Phonetic reduction and categorisation in exemplar-based representation

Observations on a Dutch discourse marker

Leendert Plug

This paper explores the division of labour between the lexicon and phonetic implementation in exemplar-based phonological representation on the basis of a case study of reduction patterns associated with the Dutch discourse marker *eigenlijk*. A partial lexical representation of *eigenlijk* is proposed, in which reference is made to pragmatic and syntactic categories. The analysis is evaluated in comparison with previous accounts of similar reduction patterns.

1. *Introduction*

The notion that performance factors play a role in shaping phonological representations has long been controversial. In speech perception models based on traditional generative phonology (Chomsky & Halle 1968), establishing phonological forms from phonetic input is assumed to involve a great deal of filtering, leaving only non-redundant linguistic information to be stored in the lexicon (Halle 1997). Resistance to this position has recently gained impetus through the development in the field of psychology of an approach to lexical representation that explicitly rejects the traditional dichotomy between linguistic and extra-linguistic information in the speech signal. In this approach, commonly known as 'exemplar-based' (see the papers in Johnson & Mullennix 1997, as well as Bybee 2001 and Pierrehumbert 2001a; 2002; 2003), the memory encodes specific episodes of speech with a minimal amount of filtering. These episodes are segmented and the segments categorised — with reference to linguistic and extra-linguistic information — according to their phonetic similarity to existing lexical items. Rather than a list matching morphological units to single phonological forms, an exemplar-based lexicon is a 'multi-entry' network of category labels, each associated with a set of remembered tokens of the category; these remembered tokens are the 'exemplars' that give the approach its name.

The idea that the lexicon is composed not of minimally redundant, abstract representations, but of concrete memory traces of stretches of speech allows straightforward accounts of experimental findings that are difficult to explain under abstractionist assumptions, including the impact of extra-linguistic knowledge on performance in linguistic tasks (see Lachs et al. 2002 for

Proceedings of ConSOLE XIII, 2005, 287-311
http://www.sole.leidenuniv.nl

an overview) and frequency effects on well-formedness judgements (Coleman & Pierrehumbert 1997, Frisch et al. 2000, Hay et al. 2003). In addition, it has major implications for the phonological treatment of phonetic variation. Under an exemplar-based view, variation is an integral part of lexical representation, rather than something that is generated in production and abstracted away from in perception. As such, an exemplar-based approach 'dispenses with the non-invariance "problem" at a stroke' (Docherty & Foulkes 2000:119).

1.1. Phonetic reduction

Still, even though non-invariance is considered unproblematic in this approach, the underlying question remains of what the relationship between stored and produced forms is. This question is particularly pertinent in the phonological treatment of phonetic reduction patterns. In much of the literature, reduction is considered to be primarily physiologically driven; it results from a general tendency of speakers to minimise articulatory effort, and occurs when speakers are under relatively few constraints to articulate clearly (Lindblom 1990, Kohler 1991). A recent example of this approach, in the framework of Optimality Theory, is Kirchner (2001): through the introduction of a family of effort-minimising constraints into the grammar, Kirchner allows any apparent instance of reduction to be explained in physiological terms. Some researchers, however, have questioned the explanatory adequacy of this approach. In particular, Simpson (2001) describes a recurrent phonetic pattern involving several apparent instances of segmental reduction associated with a particular grammatical structure in English. He argues that an account in terms of effort minimisation misses the point that through its distribution, the pattern carries grammatical information. In his own account, the phonetic pattern is phonologically represented as a template associated with the grammatical category.

The question here is what constitutes an input form in speech processing. If it is assumed that the input form of a stretch of speech is its citation form, as in most of the literature on reduction, any observed form that deviates from the citation form can be accounted for in terms of physiological constraints. If, on the other hand, it is assumed that apparently reduced forms are possible inputs in speech processing, because the contextual distribution of phonetic patterns forms the basis of their underlying representation, physiological tendencies such as effort minimisation play a much less prominent role in accounting for the patterns.

In an exemplar-based approach, any stored form can in principle be an input form in processing; citation forms have no *a priori* phonological status. Moreover, through their labels, exemplar sets are related directly to information at multiple levels of structure; for example, 'a recollection of the phrase *Supper's ready!* could be labelled "Mom" and "female speech", in addition to exemplifying the words and phonemes in the phrase' (Pierrehumbert 2001a:140). These characteristics would suggest a great potential for developing representations of the type that Simpson (2001) describes. At the same time, however, an exemplar-based model of speech processing must contain a phonetic implementation procedure for mapping perceptual exemplars onto motor commands in production. In this procedure, physiological tendencies such as effort minimisation may well play a role. So far, proponents of exemplar-based representation have discussed reduction patterns in terms of this phonetic implementation procedure; Bybee (2001) treats reduction patterns as 'automation' effects of repeated production, and

Pierrehumbert (2001a:147) models diachronic lenition processes using a 'systematic production bias', by which stored exemplars are produced slightly reduced, resulting in shifts over time towards exemplar sets in which more reduced are increasingly frequent. As such, the potential of exemplar-based models for representing (synchronic) patterns of variation in terms of lexical categorisation, and the general issue of the division of labour between lexical representation and phonetic implementation in an exemplar-based approach remain largely unexplored. This issue is the general topic of this paper.

1.2. Word form variation and categorisation

In her exemplar-based account of lenition processes, Pierrehumbert (2001a:145) states that 'we will not attempt to model the deeper causes which may figure in the choice amongst possible exemplars'. This paper discusses some of these 'deeper causes'; in particular, those which may figure in the choice amongst possible exemplars of a single word-level category.

It is well-known that some words are associated with multiple phonetic forms that occur in distinct contexts; these are sometimes called strong and weak forms. Some previous work on strong and weak forms seems amenable to interpretation in terms of subcategorised exemplar sets in a multi-entry lexicon. For example, Ogden (1999) proposes an analysis of strong and weak auxiliaries in English in the framework of Declarative Phonology. Instead of deriving various forms from a single representation, such as [hav], [həv], [əv] and [v] from /hav/, Ogden treats the forms as exponents of distinct subtypes of the type V[AUX]. His account is similar to that of Kaisse (1985), who analyses strong and weak forms of auxiliaries as separate lexical items; however, Ogden's declarative formalism allows him to index the close relation between the various forms of the verb through shared structure, so that their commonalities are reflected in their representations. This is broadly compatible with an exemplar-based account in which exemplars of the grammatical category HAVE are organised into labelled subsets on the basis of differences in distribution, as represented informally in Figure 1.

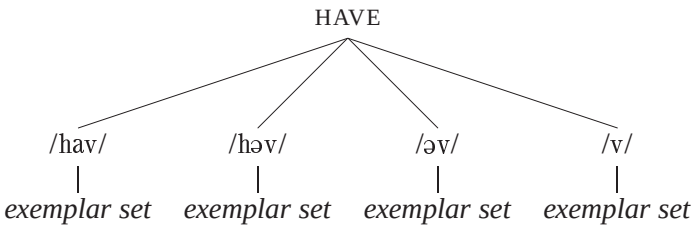


Figure 1: Strong and weak forms of *have*, following Ogden (1999)

Among the factors that determine the distribution of strong and weak forms are syntactic and pragmatic factors. For example, it has long been noted that English *that* is associated with different ranges of variation depending on its syntactic status as a pronoun (as in *That's nice*) or complementiser (as in *I know that I'm right*) (e.g. Berkenfield 2001; see Jurafsky et al. 2002 for similar examples). Moreover, Local (2003:326–328) observes that when *I think* is used as an interactional 'hedge', as in *they should be here by the time you come out next weekend I think*, it is often phonetically reduced to an extent that is not commonly observed when it has what Local

calls 'lexical meaning', as in *I think that's interesting* (cf. Scheibman 2000 on *I don't know*). On the basis of these findings, Local (2003:326) suggests that 'Such phonetic discriminability of forms prompts the questions of whether "form" and "function" may be rather more closely linked than is usually thought, and of the uses that may be made of this link by the perceptual system'.

This paper suggests how we might begin to address these questions in an exemplar-based approach to phonological representation, on the basis of a case study of a complex pattern of phonetic variation, involving various degrees of reduction, associated with the Dutch discourse marker *eigenlijk*, in which both syntactic and pragmatic factors play a role. The case study is presented in Section 2. Section 3 sketches an account of the empirical observations in the representational framework developed by Bybee (2001) and Pierrehumbert (2001a; 2002; 2003), and Section 4 evaluates the account in comparison with previous work on similar reduction patterns.

2. *Observations on eigenlijk*

This section presents results of an investigation into the distribution of phonetic forms associated with the Dutch discourse marker *eigenlijk*, variously glossed as 'actually', 'in fact' and 'now that I'm thinking about it' (Ernestus 2000, Kemps et al. 2004, Mazeland 2004). The observations presented here are based on a selection from a corpus of 'casual' Dutch designed and recorded by Mirjam Ernestus between 1995 and 1996 (Ernestus 2000). The corpus contains speech by ten pairs of male speakers of Standard Dutch, mostly pairs of friends or colleagues, involved in several tasks. Recordings were made in a professional recording studio. The selected material comprises informal interviews which Ernestus undertook with each of the pairs, and one-to-one conversations between the two members of each pair on a range of topics — some suggested by Ernestus, others offered spontaneously. This data set amounts to approximately 10 hours of speech and contains 269 tokens of *eigenlijk*.

As pointed out by Ernestus (2000:140–141), *eigenlijk* is associated with considerable variation in phonetic form, both between speakers and within the speech of individuals. She presents the list of variants in (1), based on observations on over 400 tokens in a corpus including the data set used in the present study.

(1) [ˈʔɛixələk], [ˈʔɛixlək], [ˈʔɛixlk], [ˈʔɛixək], [ˈʔɛixk], [ˈʔɛik]

These transcriptions are evidently rather broad, but they accurately reflect that the range of variation with which *eigenlijk* is associated encompasses phonetically trisyllabic forms of the broad shape [ˈʔɛixələk], disyllabic forms of the shapes [ˈʔɛixlək], [ˈʔɛixlk] and [ˈʔɛixək], and monosyllabic forms of the shapes [ˈʔɛixk] and [ˈʔɛik]. The more detailed transcriptions in Table 1, made by myself on the basis of repeated listening and concurrent inspection of waveforms and spectrograms, show that the variation is not due only to preferences of individual speakers for a particular phonetic shape: these speakers use forms at either ends of Ernestus' 'reduction continuum'.[1]

The design of the Ernestus corpus controls for a number of factors that may be expected to have an impact on the variation: in particular gender (all speakers are male), age (most are in

[1]This is not to say that such preferences are not observed; see Section 4.

C	J	N	T
[ʔææxəɫɣɡ]	[ɛɛxəɫək]	[ɛxlɣk]	[æɛɛxɣlɣk]
[aɯɫ]	[ɛɜkʷ]	[aɣk]	[aɣx]

Table 1: Some attested forms of *eigenlijk* for speakers C, J, N and T

their thirties or forties), and social and regional background (all are highly educated and speak a variety of Dutch without strong regional characteristics). In the remainder of this section I will show that other factors can be distinguished; in particular, some of the phonetic variation associated with *eigenlijk* can be accounted for with reference to its pragmatic function and syntactic placement, and to general phonetic features of the utterances it occurs in. I focus on three particular pragmatic contexts in which *eigenlijk* is routinely used. These are described in the next subsection.

2.1. Three pragmatic contexts

From a semantic perspective, most tokens of *eigenlijk* in the data set mark some kind of contrast; in this respect, it is indeed similar to English *actually*, which often carries 'counterfactual' meaning (Clift 2001). [2] From a pragmatic perspective, we can distinguish a number of more specific contexts, or sequence types, in which speakers routinely use *eigenlijk*. I describe three here,[3] using the analytic terminology of Conversation Analysis (Sacks 1992, Drew 2004): sequences in which a contradiction or paradox is described (2.1.1), sequences in which an extended turn is closed prematurely or a multi-turn project abandoned (2.1.2), and sequences in which an elicitation is followed by a dispreferred response (2.1.3).

2.1.1. Describing a contradiction or paradox

An example of the first sequence type is given in (2), taken from Ernestus' interview data. Prior to this fragment, T has been asked where he has lived after secondary school. In this fragment he explains why this is a difficult question for him to answer.

(2) Ernestus/Interview/S–T/14

```
1T:  (dus) ik ben eh gaan  varen, .hh toen was ik
     so    I  am  er to-go sailing    then was I
     So I went er, sailing. At that time I was
2    al      vrij  veel van  huis af   dus eh wja  toen .hh
     already quite much from home away so  er well then
     already away from home quite a lot so er, well, at the time—
```

[2] *Eigenlijk* also occurs in a number of contexts in which neither *actually* nor *in fact* would seem appropriate, as the gloss 'now that I think about it' (Ernestus 2000:141) would suggest. These are not further discussed here; in the examples below, 'actually' will do as a gloss.

[3] In other words, the account offered below is *partial*, covering about 25% of the tokens of *eigenlijk* in the data set.

```
3   officieel  was ik ingeschreven in eh- in vinkenveen:
    officially was I  registered   in er  in Vinkenveen
    officially I was registered in er, in Vinkeveen
4   m:aar: ik woonde eigenlijk overal
    but    I  lived            everywhere
    but I actually lived all over the place
```

T's response to the inquiry about his whereabouts after secondary school is less than straightforward because as a shipper he was permanently travelling, despite being a registered resident in Vinkeveen. The contrast between his official and actual residence is made explicit in two turn construction units (TCUs, see Ford & Thompson 1996, Schegloff 1996) linked by *m:aar:*, with *eigenlijk* in the second TCU. The second TCU, *ik woonde eigenlijk overal*, functions as a refinement of the first; *officieel was ik ingeschreven in eh- in vinkenveen:* alone may occasion the incorrect inference that T lived in Vinkeveen. Notice, however, that the second TCU does not negate the first; both TCUs are presented as conveying accurate information, although the two pieces of information can be treated as paradoxical.

The data set contains 31 clear instances of this sequence type. In many of these, *eigenlijk* occurs in a TCU linked to a preceding or following TCU by *maar* 'but' or *terwijl* 'while', although examples with different structures are also found. One is partially represented in (3). L reports an assessment of a new local express tram.

(3) Ernestus/Interview/K–L/65

```
1L: die  die  sneltram     in buitenveldert waarvan  dan
    that that express-tram in Buitenveldert of-which then
    that, that express tram in Buitenveldert of which people
2   gezegd wordt van  ja .hhh 't  is eigenlijk een trei:n
    said   is    like well     it is           a   train
    say well, it's actually a train
```

The contrast here is between the vehicle's official status — a type of tram — and its perceived status in terms of size, speed etc. — more like a train. Note that this *could* be rendered as a construction with 'but' or 'while': e.g. 'It's called a tram, but it's actually a train'.

2.1.2. Closing an extended turn or abandoning a multi-turn activity

An example of the second sequence type is given in (4). Prior to this fragment, K has claimed that *bijna iedereen* 'almost everyone' of his work colleagues plays a musical instrument.

(4) Ernestus/Roleplay/K–L/316

```
1K: eh:: (0.3) .hh ((name)) speelt piano
    er                      plays  piano
    Er, ((name)) plays the piano,
    .
    ((Several lines omitted, in which K mentions other colleagues and
    the musical instruments they play))
    .
```

```
2   ((name)) (eh be)speelt eh: cello,
                 er plays     er  cello
    ((name)) er plays er cello,
3   en  voor de  rest weet ik het eigenlijk niet maar
    and for  the rest know I  it           not  but
    and for the rest I don't know actually, but,
4   .hh d'r   zitten aardig wat  muzikale mensen
        there sit    quite  some musical  people
    there are quite a few musical people there.
```

In line 1 K initiates a list of colleagues and their musical skills. He closes the list in line 3, with the claim that of the colleagues that he has not mentioned, he does not know if they are musical or not. This closing seems premature: firstly, the final-rise pitch contour associated with line 2 projects a further list item (see Caspers 1998; 2003); and secondly, in line 4, K downgrades his earlier claim that 'almost everyone' plays an instrument to the claim he has 'quite a few' musical colleagues. This revision can be related to an incongruence between the strength of K's initial claim and the small size of the list he has managed to come up with (cf. Drew 2003 on exaggeration in interaction). In a similar example, speaker A is asked to list TV programs he regularly watches. After three items he projects a fourth with *en: eh::* 'and er', only to close the list with a TCU containing *eigenlijk*:

(5) Ernestus/Interview/A–B/25

```
1A:  .mmm ja  eigenlijk is dat  het wel zo'n   beetje
          well          is that it  DM  such-a bit
     and er, well, that's pretty much it actually
```

In several others, the TCU with *eigenlijk* abandons an activity pursued over multiple turns. For example, in the case of (6), H is being teased by his co-participants. He has repeatedly started up turns with *nee*, projecting disagreement (cf. Drew 1987 on 'po-faced' receipts of teases), but his turns have been interrupted by further teasing.

(6) Ernestus/Interview/D–H/46

```
1H:  nee (.) dat  eh: (2.3) nee eh: (d-) ehhh[ehe
     no      that er        no  er
     No, that er, no er, ((starts laughing))
2D:                                          [((chuckling))
3H:  laat ook eigenlijk maar zitten
     let  DM           DM   sit
     Actually, forget it.
```

Here H again projects disagreement with *nee* (line 1), but, at incoming laughter by D, abandons the activity of challenging the teases with a TCU containing *eigenlijk* (line 3). In doing so, H displays a reversal of his stance towards the teasing; while the sequence-so-far has suggested that H strongly disagrees with the teasing, the TCU with *eigenlijk* marks the issue as not worth pursuing.

The data set contains 15 clear instances of this sequence type. These are different from those described in Section 2.1.1 in interactional terms. In the examples in Section 2.1.1, *eigenlijk* is associated with the description of two states of affairs that are in some way contradictory

or paradoxical. In interactional terms, the TCU with *eigenlijk* pre-empts possible problems of interpretation. As indicated above, this is achieved through a refinement rather than a correction of aspects of the surrounding talk. In examples such as (4) to (6), on the other hand, the TCU with *eigenlijk* marks an aspect of the same speaker's prior talk — a claim, a projection of further talk of a particular kind, a stance towards an activity — as inaccurate or unmotivated. As such, this second sequence type can be seen as an instantiation of the general practice of (self-initiated) self-repair (Schegloff et al. 1977, Schegloff 1997).

2.1.3. Dispreferred response

An example of the third sequence type is given in (7).

(7) Ernestus/One-to-one/C–E/150

```
1 E:  heb  je  verder  nog   wat       gedaan van de  week
      have you further still something done   of  the week
      Have you done anything else this week?
2     (0.5)
3 C:  eh:m d- j:::a wat  heb  ik gedaan (0.5) wat  heb  ik gedaan
      erm     well  what have I  done         what have I  done
      Erm, well, what have I done, what have I done?
4     (0.8) nou  niet veel ei[genlijk
            well not  much
      Well, not much actually
5 E:                        [nee:?
                             no
      No?
6 C:  nee de  dagelijkse routine: afgedraaid
      no  the daily      routine  taken-care-of
      No, taken care of the daily routine.
```

E's inquiry in line 1 serves as an invitation for C to offer a topic for further discussion. C's response is treatable as inadequate in that *niet veel* (line 4) does not offer an obvious candidate topic — and by rephrasing *niet veel* to *de dagelijkse routine afgedraaid* (line 6) C only reinforces the non-newsworthiness of his alleged activities. His response is indeed treated as inadequate by E, who following this fragment launches a new topic (data not shown).

C displays an orientation to the fact that his turn is treatable as an inadequate response in the design of the turn: it contains several features of a dispreferred turn type (see Pomerantz 1984, Schegloff 1988).[4] Most notably, C's response is delayed, it contains a variant of 'er' and a cut-off (*eh:m d-* in line 3), and the TCU with *eigenlijk* is prefaced by *nou* 'well' (see Mazeland 2004). This is a recurrent pattern, as can be seen in (8) and (9). In (8), P's claim of lack of knowledge in line 3, which denies the grounds on which to offer a fitted 'yes' or 'no' response to O's inquiry in line 1, follows a considerable pause. In (9), J's claim of a lack of strong opinion in line 3, which again denies the grounds on which to offer the type of response that the co-participant's

[4]Notice that 'dispreferred' is a structural notion, not a psychological one. That is, it refers to a set of turn design features, rather than the participants' presumed stance towards what is conveyed in the turns. See in particular Schegloff (1988) for discussion of this point.

turn is designed to elicit — in this case an agreement or a disagreement — contains long pauses and a cut-off (*i-*, line 3), and starts with *nou ja* 'well'.

(8) Ernestus/One-to-one/O–P/1119

```
1O:  en  daar  zit  nu  ook  de  hele  familie weer  bij? of niet
     and there sits now also the whole family  again with or not
     and again the whole family is with him, or not?
2    (0.5)
3P:  weet ik niet eigenlijk
     know I  not
     I don't know actually.
```

(9) Ernestus/One-to-one/J–R/07

```
1R:  afijn  ik: merk   dat  jij het helemaal
     anyway I   notice that you it  completely
     Anyway, I notice that you're entirely
2    met  mij eens   ben, hh[aha
     with me  agreed are
     in agreement with me ((laughs))
3J:                         [n:ou ja ik (1.0) i- (.) ik heb
                             well    I               I  have
     Well, I—I don't have
4    er    niet zo'n    uitgesproken mening  over eigenlijk
     there not  such-an outspoken    opinion about
     a very outspoken opinion on this actually.
```

The data set contains 16 clear instances of this sequence type. These are interactionally different from those described in Sections 2.1.1 and 2.1.2 in that here, in providing a response to an elicitation that is treatable as inadequatethe TCU with *eigenlijk* runs counter to assumptions underlying — and thus inferrable from — the *co-participant's* prior turn.

2.2. Syntactic placement

Before we return to the phonetics of *eigenlijk*, an observation can be made on its syntactic placement in the sequence types described in Section 2.1. Like *actually* in English, *eigenlijk* can be placed in various positions in the clause. It has been shown that in the case of *actually*, 'Syntactic alternatives ... are found to be selected by reference to interactional exigencies' (Clift 2001:245); that is, it recurrently occurs in similar positions in similar pragmatic contexts. The details of the patterns do not concern us here, but the present investigation suggests that the placement of *eigenlijk*, too, is related to the sequence type it occurs in. With respect to the sequence types discussed above, the patterns are as follows.

In sequences describing a contradiction or paradox, described in Section 2.1.1, *eigenlijk* overwhelmingly occurs in clause-medial position. In the case of (2), an alternative structure of the clause with *eigenlijk* would be *maar eigenlijk woonde ik overal*, with *eigenlijk* directly following the conjunction *maar*, or *maar ik woonde overal eigenlijk* with *eigenlijk* in final position. All of these structures are strictly speaking grammatical, but those with *eigenlijk* in final

position are not attested in the 31 examples of this sequence type. Similarly, in sequences of the type described in Section 2.1.2 *eigenlijk* mainly occurs in clause-medial position. In the 16 fragments of this type in the data set, no clause- or turn-final tokens of *eigenlijk* are found.

In the dispreferred-response sequences described in Section 2.1.3, on the other hand, *eigenlijk* recurrently appears in clause-final position: recall *nou niet veel eigenlijk* in (7), *weet ik niet eigenlijk* in (8) and *ik heb er niet zo'n uitgesproken mening over eigenlijk* in (9): all are clause-final (and turn-final), and in all three cases at least one alternative placement of *eigenlijk* would result in a grammatical structure: e.g. *nou eigenlijk niet veel*, *weet ik eigenlijk niet* and *ik heb er eigenlijk niet zo'n uitgesproken mening over*. In fact, Mazeland (2003:111–112) suggests that in the context of a dispreferred response, *eigenlijk* "typically" occurs in final position in the turn or TCU — and thus, in most cases, in the clause (cf. Ford & Thompson 1996). The present data set does not confirm this: five clause-final tokens of *eigenlijk* are found in 16 fragments. Still, the fact that clause-final tokens of *eigenlijk* only occur in one of the three contexts described here does confirm that the syntactic placement of *eigenlijk* is to some extent constrained by the pragmatic context it is employed in.

2.3. The distribution of phonetic variants

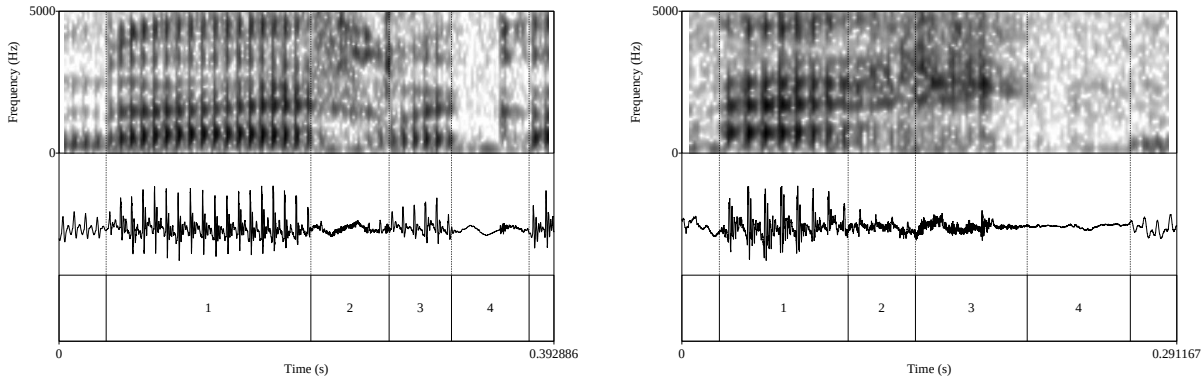
Having established that *eigenlijk* is used in interactionally distinct pragmatic contexts and that in these contexts it occurs in different ranges of syntactic positions, we now return to the phonetics of *eigenlijk*. The six broad phonetic shapes of *eigenlijk* transcribed by Ernestus (2000:140–141) are repeated in (10).

(10) [ˈʔɛixələk], [ˈʔɛixlək], [ˈʔɛixlk], [ˈʔɛixək], [ˈʔɛixk], [ˈʔɛik]

With respect to the distribution of variants of these broad shapes across the three pragmatic contexts described in Section 2.1, the following patterns can be noted. In the 31 sequences describing a contradiction or paradox, a wide range of forms of *eigenlijk* are observed; to be more precise, forms of all of the shapes in (10) except the broad shape [ˈʔɛixələk], with three delimitable vowel portions. Figure 2 presents segmented spectrograms and waveforms of two tokens of *eigenlijk* in this context; one of the broad shape [ˈʔɛixlk], attested in (2), and one of the broad shape [ˈʔɛixk], attested in another sequence of this type in the data set.

In the 15 sequences in which the TCU with *eigenlijk* marks the closure of an extended turn or the abandonment of a project pursued over multiple prior turns, the range of variation in the overall shape of *eigenlijk* is very different: 14 out of the 15 forms are of the broad shapes [ˈʔɛixk] or [ˈʔɛik]; the remaining one has the broad shape [ˈʔɛixək]. In other words, this context appears to 'favour' relatively reduced forms of *eigenlijk*. Figure 3 presents segmented spectrograms and waveforms of two tokens of *eigenlijk* in this context: one of the broad shape [ˈʔɛik], attested in (4), and one of the broad shape [ˈʔɛixk], attested in (5).

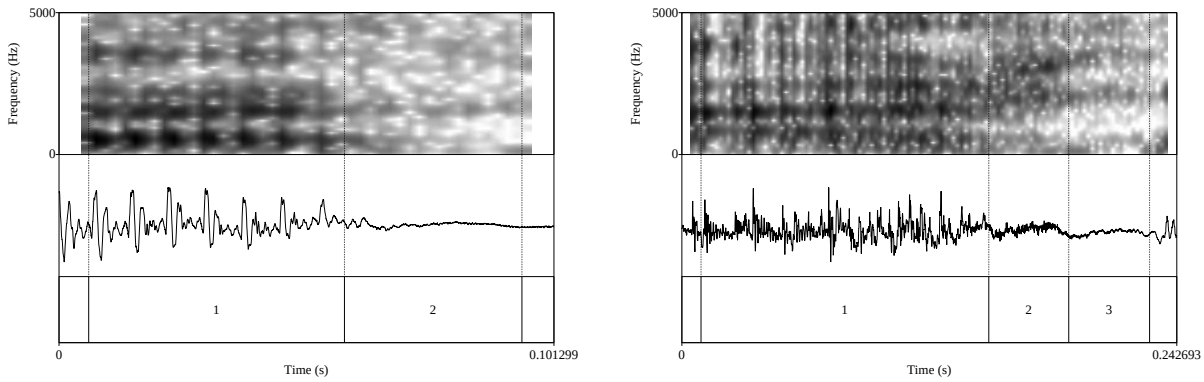
In the 16 dispreferred-response sequences the range of variation is different still. In this context, the majority of forms (12 out of 16) has at least two vowel portions and a lateral portion, and five 'canonical' forms, which are not attested in the other two contexts, are attested here. That is, most of the forms in this context are of the shapes [ˈʔɛixələk], [ˈʔɛixlək] and [ˈʔɛixlk]. Figure 4 presents segmented spectrograms and waveforms of two tokens of *eigenlijk*



(a) [ʔæɛ̞x̞l̪k̟]: 1 vowel, 2 dorsal frication, 3 lateral/vowel, 4 dorsal plosion

(b) [ʔæʁχkˀ]: 1 vowel, 2 voiced dorsal frication, 3 voiceless dorsal frication, 4 dorsal closure

Figure 2: Segmented spectrograms and waveforms of two tokens of *eigenlijk* in a turn describing a contradiction or paradox; that in (2) above on the left



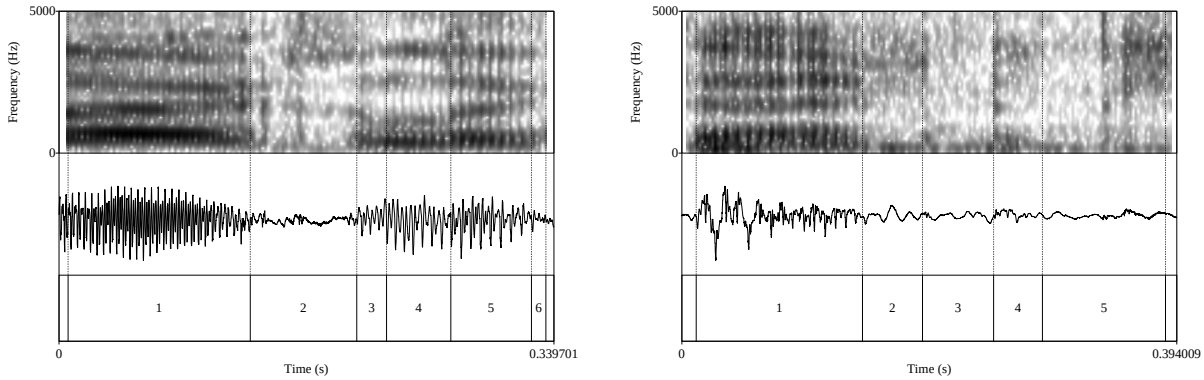
(a) [ɛ̞kˀ]: 1 vowel, 2 dorsal closure

(b) [ɑ̃æxx̞]; 1 vowel, 2 dorsal frication, 3 dorsal near-closure

Figure 3: Segmented spectrograms and waveforms of two tokens of *eigenlijk* in a TCU closing an extended turn or abandoning a multi-turn activity: that in (4) above (left), and that in (5) above (right)

in this context: one of the broad shape [ˈʔɛixələk], attested in (7), and one of the broad shape [ˈʔɛixlək], attested in (8).

Recall that in dispreferred-response sequences, the syntactic placement of *eigenlijk* is more variable than in the other two sequence types described here, with *eigenlijk* occurring in clause- and turn-final as well as initial and medial positions. Interestingly, of the five ‘canonical’ forms attested in this context, four are clause- and turn-final. Moreover, the remaining turn-final form in this context is P’s [ɛ̃ɛ̞χlək], which, if not exactly ‘canonical’ in shape, is not far removed from it either. These observations suggest that the syntactic placement of *eigenlijk*, especially in terms of its position in the turn, constrains its phonetic form, with turn-final tokens display-



(a) [æɛχələk]: 1 vowel, 2 dorsal frication, 3 vowel, 4 lateral, 5 vowel, 6 dorsal closure

(b) [ɛ̰ɛ̰χ̞lək]: 1 vowel, 2 dorsal frication, 3 lateral, 4 vowel, 5 dorsal plosion

Figure 4: Segmented spectrograms and waveforms of two tokens of *eigenlijk* in a TCU closing an extended turn or abandoning a multi-turn activity: that in (7) above (left), and that in (8) above (right)

ing a narrower range of variation than turn-medial ones. A consideration of the entire data set confirms this: in turn-final position, only forms of the broad shapes [ˈʔɛixələk], [ˈʔɛixlək] and [ˈʔɛixlk] are attested — that is, only trisyllabic and disyllabic forms with a lateral portion.[5] The pattern observed here, then, involves an interaction between pragmatic context, syntactic structure and phonetic form: certain pragmatic contexts favour certain syntactic structures, which are associated with particular ranges of phonetic variation.

2.4. Wider phonetic patterns

The patterns in the phonetic variation of *eigenlijk* outlined in Section 2.3 are significant in their own right, but a more detailed consideration of the sequence types in which *eigenlijk* occurs suggests that they are part of wider phonetic patterns. In sequences describing a contradiction or paradox, the TCUs with *eigenlijk* do not appear to have recurrent phonetic characteristics. The 15 TCUs with *eigenlijk* which mark the closure of an extended turn or the abandonment of an activity pursued over multiple prior turns, however, are noticeably similar: all are fast relative to the prior TCUs, and most contain examples of ‘reduction’ phenomena throughout. By contrast, most of the dispreferred responses with *eigenlijk* are relatively slow and contain more ‘canonical’ phonetic forms throughout.

As an illustration of this difference, consider the transcriptions in (11) and (12), which correspond to examples (4) to (6) and (7) to (9), respectively.

[5]Ernestus’ (2000: 143) observation that ‘the subjects generally realize the suffix /lək/ as [k] only in the middle of Intonational Phrases’ may be along the same lines. A consideration of the mapping between turn and Intonation Phrase is beyond the scope of this paper, but the present investigation suggests that the distinction *final* vs. *non-final* is more significant than *medial* vs. *non-medial*: in turn-initial (and thus IP-initial) position, forms such as [aɣk] are attested.

(11) a. `en voor de rest weet ik het eigenlijk niet maar`
[ə̃fɔɾəːsˈf̝ɛ̝kdːɛ̞k˺nit˺ma̝ɚ]

b. `ja eigenlijk is dat het wel zo’n beetje`
[ja̰æxx̝ˈɪsɑdz̝ʋɛl̞sə̃mbe̞e̝ɕ]

c. `laat ook eigenlijk maar zitten`
[la̠tɵgɛ̰ḛ̞k˺mɐ̰ˈsɪ̰tʰ]

(12) a. `nou niet veel eigenlijk`
[na̠ɵnitˈfe̞eɫæɛχələk]

b. `weet ik niet eigenlijk`
[ˈʋee̝tɪk˺nitɛ̰ɛ̝χlək]

c. `ik heb er niet zo’n uitgesproken mening over eigenlijk`
[ʔɪkɛpən̠ʏtsʊnœ̠ɵtχˈspɾokəme̠n̞ɪŋo̞vɽɛ̰̞ɛxələk]

The stretches in (11), all of which are TCUs which mark the closure of an extended turn or the abandonment of an activity pursued over multiple prior turns, are characterised by various reduction phenomena. For example, in (11a), a segmented spectrogram and waveform of which is given in Figure 5, *voor de rest* is not associated with three syllables, but with two: [fɔɾəːs]; moreover, *rest* does not end in alveolar closure. Similarly, *weet ik* is associated with a monosyllabic form: [f̝ɛ̝k]; and the final alveolar closure in *niet* is unreleased due to the early onset of bilabial closure. In (11b), *dat* is not associated with initial plosion, the lateral gesture for *wel* is noticeably open, and *beetje* lacks a second vowel portion. In (11c), the transition from *ook* to *eigenlijk* is fully voiced, and *zitten* lacks a second vowel portion. The mean articulation rate across these stretches is 10.2 sylls/sec, as shown in Table 2, and in each case the stretch is noticeably fast with respect to prior TCUs: as seen in (4) to (6), each of the TCUs with *eigenlijk* is preceded by a stretch of speech containing regular pauses and ‘stretched’ segments.

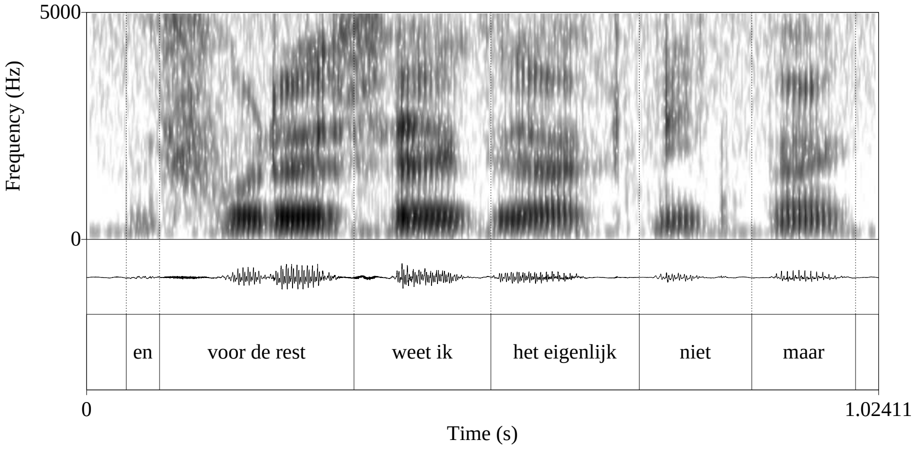


Figure 5: Segmented spectrogram and waveform of the stretch in (11a)

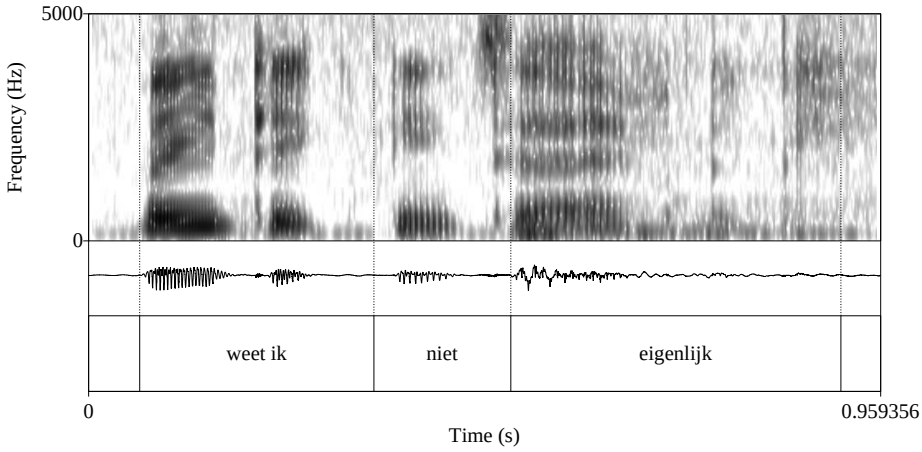


Figure 6: Segmented spectrogram and waveform of the stretch in (12b)

The stretches in (12), all of which are part of dispreferred responses, are phonetically much closer to 'canonical'. Notice, for example, that the end of *niet* is marked by voiceless alveolar plosion in all three stretches, despite the potential for loss of release, voicing or deletion in these phonetic contexts. Notice also that while *weet ik* is associated with one syllable in (11a), in (12b), a segmented spectrogram and waveform of which is given in Figure 6, it is associated with two, separated by a tight alveolar closure: [ʋeet̪ɪk˺]. The mean articulation rate across these stretches is 6.3 sylls/sec, as seen in Table 2, and in each case the response turn is slower than that of the prior elicitation. In the case of (12a), the elicitation — *maar heb je verder nog wat gedaan van de week*, see line 1 in (7) above — has a rate of 8.6 sylls/sec; in the case of (12b) — *en daar zit nu ook de hele familie weer bij of niet*, see line 1 in (8) above — 9.7 sylls/sec. In the case of (12c) — *ik: merk dat jij het helemaal met mij eens ben*, see lines 1 and 2 in (9) above — the sound stretch on *ik* disrupts the rhythm of the elicitation turn. The response is noticeably slower than *dat jij het helemaal met mij eens ben*, for which an articulation rate of 7.6 is measured.

Closing an extended turn or abandoning a multi-turn activity		Dispreferred response	
Stretch	Rate	Stretch	Rate
`en voor de rest weet ik het eigenlijk niet maar`	13.2	`nou niet veel eigenlijk`	5.7
`ja eigenlijk is dat het wel zo'n beetje`	8.3	`weet ik niet eigenlijk`	6.8
`laat ook eigenlijk maar zitten`	9.0	`ik heb er niet zo'n uitgesproken mening over eigenlijk`	6.3
Mean	10.2	Mean	6.3

Table 2: Articulation rate measurements for the stretches in (11) (left) and (12) (right), calculated by dividing the number of syllables in a canonical rendering of the stretch by its observed duration

2.5. Summary: Observations on eigenlijk

This section has shown that a consideration of the pragmatics and syntax of *eigenlijk* offers useful insights into the distribution of its phonetic variants, in that particular pragmatic contexts and syntactic placements are associated with particular ranges of variation in the phonetic shape of *eigenlijk*. I have further suggested that in the case of two of the pragmatic contexts discussed, the phonetic shape of *eigenlijk* is 'fitted' to its phonetic context; that is, these pragmatic contexts appear to be associated with phonetic features which span entire TCUs or turns. The next section discusses the phonological implications of these findings.

3. Towards an exemplar-based analysis

Given the wider phonetic patterns identified in Section 2.4 — in short, forms of the broad shapes [ˈʔɛixk] and [ˈʔɛik] occur in the middle of utterances that are overall fast, while forms of the broad shape [ˈʔɛixələk] occur finally in utterances that are overall slow — one might argue that the variation in the phonetic shape of *eigenlijk* can be explained with reference to speech rate and domain-final lengthening; this is what Kirchner (2001) does, for example. However, if our aim is to represent the speakers' knowledge of the patterns described here, this cannot be considered a complete account: the influence of syntactic and pragmatic factors must be represented at some level. In an exemplar-based approach, this level is that of the lexicon.

3.1. Syntax, pragmatics and categorisation

There are several reasons to hypothesise that syntactic and pragmatic factors of the type found in this investigation play a role in the categorisation of lexical items in an exemplar-based framework. With respect to the syntax, it is generally accepted that in speech perception, the incoming signal is segmented into chunks which correspond to syntactic domains of various sizes; these chunks are then matched against lexical representations. If parts of these domains are consistently associated with particular phonetic patterns, such as domain-final lenthening, it seems plausible that this information is represented at the lexical level, since it speeds up the segmentation and matching process (Pierrehumbert 2003).

With respect to the pragmatics, the pragmatic concepts referred to in the previous section, such as dispreferred response, sequence closure and turn-finality constitute structural units for turn-taking and sequence organisation in everyday interactive language use. Research in the field of Conversation Analysis has shown that language users constantly monitor and orient to this level of organisation in managing interaction (see e.g. Ochs et al. 1996, Couper-Kuhlen & Selting 2001). For example, the TCUs with *eigenlijk* that abandon an activity pursued over multiple turns are typically followed immediately by a co-participant's turn initiating topic change. The TCUs that are part of a dispreferred response, on the other hand, are often followed by further talk on the same topic. With reference to turn-finality, participants generally manage to time the starts of their speaking turns very precisely in relation to the co-participants' prior turns, to the extent that long breaks between turns are relatively uncommon

and turns frequently start just before the end of the prior. Moreover, speakers may manipulate these features to prevent turn transition from occurring in the construction of multi-unit turns (Local & Walker 2004).

Furthermore, patterns such as those identified in the previous section are recurrent. In an exemplar-based approach, the categorisation of phonetic forms depends crucially on recurrent experience of particular associations between phonetic form and information at some other level. For example, patterns of allophonic variation lead to robust categorisation, since the evidence for such patterns — that is, for associations between segmental features and, for example, syllable structure — is highly recurrent, and an orientation to these patterns facilitates the parsing of the signal (Lindblom 1992, Pierrehumbert 2003). Recent work reported, for example, in Couper-Kuhlen & Ford (2004), has established a variety of recurrent associations between phonetic events and the sequential organisation of talk-in-interaction. The combination of recurrence and demonstrable participant orientation to the features involved constitutes empirical evidence for phonological categorisation in an exemplar-based approach.

Finally, in the case of *eigenlijk*, the occurrence of the word is itself associated with a particular range of pragmatic contexts, in a way that *the* or *John* are not. As a 'discourse marker', *eigenlijk* has a relational function, and as such it focusses attention on the particular pragmatic context it occurs in in a given instance. When for an item of this type, phonetic patterns can be associated with pragmatic information, an analysis in terms of lexical categorisation is particularly plausible.

3.2. Word-level representation

If we accept that the patterns identified in Section 2 are to be accounted for in terms of the lexical representation of *eigenlijk*, how can we conceptualise this representation?

A useful way of looking at an exemplar model of representation is in terms of a multi-dimensional perceptual map (Pierrehumbert 2002). Bivariate scattergrams such as F1–F2 vowel plots are two-dimensional examples of such a map. A vowel plot typically contains points relating to single tokens, organised into sets with category labels, referring for example to phonemes. An example is given in Figure 7. Here the circles represent statistical distributions of observed tokens, and the labels indicate what type of category the tokens are exemplars of — in this case phonemic categories. Under this view, exemplars can be defined as locations on the perceptual map, associated with labels according to their proximity to and shared behaviour with other exemplars.

Staying with phonemic categories for ease of exposition, in this framework 'phonemes are sets of phonetically similar variants, and … these variants are clustered in groups, such that what we analyse as allophones constitute salient contextually determined prototypes' (Bybee 2001:53). Figure 8 represents an exemplar set associated with the phonemic category /l/. Again, the circle encompasses a statistical distribution of observed tokens associated with the category /l/ — i.e. a range of remembered laterals. Let us assume that these variants are organised in such a way that 'dark' variants are on the left of the set and 'clear' ones on the right, for example with reference to F2 values. In many varieties of English, as well as Dutch, 'clear' and 'dark' laterals are distributed differently: 'clear' laterals are associated with syllable onsets and 'dark'

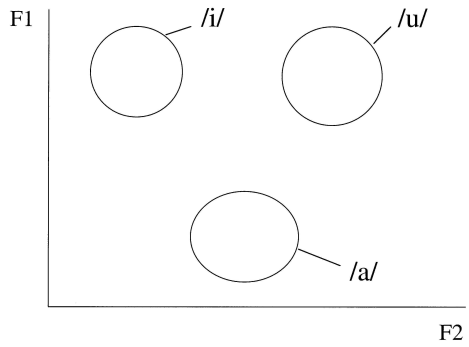


Figure 7: A two-dimensional map with category labels

laterals are associated with syllable codas. This pattern is represented in Figure 8 in terms of two labelled subsets of the set of exemplars associated with /l/.

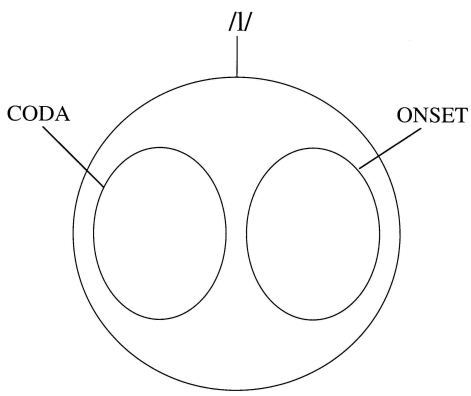


Figure 8: Allophony in an exemplar-based phonology

It is important to note that the labels of these subsets are not phonetic descriptions, as in a traditional generative statement of allophony of the type /l/ → [ɫ] / . . . . Rather, the labels are 'functional links to other levels of representation' (Pierrehumbert 2001a:140) — in this case ONSET and CODA refer to units of syllable structure, and /l/ refers to a term in an abstract (phonemic) system of contrast. The relationship between label and exemplar set is one of association, not derivation.[6] In language production, phonological processing consists of associating the most highly specified set of exemplars with the various structural positions. In this case, if a syllable coda is filled by /l/, the representation in Figure 8 specifies that an exemplar is selected from the set specified CODA rather than that specified ONSET.[7] In perception, matching an incoming

[6]This non-derivational approach to allophony is similar to that taken in Declarative Phonology, which treats allophony as 'the different interpretation of the same element in different structural contexts' (Coleman 1998:178).

[7]Again parallels with Declarative Phonology — and 'unification-based' frameworks in general (see Pollard & Sag 1994) — can be observed here: the procedure of matching structural units and exemplar sets in building linguistic structures may well be formalisable as a unification procedure.

lateral to remembered tokens on the map in Figure 8 provides structural information — that is, information about syllable structure — which facilitates parsing.

Let us now turn to *eigenlijk*. In Bybee's usage-based phonology, the main units of lexical representation are words and frequent phrases. Generalisations over smaller units, such as syllables and phonemes are assumed to emerge from these word and phrase representations in language acquisition, as they facilitate processing (see Lindblom 1992, Pierrehumbert 2003). Word-level representations can be conceptualised in the same way as phoneme-level representations. First consider Figure 9, which represents the relations between the categories distinguished in Section 2. There is the morphosyntactic–semantic category *eigenlijk*; the three syntactic categories (of placement in the turn)[8] INITIAL, MEDIAL and FINAL; and the three contextual, pragmatic categories CONT, CLOS and DISP, which refer to sequences describing a CONTradiction or paradox, TCUs marking the CLOSure of an extended turn or the abandonment of a multi-turn activity, and DISPreferred-response sequences, respectively. The category *eigenlijk* is, of course, associated with all other categories. Figure 9 further represents the observations that in DISPreferred-response sequences, *eigenlijk* occurs in all three syntactic positions, that this is the only one of the three pragmatic contexts in which *eigenlijk* occurs turn-finally, and that in TCUs marking the CLOSure of an extended turn or the abandonment of a multi-turn activity, *eigenlijk* only occurs in turn-medial position.

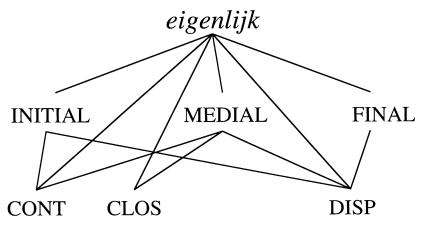


Figure 9: An exemplar-based representation of *eigenlijk*: category network

In an exemplar-based model, each of the combinations of associated features can in principle be associated with a set of exemplars. Figure 10 represents the main patterns described in Section 2 in terms of sets of exemplars associated with the categories in Figure 9. In Figure 10, the big circle represents a set of exemplars associated with the word-level category *eigenlijk*, organised along multiple phonetic parameters. Assuming (arbitrarily) that in Figure 10, highly reduced forms of *eigenlijk* are on the lower right side of the circle and 'canonical' forms are on the upper left side, the labels referring to pragmatic context and syntactic placement — here only FINAL, for clarity — can be associated with partly overlapping subsets of the overall set of exemplars of *eigenlijk*. The size of the circle roughly reflects the range of the variation, and the location reflects central tendency. For example, TCUs which mark the CLOSure of an extended turn or the abandonment of a multi-turn activity are associated with a relatively narrow range of variation centred around highly reduced, monosyllabic forms of *eigenlijk*, which also occur in sequences describing a CONTradiction or paradox, but not frequently in DISPreferred responses.

[8] I leave the relation between placement in the clause and placement in the turn aside here.

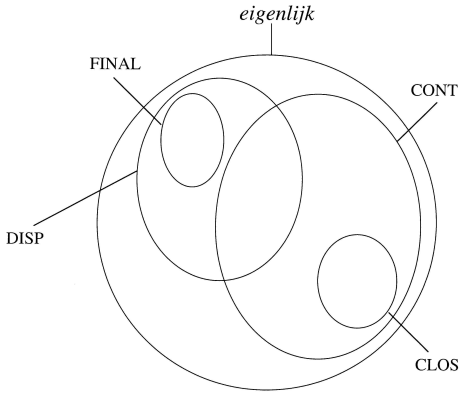


Figure 10: An exemplar-based representation of *eigenlijk*: labelled exemplar sets

Again, in production the labels function as pointers to the most appropriate subset of exemplars for a given word in a given context — syntactic, pragmatic or otherwise. In perception, matching an incoming signal to stored exemplars, with reference to the phonetic parameters of the perceptual map, also provides structural and contextual information through the labels associated with the map: in the case of *eigenlijk*, when a form such as [ɛkˀ] is perceived, it is likely that in addition to *eigenlijk*, the labels CLOS and CONT will be highly activated, but FINAL and DISP will not.[9]

3.3. Beyond the word: specification paths and schemas

The representation in Figure 10 is schematic and partial, but it gives some impression of how a word-level representation may be conceptualised in an exemplar-based approach. The question we need to address now is how the wider phonetic patterns of which *eigenlijk* has been shown to be a part can be accounted for in this approach. To this end, let us return briefly to the representation of allophony in Figure 8. It will be clear that /l/ is not the only phonemic category that is associated with exemplar sets labelled ONSET and CODA: for example, aspirated and unaspirated voiceless plosives will be distinguished in a similar fashion. In these representations, ONSET and CODA can be seen as underspecified category labels; in the case of Figure 8 the full specification paths are /l/|ONSET and /l/|CODA, respectively.[10] Thus, all categories with the terminal path /*x*/|ONSET together define the system of contrast associated with

[9]Experiments have shown that when faced with a 'reduced' form, listeners often report hearing segments that are not apparently present in the signal; for example, when prompted, they report hearing /l/ in [ɛixk] (Ernestus et al. 2002, Kemps et al. 2004). On the face of it, this seems to provide evidence against the hypothesis that citation forms have no *a priori* status. Space restrictions permit a full discussion of these findings, but one way of accommodating them in an exemplar-based model is to hypothesise that in processing [ɛixk] in analysis tasks such as those used by Ernestus et al. (2002) and Kemps et al. (2004), the exemplar set of a word category is activated *as a whole*, with all of its associated phoneme labels, and that more highly specified subsets — e.g. DISP in the case of *eigenlijk* — are difficult to access out of context.

[10]The order of the category labels in the specification paths is important in a formal analysis, but does not matter much here.

the syllable onset, and all those with the terminal path /*x*/|CODA together define the coda system. These systems of categories with shared specification paths allow for generalisations to be made — for example, that aspiration is a feature commonly observed in syllable onsets, but not in codas, while for velarisation the opposite pattern holds.[11] According to Bybee (2001), these generalisations are stored in 'schemas' — 'emergent generalizations over complex representations' (Bybee 2001:39) — which exist alongside lexical representations and record associations between category labels and phonetic features that are recurrent across multiple lexical representations, such as the association between syllable onset and aspiration. These schemas add productivity to the model, in that they provide a template for the production of 'new' items — in the case of aspiration, of consonants that have not been previously heard in onset position.

We can apply the same analysis to the representation of *eigenlijk*: the labels of subsets are underspecified; for example, the full specification path of CLOS would be *eigenlijk*|CLOS. Together, all exemplar sets labelled *x*|CLOS define the overall phonetic characteristics of TCUs which mark the closing of an extended turn or the abandonment of a multi-turn activity. Generalisations over these sets are stored in schemas. For example, it can be observed that claims of lack of knowledge occur both in TCUs which mark the closing of an extended turn or the abandonment of a multi-turn activity and in dispreferred responses. Phonetically, these are quite different; they tend to be relatively reduced in the former, but relatively unreduced in the latter. If we assume that a phrase like *ik weet (het) niet* is a lexical unit (see Scheibman 2000), it is likely that its representation is similar to that in Figure 10, with DISP and CLOS associated with different subsets of the overall exemplar set. Together, *eigenlijk*|CLOS and *ik weet (het) niet*|CLOS allow for a generalisation as to the areas of exemplar sets — and thus the sets of phonetic parameters — with which this particular pragmatic context is associated. In turn, this generalisation, recorded in a schema, allows any other words or phrases used in this context to be associated with an appropriate phonetic form. The schema for the structure CLOS would contain this phonetic generalisation, as well as the generalisations that *eigenlijk* and claims of lack of knowledge routinely occur in this context; in other words, it would define a prototypical form associated with this structure, based on the accumulated experience of actual exemplars.

4. Discussion

The analysis of *eigenlijk* proposed in Section 3 is admittedly sketchy, and various questions remain to be addressed. For example, what are the phonetic parameters along which exemplar sets are organised?[12] Exactly what kind of category is that labelled *eigenlijk* in Figure 10? How can we conceptualise the 'schemas' referred to in Section 3.3? Is the representation of *eigenlijk* the same for all speakers? With respect to this last question, in a framework based on the notion that the lexicon is shaped by experience, it must be assumed that each individual language user has a unique lexicon. This raises a following question: if a speaker does not exhibit the full variation

[11] Again, parallels with Declarative Phonology are evident here: an exemplar-based framework fits well with the 'polysystemic' declarative approach of Coleman (1998) and Ogden (1999). See Hawkins & Smith (2001) and Hawkins (2003) for discussion.

[12] Closely related to this is the question of what constitutes phonetic similarity in this approach. See Coleman (2003) for an outline of a multi-parameter, spectral signal processing method that could help address this question.

pattern described here for *eigenlijk*, but instead shows a preference for a particular form across contexts in which other speakers show structured variation (as is the case for some speakers in the present data set), does this mean this particular speaker's lexical representation is less complex, or does it mean that he does not exploit the complexity of his lexical representation in production? After all, the categorisation of examplar sets facilitates perception, even if it is ignored in production — and language users clearly store a lot of knowledge of sound patterns that is used routinely in perception, but not so much in production: for example, knowledge of regional or social accents other than their own. In general, the relationship between production and perception is as yet ill-defined in the exemplar-based approach (cf. Docherty & Foulkes 2000).

These issues notwithstanding, the analysis has a number of promising features. To see these, let us compare the analysis briefly to a previous analysis of the phonetics of the German counterpart of *eigenlijk*, *eigentlich* (Kohler 2001). After describing the range of variation associated with *eigentlich* in the speech of a single speaker, Kohler (2001:8) asserts that

> In view of this large variability produced by the same speaker it is inconceivable from the point of view of a mental lexicon that these forms are different lexicalizations for this speaker which he accesses under different situational and contextual conditions. These forms must refer to the same lexical item in this speaker's mental lexicon, with phonetic adjustments under contextual and situational conditions, and statistical variation within the degrees of freedom in the synchronization of the articulatory components.

On the face of it, this assertion is incompatible with the analysis developed in this paper: on the basis of psychological experiments such as those reported by Lachs et al. (2002), the exemplar-based approach accepts the fundamental hypothesis that it is *not* inconceivable that different variants are different lexical items. Still, on closer inspection the difference between the two approaches is not so great. First, recall that in the analysis of *eigenlijk*, the exemplar sets labelled CONT, FINAL etc. are not completely separate: some of them overlap phonetically and all of them are part of the overall set of exemplars of *eigenlijk* — or in other words, all share the structural specification *eigenlijk*|*x*. In this sense, the variant forms *do* refer to the same lexical category at the word level; the difference with Kohler's approach is that other lexical categories 'intervene'. In a full analysis in Kohler's approach these additional categories, such as CONT or FINAL would of course be represented too, but at the level of phonetic implementation rather than in the lexicon.

Second, recall that the exemplar-based approach assumes that exemplars are organised along multiple phonetic parameters. Therefore, any lexical category associated with more than one exemplar is in effect associated with a range of variation along multiple phonetic parameters, rather than necessarily with single target forms. For example, given a representation of the allophony of /l/ as in Figure 8, the specification path /l/|ONSET points the user to a range of F2 values observed in tokens of this category. In articulatory implementation, this perceptual range is translated into a range of gestural settings between which — in the absence of interacting categories — variation is allowed.[13] As such, these ranges of parameter settings correspond

[13]Pierrehumbert (2001a) implements this through random selection of exemplars from sets that are not further

closely to Kohler's 'statistical variation within the degrees of freedom in the synchronization of the articulatory components'. Again, what sets the two approaches apart is not what categories are represented, but *at what level* they are represented: much of what in Kohler's approach is covered by phonetic implementation rules is covered by lexical representation in an exemplar-based model.

As indicated in Section 1.1, an exemplar-based model must incorporate a level of phonetic, at which perceptual representations are translated into motor commands. In much previous work, including that by Kohler, this level is a very complex one, at which general physiological constraints interact with highly detailed, language-specific, contextually motivated ones of the type 'in context *x*, implement *y* with feature *z*' (cf. Keating 1996). In an exemplar-based model, on the other hand, the level of phonetic — i.e. articulatory — implementation is relatively impoverished, containing only general physiological constraints: all context-bound regularities are accounted for in terms of lexical representations and schemas that express generalisations over these representations. The 'automation' effect of repeated production (Bybee 2001) and the notion of effort minimisation (Lindblom 1990) are examples of such physiological constraints, in the sense that these are general features of motor behaviour. Through shaping language production, these features may affect the nature of lexical representations, but importantly, their application is constrained by lexical representation, and they play no role in the *selection* of target forms or ranges of variation.

For example, in the case of *eigenlijk*, the occurrence of close to canonical forms in dispreferred responses does not necessarily mean that in this context, speakers do not minimise articulatory effort; rather, they minimise articulatory effort within the parameter ranges specified in the lexical representation of *eigenlijk*|DISP. Over time, this may result in shifting parameter ranges, as in lenition and grammaticalisation processes (Pierrehumbert 2001b, Krug 2001), but for any given speaker at any given time, the selection of these parameter ranges is independent of any physiological notions. Thus, an exemplar-based model incorporates functionalist principles, but is compatible with the stance, taken by Hale & Reiss (2000) and Ohala (2005) — against functionalist Optimality Theory accounts such as that of Kirchner (2001)—that these principles play no role in phonological, *cognitive* computation. From a methodological perspective, the central role of lexical categorisation in accounting for variation in an exemplar-based approach means that in investigating reduction patterns, the level of phonetic implementation is 'the last resort, the place to house those patterns which cannot be systematized in any other way', as Simpson (2001:38) proposes.

Of course, the simplification of the procedure of phonetic implementation comes at the cost of greatly increasing the complexity of the lexicon. However, as indicated in Section 1, this complexity is motivated by the need to account for the role of frequency in shaping linguistic patterns, and the interactions between linguistic and extra-linguistic knowledge; and it has provided valuable insights in areas in which traditional generative phonology and Optimality Theory fall short, such as language development (Stemberger 1992, Pierrehumbert 2003) and diachronic change (Bybee 2002, Beckman & Pierrehumbert 2003). Moreover, it has already been shown that an exemplar-based analysis of structured variation is relatively neutral with respect to production vs. perception. A relatively impoverished phonetic implementation procedure keeps

categorised.

it that way: it allows an incoming signal to be mapped onto lexical representations almost directly. In a framework such as Kohler's, on the other hand, perception involves applying a very complex phonetic implementation procedure 'backwards' to arrive at a representation that can be matched with a lexical one — a process which may well require additional computational machinery (see Johnson 2003 for discussion). Future research will need to show whether or not the complexity of exemplar-based models is problematic from a computational and cognitive perspective. So far, computational implementations suggest that the 'head-filling-up problem' attributed to exemplar-based models is more apparent than real (Johnson 1997, Kirchner 1999, Pierrehumbert 2003). In order to make these implementations as realistic as possible, detailed empirical work is needed on the categorisation of ranges of phonetic variation in actual language use. This paper has been a contribution to this project.

Acknowledgements

Thanks are due to various members of the ConSOLE audience, as well as Richard Ogden, Paul Foulkes and Gareth Walker for critical comments on versions of this paper.

References

Beckman, M. E. & J. Pierrehumbert (2003). Interpreting 'phonetic interpretation' over the lexicon. Local, J. K., R. Ogden & R. A. M. Temple (eds.), *Phonetic Interpretation: Papers in Laboratory Phonology VI*, Cambridge University Press, Cambridge, pp. 13–37.

Berkenfield, C. (2001). The role of frequency in the realization of English *that*. Bybee, J. & P. Hopper (eds.), *Frequency and the Emergence of Linguistic Structure*, John Benjamins, Amsterdam, pp. 281–308.

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

Bybee, J. (2002). Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change. *Language Variation and Change* 14, pp. 261–290.

Caspers, J. (1998). Who's next? The melodic marking of question vs. continuation in Dutch. *Language and Speech* 41, pp. 375–398.

Caspers, J. (2003). Local speech melody as a limiting factor in the turn-taking system in Dutch. *Journal of Phonetics* 31, pp. 251–276.

Chomsky, N. & M. Halle (1968). *The Sound Pattern of English*. Harper and Row, New York.

Clift, R. (2001). Meaning in interaction: The case of *actually*. *Language* 77, pp. 245–290.

Coleman, J. S. (1998). *Phonological Representations: Their Names, Forms and Powers*. Cambridge University Press, Cambridge.

Coleman, J. S. (2003). Discovering the acoustic correlates of phonological contrasts. *Journal of Phonetics* 31, pp. 351–372.

Coleman, J. S. & J. B. Pierrehumbert (1997). Stochastic phonological grammars and acceptability. *Proceedings of the Third Meeting of the ACL Special Interest Group in Computational Phonology*, Madrid, pp. 49–56.

Couper-Kuhlen, E. & C. E. Ford (eds.) (2004). *Sound Patterns in Interaction: Cross-linguistic Studies from Conversation*. John Benjamins, Amsterdam.

Couper-Kuhlen, E. & M. Selting (eds.) (2001). *Studies in Interactional Linguistics*. Cambridge University Press, Cambridge.

Docherty, G. J. & P. Foulkes (2000). Speaker, speech, and knowledge of sounds. Burton-Roberts, N., P. Carr & G. J. Docherty (eds.), *Phonological Knowledge: Its Nature and Status*, Oxford University Press, Oxford, pp. 105–129.

Drew, P. (1987). Po-faced receipts of teases. *Linguistics* 25, pp. 215–253.

Drew, P. (2003). Precision and exaggeration in interaction. *American Sociological Review* 68, pp. 917–938.
Drew, P. (2004). Conversation analysis. Fitch, K. & R. Sanders (eds.), *Handbook of Language and Social Interaction*, Lawrence Erlbaum Associates, Hillsdale, NJ.
Ernestus, M. (2000). *Voice Assimilation and Segment Reduction in Casual Dutch: A Corpus-based Study on the Phonology–Phonetics Interface*. Netherlands Graduate School of Linguistics LOT, Utrecht.
Ernestus, M., R. H. Baayen & R. Schreuder (2002). The recognition of reduced word forms. *Brain and Language* 81, pp. 162–173.
Ford, C. E. & S. A. Thompson (1996). Interactional units in conversation: Syntactic, intonational, and pragmatic resources for the management of turns. Ochs, E., E. A. Schegloff & S. A. Thompson (eds.), *Interaction and Grammar*, Cambridge University Press, Cambridge, pp. 134–184.
Frisch, S. A., N. R. Large & D. B. Pisoni (2000). Perception of wordlikeness: Effects of segment probability and length on the processing of non-words. *Journal of Memory and Language* 42, pp. 481–496.
Hale, M. & C. Reiss (2000). Phonology as cognition. Burton-Roberts, N., P. Carr & G. J. Docherty (eds.), *Phonological Knowledge: Its Nature and Status*, Oxford University Press, Oxford, pp. 161–184.
Halle, M. (1997). Some consequences of the representation of words in memory. *Lingua* 100, pp. 91–100.
Hawkins, S. (2003). Roles and representations of systematic fine phonetic detail in speech understanding. *Journal of Phonetics* 31, pp. 373–405.
Hawkins, S. & R. Smith (2001). Polysp: A polysystemic, phonetically-rich approach to speech understanding. *Italian Journal of Linguistics—Rivista di Linguistica* 13, pp. 99–189.
Hay, J., J. B. Pierrehumbert & M. E. Beckman (2003). Speech perception, well-formedness and the statistics of the lexicon. Local, J. K., R. Ogden & R. A. M. Temple (eds.), *Phonetic Interpretation: Papers in Laboratory Phonology VI*, Cambridge University Press, Cambridge, pp. 58–74.
Johnson, K. (1997). Speech perception without speaker normalization: An exemplar model. Johnson, K. & J. W. Mullennix (eds.), *Talker Variability in Speech Processing*, Academic Press, San Diego, pp. 145–165.
Johnson, K. (2003). Massive reduction in conversational American English. *Proceedings of the Workshop on Spontaneous Speech: Data and Analysis*, Tokyo.
Johnson, K. & J. W. Mullennix (eds.) (1997). *Talker Variability in Speech Processing*. Academic Press, San Diego.
Jurafsky, D., A. Bell & C. Girand (2002). The role of the lemma in form variation. Gussenhoven, C. & N. Warner (eds.), *Laboratory Phonology 7*, Mouton de Gruyter, Berlin, pp. 3–34.
Kaisse, E. M. (1985). *Connected Speech: The Interaction of Syntax and Phonology*. Academic Press, San Diego.
Keating, P. A. (1996). The phonology–phonetics interface. Kleinhenz, U. (ed.), *Interfaces in Phonology*, Akademie Verlag, Berlin, pp. 262–278.
Kemps, R., M. Ernestus, R. Schreuder & R. H. Baayen (2004). Processing reduced word forms: The suffix restoration effect. *Brain and Language* 90, pp. 117–127.
Kirchner, R. (1999). Preliminary thoughts on 'phonologization' within an exemplar-based speech processing system. *UCLA Working Papers in Linguistics* 1, pp. 207–231.
Kirchner, R. (2001). Phonological contrast and articulatory effort. Lombardi, L. (ed.), *Segmental Processes in Optimality Theory*, Cambridge University Press, Cambridge.
Kohler, K. J. (1991). The phonetics/phonology issue in the study of articulatory reduction. *Phonetica* 48, pp. 180–192.
Kohler, K. J. (2001). Articulatory dynamics of vowels and consonants in speech communication. *Journal of the International Phonetic Association* 31, pp. 1–16.
Krug, M. G. (2001). Frequency, iconicity, categorization: Evidence from emerging modals. Bybee, J. & P. Hopper (eds.), *Frequency Effects and the Emergence of Linguistic Structure*, John Benjamins, Amsterdam, pp. 309–335.
Lachs, L., K. McMichael & D. B. Pisoni (2002). Speech perception and implicit memory: Evidence for detailed episodic encoding of phonetic events. Bowers, J. S. & C. J. Marsolek (eds.), *Rethinking Implicit Memory*, Oxford University Press, Oxford, pp. 215–235.
Lindblom, B. (1990). Explaining phonetic variation: A sketch of the H&H theory. Hardcastle, W. J. & A. Marchal (eds.), *Speech Production and Speech Modelling*, Kluwer Academic, Dordrecht, pp. 403–439.
Lindblom, B. (1992). Phonological units as adaptive emergents of lexical development. Ferguson, C. A., L. Menn & C. Stoel-Gammon (eds.), *Phonological Development: Models, Research, Implications*, York Press, Timonium, Maryland, pp. 131–163.

Local, J. K. (2003). Variable domains and variable relevance: Interpreting phonetic exponents. *Journal of Phonetics* 31, pp. 321–339.

Local, J. K. & G. Walker (2004). Abrupt-joins as a resource for the production of multi-unit, multi-action turns. *Journal of Pragmatics* 36, pp. 1375–1403.

Mazeland, H. (2003). *Inleiding in de Conversatieanalyse*. Coutinho, Bussum.

Mazeland, H. (2004). Responding to te double implication of telemarketers' opinion queries. *Discourse Studies* 6, pp. 95–115.

Ochs, E., E. A. Schegloff & S. A. Thompson (eds.) (1996). *Interaction and Grammar*. Cambridge University Press, Cambridge.

Ogden, R. (1999). A declarative account of strong and weak auxiliaries in English. *Phonology* 16, pp. 55–92.

Ohala, J. J. (2005). Phonetic explanations for sound patterns: Implications for grammars of competence. Hardcastle, W. J. & J. Mackenzie Beck (eds.), *A Figure of Speech: A Festschrift for John Laver*, Lawrence Erlbaum Associates, Mahwah, NJ, pp. 23–38.

Pierrehumbert, J. B. (2001a). Exemplar dynamics: Word frequency, lenition, and contrast. Bybee, J. & P. Hopper (eds.), *Frequency Effects and the Emergence of Linguistic Structure*, John Benjamins, Amsterdam, pp. 137–157.

Pierrehumbert, J. B. (2001b). Stochastic phonology. *Glot International* 5, pp. 195–207.

Pierrehumbert, J. B. (2002). Word-specific phonetics. Gussenhoven, C. & N. Warner (eds.), *Laboratory Phonology 7*, Mouton de Gruyter, Berlin, pp. 101–139.

Pierrehumbert, J. B. (2003). Phonetic diversity, statistical learning, and acquisition of phonology. *Language and Speech* 46, pp. 115–154.

Pollard, C. & I. A. Sag (1994). *Head-driven Phrase Structure Grammar*. Chicago University Press, Chicago.

Pomerantz, A. (1984). Agreeing and disagreeing with assessments: Some features of preferred/dispreferred turn shapes. Atkinson, J. M. & J. Heritage (eds.), *Structures of Social Action: Studies in Conversation Analysis*, Cambridge University Press, Cambridge, pp. 57–101.

Sacks, H. (1992). *Lectures on Conversation*. Blackwell, Oxford. 2 volumes.

Schegloff, E. A. (1988). On an actual virtual servo-mechanism for guessing bad news: A single case conjecture. *Social Problems* 35, pp. 442–457.

Schegloff, E. A. (1996). Turn organization: One intersection of grammar and interaction. Ochs, E., E. A. Schegloff & S. A. Thompson (eds.), *Interaction and Grammar*, Cambridge University Press, Cambridge, pp. 52–133.

Schegloff, E. A. (1997). Third turn repair. Guy, G. R., C. Feagin, D. Schiffrin & J. Baugh (eds.), *Towards a Social Science of Language 2*, John Benjamins, Amsterdam, pp. 249–281.

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

Scheibman, J. (2000). *I dunno*: A usage-based account of the phonological reduction of *don't* in American English conversation. *Journal of Pragmatics* 32, pp. 105–124.

Simpson, A. P. (2001). Does articulatory reduction miss more patterns than it accounts for? *Journal of the International Phonetic Association* 31, pp. 29–39.

Stemberger, J. P. (1992). A connectionist view of child phonology: Phonological processing without phonological processes. Ferguson, C. A., L. Menn & C. Stoel-Gammon (eds.), *Phonological Development: Models, Research, Implications*, Timonium, Timonium, Maryland, pp. 165–189.