised canonical segments in the repair; 36 have the same proportion across repair and reparandum; and 2 instances have a higher proportion in the repair. Representative transcriptions are given in Table 8. Error and appropriateness repairs have a very similar mean difference between repair and reparandum (7.46 *vs* 7.48, $t(53)$=–0.004, p=0.99), and show no significant difference in terms of proportions of positive, negative and zero values (Fisher’s, $p>0.05$). In other words, like excluding editing terms, excluding repeated lexical material from measurement is likely to affect both subgroups of repair to a similar extent.

Table 8: Transcriptions of selected repeated lexical items

Repeated item(s)	Reparandum	Repair stretch
van de ‘of the’	fɑndə	fnə
ik heb het nu ‘I have it now’	ɪk̝ɛpəny	k̝əβ̝ən̝y
die ‘that’	di	dʲ
tot ‘until’	tɔt	t̝ɜt̝
voor ‘for’	fɔɾ	fɔɾ̝
gebeuren ‘happen’	χbœɾə	χbœɾə
daar is ‘there is’	dəs	dɐɾəz

3.4 Corrected lexical items only

Table 9 shows the results of a recalculation of proportional values excluding any editing terms and repeated lexical items that may occur in the repair stretch. In terms of the overall distribution of proportional values, a lowering effect of controlling for editing terms and repetition is only weakly observed. The range and mean are marginally lower than in the gross comparison reported above, and the proportion of values below 0.90 has increased by 4% only. The recalculation has little effect on the differentiation of error and appropriateness repairs, too. The expected lowering effect is observed more clearly in the error repairs, but the resulting difference in mean between the two subgroups (1.30 *vs* 1.40) is not statistically significant ($t(74)$=–0.86, p=0.39). In terms of the distribution of instances across the three ranges of values, it can be seen that the subgroup of appropriateness repairs has a higher proportion of instances in the ‘reduction’ range and a lower proportion in the ‘expansion’ range in comparison with the error repairs. While this difference is consistent with the idea that appropriateness repairs are more likely to undergo phonetic reduction than error repairs, it is not robust enough to reach statistical significance in the data under consideration (Fisher’s, p>0.05).

Table 9: Speech rate of the repair stretch (excluding any editing terms and repeated lexical items) as a proportion of that of the reparandum: descriptive statistics and numbers of values in three ranges

		All (N=76)	Error (N=41)	Appropriateness (N=35)
Range		0.56–2.97	0.56–2.82	0.70–2.97
Mean (SD)		1.37 (0.53)	1.30 (0.50)	1.40 (0.52)
Reduction	(> 1.10)	50 (66%)	25 (61%)	25 (71%)
Equivalence	(0.90–1.10)	15 (20%)	8 (20%)	7 (20%)
Expansion	(< 0.90)	11 (14%)	8 (20%)	3 (9%)

The effect of reparandum type on the proportional values is similar to that reported above (see Table 4). Again, while the effect of reparandum type is statistically significant (ANOVA, $F(2)$=4.08, p=0.02) due to a significant difference between repairs with pre-repair lengthening on the one hand and those with a neutral or cut-off reparandum on the other (Tukey, p<0.01), there is no significant interaction between repair type and reparandum type ($F(2)$=1.36, p=0.26). In other words, controlling for reparandum type does not result in the emergence of a difference between error and appropriateness repairs. Moreover, the correlation between proportional values and corresponding lexical frequency values is weak and does not reach significance (R^2=0.08, p=0.06) in the subset of instances involving straightforward lexical repair: that is, it is unlikely that the distribution of proportional values across instances is an effect of differences in lexical frequency between reparandum and repair items.

Finally, Table 10 shows the results of a comparison between repair stretch and reparandum in the proportion of realised canonical segments, excluding editing terms and repeated items. The main effects of the exclusion are an increase in the overall range of values and an increase in the proportion of instances with a repair and reparandum that are equal in terms of the realisation of canonical segments. In other words, considering just the new information contained in the repairs results in more extreme differentiation of repair stretch and reparandum, but only in a small minority of instances. Crucially, these instances appear to be evenly distributed across error and appropriateness repairs: again, there is no significant difference between error and appropriateness repairs in means ($t(74)$=–0.48, p=0.64) or in distribution across the three ranges of values (Fisher's, p>0.05).[8] Representative transcriptions are given in Table 11.

Table 10: Proportion of realised canonical segments for the repair stretch (excluding any editing terms and repeated lexical items) subtracted from the proportion for the reparandum: descriptive statistics and numbers of values in three ranges

		All (N=76)	Error (N=41)	Appropriateness (N=35)
Range		–50.00 – 67.00	–50.00 – 50.00	–30.00 – 67.00
Mean (SD)		6.74 (18.43)	5.80 (19.52)	7.83 (19.29)
Reduction	(> 0)	42 (55%)	21 (51%)	21 (60%)
Equivalence	(0)	16 (21%)	10 (24%)	6 (17%)
Expansion	(< 0)	18 (24%)	10 (24%)	8 (23%)

[8]Analyses of the influence of reparandum type and lexical frequency on segmental values are not reported here; as above, no significant effects were found.

Table 11: Transcriptions of old and new information in instances of repair discussed in this paper

	Reparandum	Repair
(2)	*gozer* ‘guy’	*kerel* ‘fellow’
Canonical form	xozər	kerəl
Observed form	χo̝sə̆	kɪɹ
(3)	*gaan* ‘go’	*gaat* ‘goes’
Canonical form	ɣan	ɣat
Observed form	xã	xa̠t
(4)	*opgeschaveld* ‘NONWORD’	*gestapeld* ‘stacked’
Canonical form	ɔpxəsxavəlt	xəstapəlt
Observed form	ɔpxəsxavəl̝t	xstap̝ɜt
(5)	*weet je* ‘you know’	*ik weet* ‘I know’
Canonical form	wet jə	ɪk wet
Observed form	ʋ̞eçə	ɪkʋ̞et

4 Discussion

This paper sets out to explore the influence of informational redundancy on temporal and articulatory reduction in the context of self-initiated self-repair in Dutch. Its starting point were three hypotheses: first, that self-repair is more likely, on the whole, to be associated with phonetic expansion than with phonetic reduction, given that its function is to introduce new information; second, that repair stretches are likely to show internal variation in degree of reduction, given that the new information introduced by a repair is often accompanied by editing terms and repeated lexical items, whose propositional value is minimal; and third, that the distinction between error and appropriateness repairs is relevant since error repairs are, on the face of it, more highly informative than appropriateness repairs.

The results of the study reported here challenge all three hypotheses. First, the majority pattern appears to be relative reduction across the repair stretch, not expansion. Second, while editing terms are certainly recurrently reduced relative to canonical realisations, repeated lexical items are not invariably more reduced in the repair than in the reparandum, and excluding editing terms and repeated lexical items from analysis has little effect on the comparison of temporal and segmental measures between the two repair components. Third, no statistically significant effect of repair type — error *vs* appropriateness — was attested. Additional findings are that pre-repair lengthening is a significant factor, while a comparison of lexical frequency between repair and reparandum items does little to explain their relative degrees of phonetic reduction.

Starting with the third main finding, the lack of differentiation between error and appropriateness repairs suggests that the two types of repair are treated similarly by interactants in the material under consideration in terms of their informativeness. Recall that the majority of both error and appropriateness repairs in the data set are lexical repairs. Recall also that Levelt and Cutler (1983), who report a significant difference between error and appropriateness repairs in the proportion of prosodically marked instances in the two subgroups, base their observations on a corpus of task-oriented dialogue. The difference between a lexical error and an infelicity is arguably more significant in the context of an instruction than it is in the context of an informing in free conversation: compare the significance of saying *left* instead of *right* in giving a direction with claiming one's brother is twenty-three rather than twenty-two in informal talk. Both would lead to an error repair, but the former would be more highly informative than the latter, in the sense that the success of the interactional task at hand depended on it. In the context of informal talk, pragmatic infelicity may in fact be more significant than factual or linguistic accuracy in terms of its contribution to the avoidance of interactional 'trouble'.

In other words, to fully understand the influence of informational redundancy on sound patterns in the context of self-repair, we would need to adopt a more context-sensitive analytic approach than that demonstrated in this paper. This should involve measures of the contextual predictability of reparandum and repair items; as shown in this paper, lexical frequency alone is not an explanatory factor (cf. Pluymaekers et al. 2005a). In fact, Levelt and Cutler report that the likelihood that an error repair is prosodically marked depends on the size of the semantic set from which the reparandum and repair items are selected: the smaller the set, the higher the contrastive value of the repair, and the higher the likelihood of prosodic marking. While the analysis of semantic set sizes is more straightforward in task-oriented dialogue with a highly constrained vocabulary than in free conversation, this approach constitutes a useful starting point for more context-sensitive investigation of self-repair in spontaneous speech.

With respect to the first main finding of this study, more context-sensitive investigation may confirm that contrary to our intuitions, many instances of self-repair in spontaneous conversation are informationally redundant and therefore predictably associated with local phonetic reduction. Still, it is worth considering an alternative account for the preponderance of phonetic reduction in self-initiated self-repair, which refers to a conflict between information-based and pragmatic constraints. A common observation in the conversation-analytic literature on self-repair (Schegloff 1979, Fox and Jasperson 1995, Jasperson 2002, Rieger 2003) is that in spontaneous conversation, speakers tend to do self-repair work without delay, while *other*-repair — in which listeners notice an error and invite the speaker to repair it — is frequently delayed, if not avoided altogether, as shown by Schegloff et al. (1977). Psycholinguistic studies confirm that speakers tend to initiate self-repair as soon as an error is detected (Levelt 1983, Blackmer and Mitton 1991, Nooteboom 2005).

Together, early onset and hypoarticulation throughout the repair stretch are consistent with an attempt by the speaker to enable a soonest possible resumption of post-repair talk (cf. Jasperson 2002: 278). An interpretation in terms of face-saving seems plausible: in self-repair, the speaker moves the discourse away from the error and its correction as quickly as possible, while in other-repair the listener gives the speaker as much opportunity as possible to do the same, by delaying the initiation of repair. Thus, speakers may be orienting to a pragmatically-motivated constraint which promotes hypoarticulation throughout the repair stretch — even if its level of informational redundancy would seem to promote local *hyper*articulation. Again, establishing the validity of this account requires highly context-sensitive analysis: not only in terms of the semantics of the repairs, but crucially in terms of their pragmatic and interactional import. If anything, the present study confirms that the interaction between information-based and pragmatically motivated constraints, discussed briefly by Lindblom (1990) and Rischel (1992) but not extensively explored in subsequent work, is a major area for further research — particularly in relation to phonetic reduction.

References

Aylett, M., Turk, A., 2006. Language redundancy predicts syllabic duration and the spectral characteristics of vocalic syllable nuclei. Journal of the Acoustical Society of America 119, 3048–3058.

Ball, M., 2001. On the status of diacritics. Journal of the International Phonetic Association 31, 259–264.

Bard, E. G., Anderson, A. H., Sotillo, C., Aylett, M., Doherty-Sneddon, G., Newlands, A., 2000. Controlling the intelligibility of referring expressions in dialogue. Journal of Memory and Language 42, 1–22.

Bell, A., Jurafsky, D., Fosler-Lussier, E., Girand, C., Gregory, M., Gildea, D., 2003. Effects of disfluencies, predictability, and utterance position on word form variation in English conversation. Journal of the Acoustical Society of America 113, 1001–1024.

Benkenstein, R., Simpson, A. P., 2003. Phonetic correlates of self-repair involving repetition in German spontaneous speech. In: Proceedings of DiSS'03. Gothenburg, pp. 81–84.

Binnenpoorte, D., Cucchiarini, C., Boves, L., Strik, H., 2005. Multiword expressions in spoken language: An exploratory study on pronunciation variation. Computer Speech and Language 19, 433–449.

Blackmer, E. R., Mitton, J. L., 1991. Theories of monitoring and the timing of repairs in spontaneous speech. Cognition 39, 173–194.

Brédart, 1991. Word interruption in self-repairing. Journal of Psycholinguistic Research 20, 123–137.

Bybee, J., 2001. Phonology and Language Use. Cambridge University Press, Cambridge.

Cucchiarini, C., 1996. Assessing transcription agreement: Methodological aspects. Clinical Linguistics and Phonetics 10, 151–155.

Cutler, A., 1983. Speakers' conceptions of the function of prosody. In: Cutler, A., Ladd, D. R. (Eds.), Prosody: Models and Measurements. Springer, Heidelberg, pp. 79–91.

Eefting, W. Z. F., Rietveld, A. C. M., 1989. Just noticeable differences of articulation rate at sentence level. Speech Communication 8, 355–361.

Ernestus, M., 2000. Voice Assimilation and Segment Reduction in Casual Dutch. LOT, Utrecht.

Fowler, C. A., 1988. Differential shortening of repeated content words produced in various communicative contexts. Language and Speech 31, 307–319.

Fox, B. A., Jasperson, R., 1995. A syntactic exploration of repair in English conversation. In: Davis, P. W. (Ed.), Alternative Linguistics: Descriptive and Theoretical Modes. John Benjamins, Amsterdam, pp. 77–134.

Fox Tree, J. E., Clark, H. H., 1997. Pronouncing 'the' as 'thee' to signal problems in speaking. Cognition 62, 151–167.

Heemskerk, J., Zonneveld, W., 2000. Uitspraakwoordenboek. Het Spectrum, Utrecht.

IPA, 1999. Handbook of the International Phonetic Association. Cambridge University Press, Cambridge.

Jasperson, R., 2002. Some linguistic aspects of closure cut-off. In: Ford, C. E., Fox, B. A., Thompson, S. A. (Eds.), The Language of Turn and Sequence. Oxford University Press, Oxford, pp. 257–286.

Johnson, K., 2004. Massive reduction in conversational American English. In: Proceedings of the Workshop on Spontaneous Speech: Data and Analysis. Tokyo, pp. 29–54.

Jurafsky, D., Bell, A., Gregory, M., Raymond, W. D., 2001. Probabilistic relations between words: Evidence from reduction in lexical production. In: Bybee, J., Hopper, P. (Eds.), Frequency and the Emergence of Linguistic Structure. John Benjamins, Amsterdam, pp. 229–254.

Keune, K., Ernestus, M., van Hout, R., Baayen, R. H., 2005. Variation in Dutch: From written MOGELIJK to spoken MOK. Corpus Linguistics and Linguistic Theory 1, 183–223.

Kohler, K. J., 1991. The phonetics/phonology issue in the study of articulatory reduction. Phonetica 48, 180–192.

Kohler, K. J., 2000. Investigating unscripted speech: Implications for phonetics and phonology. Phonetica 57, 85–94.

Kormos, J., 1999. Monitoring and self-repair in L2. Language Learning 49, 303–342.

Levelt, W. J. M., 1983. Monitoring and self-repair in speech. Cognition 14, 41–104.

Levelt, W. J. M., Cutler, A., 1983. Prosodic marking in speech repair. Journal of Semantics 2, 205–217.

Lindblom, B., 1990. Explaining phonetic variation: A sketch of the H&H theory. In: Hardcastle, W. J., Marchal, A. (Eds.), Speech Production and Speech Modelling. Kluwer Academic, Dordrecht, pp. 403–439.

Nooteboom, S. G., 2005. Lexical bias revisited: Detecting, rejecting and repairing speech errors in inner speech. Speech Communication 47, 43–58.

Oostdijk, N., Broeder, D., 2003. The Spoken Dutch Corpus and its exploitation environment. In: Proceedings of 4th International Workshop on Linguistically Interpreted Corpora (LINC-03). Budapest, pp. 93–100.

Plug, L., 2005. From words to actions: The phonetics of *eigenlijk* in two pragmatic contexts. Phonetica 62, 131–145.

Pluymaekers, M., Ernestus, M., Baayen, R. H., 2005a. Articulatory planning is continuous and sensitive to informational redundancy. Phonetica 62, 146–159.

Pluymaekers, M., Ernestus, M., Baayen, R. H., 2005b. Lexical frequency and acoustic reduction in spoken Dutch. Journal of the Acoustical Society of America 18, 2561–2569.

Postma, A., Kolk, H., 1993. The covert repair hypothesis: Prearticulatory repair processes in normal and stuttered disfluencies. Journal of Speech and Hearing Research 36, 472–487.

Quené, H., 2007. On the just noticeable difference for tempo in speech. Journal of Phonetics 35, 353–362.

Rieger, C. L., 2003. Repetitions as self-repair strategies in English and German conversations. Journal of Pragmatics 35, 47–69.

Rietveld, A. C. M., van Heuven, V. J., 1997. Algemene Fonetiek. Coutinho, Bussum.

Rischel, J., 1992. Formal linguistics and real speech. Speech Communication 11, 379–392.

Schegloff, E. A., 1979. The relevance of repair to syntax-for-conversation. Syntax and Semantics 12, 261–286.

Schegloff, E. A., Jefferson, G., Sacks, H., 1977. The preference for self-correction in the organization of repair in conversation. Language 53, 361–382.

Schüppler, B., Ernestus, M., Scharenborg, O., Boves, L., 2008. Preparing a corpus of Dutch spontaneous dialogues for automatic phonetic analysis. In: Proceedings of Interspeech 2008. Brisbane, pp. 1638–1641.

Schuurman, I., Schouppe, M., Hoekstra, H., van der Wouden, T., 2003. CGN, an annotated corpus of spoken Dutch. In: Proceedings of 4th International Workshop on Linguistically Interpreted Corpora (LINC-03). Budapest, pp. 101–108.

Shattuck-Hufnagel, S., Cutler, A., 1999. The prosody of speech error corrections revisited. In: Proceedings of the Fourteenth International Congress of Phonetic Sciences (ICPhS 1999). Vol. 3. San Francisco, pp. 1483–1486.

Shriberg, E., 2001. To ‘errr’ is human: Ecology and acoustics of speech disfluencies. Journal of the International Phonetic Association 31, 153–169.