Spoken Syntax: The phonetics of *giving a hand* in New Zealand English*

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Abstract

This paper considers the exemplar theories which are independently developing in phonetics and in syntax, and argues that they jointly make some predictions that neither does alone. One of these predictions is explored in the context of two sound changes which occurred in the history of New Zealand English. We show that both of these phonetic changes were affected by phrase-level factors. The raising of /æ/ was more advanced in the word hand when it referred to a limb, than when used in phrases such as give a hand or lend a hand. And the centralization of the /ɪ/ vowel was more advanced in utterances of give involving abstract themes (give a chance), than when it had a meaning of transfer of possession (give a pen). We argue that existence of such effects lends support both to the idea (from syntactic exemplar theory) that phrases are stored, and the idea (from phonetic exemplar theory) that lexical representations are phonetically detailed.

1 Introduction

Over the last few years, exemplar approaches have received increasing attention in both syntax and phonetics. In syntax, the exemplar approach investigates the degree to which the grammar may emerge as a set of analogical generalizations over stored phrases. In phonetics, the exemplar approach hypothesizes that lexical representations consist of distributions of memories, complete with phonetic detail.

These two literatures have developed more or less independently of one another. In this paper we argue that taken together, they make some joint predictions that neither do alone. To test some of these predictions, we conduct some preliminary analysis of sound changes from early New Zealand English, in order to establish the plausibility of stored phrases participating in sound change. First, we consider the raising of /æ/, and demonstrate that this sound change was more advanced in the word *hand* when it referred to a limb, than when used in phrases such as *give a hand* or *lend a hand*. Second, we consider the centralization of the /ɪ/ vowel, demonstrating that this sound change was more advanced in utterances

of *give* involving abstract themes (*give a chance*), than when it had a meaning of transfer of possession (*give a pen*). These results reinforce the interpretation that syntactic phrases may be stored, and suggests that memories for stored phrases may include phonetic detail.

2 Background

Exemplar theories of identification and categorization have been proposed in psychology for several decades. Such theories assume that people represent categories by storing individual exemplars of that category in memory. Classification of a new exemplar proceeds by assessing its similarity to existing exemplars (Nosofsky 1987, Hintzman 1986, Medin and Schaffer 1978). This type of model has also been extended to account for stereotype formation and social judgement (Smith and Zarate 1992).

More recently, it has been proposed that exemplar models may help shed light on a variety of linguistic phenomena. Our focus in this article will be on its applications in syntax and in phonetics. In syntax, researchers have proposed that the grammar arises as an analogical generalization over stored memories of previously encountered phrases (see, e.g. Bod 1998). In phonetics, it has been proposed that lexical items are distributions of stored memories, complete with phonetic detail (see, e.g. Johnson 1997). These two lines of inquiry in linguistics have developed relatively independently of one another. In this paper we explore the possible consequences of their predictions, when considered together. We first provide a brief discussion of the exemplar approach in phonetics and syntax, and outline the assumptions of each.

2.1 Probabilistic and Exemplar approaches to Syntax

An emerging group of researchers in syntax been working on developing exemplar theoretic approaches to syntactic theory. According to the exemplar-based conception, there are no explicit rules of grammar. The grammar arises as a set of analogical generalizations over stored chunks of previously experienced language—lexicalized phrases or constructions—

which are used to build new expressions analogically. In syntax, these models are associated with Cognitive Grammar (Langacker 1998) and also with the family of lexical constraint-based theories including Construction Grammar, HPSG, and LFG (see Jackendoff 2002 for a synthesis). For computational studies of exemplar-based syntax which include formalizations of analogical structure-building, see Bod (1998, this volume) and Bod, Scha, and Sima'an (2003).

Probabilistic grammars provide a related conception of quantitative syntax. These associate probabilities with conventional rules, constraints, parameters, or grammars, which define a probability distribution over their outputs (see Manning 2003, Smith and Cormack 2002, Bresnan and Nikitina 2003, Yang 2004, Anttila and Fong 2004, and Jäger and Rosenbach to appear for various perspectives.) The sensitivity of probabilistic grammars to use and context is explained by statistical learning algorithms or by deriving their properties from models of language perception and production (Boersma and Hayes 2001; Boersma 2004; Goldwater and Johnson 2003; Jäger in press; Ferreira 1996; Chang, Dell, and Bock in press).

The exemplar approach and the probabilistic approach differ in that the latter sees a place for relatively explicit abstract structure and rules or constraints, whereas in the former, there is a larger role for online analogical reasoning. What they both share, however, is the assumption that the grammar is highly dynamic and usage based. Different exposures should lead to different 'grammars' (either because the analogical data-banks vary, or because the input on which the probabilistic grammar was trained varied).

The exemplar approach requires that encountered phrases are stored. While the probabilistic approach does not, it is highly compatible with the hypothesis of phrasal storage.

There is certainly abundant evidence that at least some phrases are stored: much effort has gone into documenting the storage of so-called formulaic phrases (see, e.g. the papers in Schmitt 2004). For example, Underwood, Schmitt and Galpin (2004) demonstrate that in eye-tracking, native speakers fixate on a word for less time if it is the final word in a formulaic sequence rather than a non formulaic sentence. And Flores d'Arcais (1993) demonstrated

that participants could locate errors more quickly inside frequent idioms than less frequent ones. It is important to note that if phrases are stored, and activated during perception and production, this does not necessarily rule out the possibility that they are stored in analyzed form, or that computation may be involved in their retrieval – and there is some evidence that this is the case (Nooteboom 1999, Cutting and Bock 1997).

The evidence for storage of phrases extends beyond the storage of relatively formulaic sequences. Bod (2000, 2001) demonstrates that participants respond faster to frequent sentences than infrequent ones, even when semantic plausibility, lexical frequency, syntactic complexity and the like are controlled. Sosa and MacFarlane (2002) investigate people's ability in a word-spotting task, where they are asked to monitor for the word *of*. They are better at identifying the preposition when it occurs in an infrequent phrase, suggesting that access to frequent phrases may be via a stored representation. And there is a host of work which demonstrates individuals' sensitivity to the conditional probability of word sequences (see review in Jurafsky 2003).

The evidence from acquisition supports the view that the grammar emerges as a generalization over stored exemplars. The literature shows that the amount of generalization engaged in by children younger than three is extremely limited. See, for example, the extensive review provided by Tomasello (2006), who concludes that "based on all of the available evidence, it would appear that children's early linguistic representations are highly concrete, based in concrete and specific pieces of language not in abstract categories...".

In what follows, we use 'exemplar theory' with respect to syntax, as a cover term which refers to theories of syntax which assume storage of encountered phrases, and allow for production and perception to proceed analogically on at least some occasions. We include in this term theories in which a relatively explicit probabilistic grammar is emergent from these stored phrases, and is continually updated as more phrases are encountered. While the degree of explicitness of such a grammar (or the degree to which it exists at all) is an important question, it is not our primary concern here.

Results from syntactic priming would seem to find their most straightforward explanation

in a theory in which some abstract structure was represented. A variety of corpus and experimental studies show an effect of syntactic priming - speakers tend to converge in their use of syntactic structures (Schenkein 1980, Tannen 1989, Levelt and Kelter 1982, Bock 1986, Bock 1989, Bock and Loebell 1990, Pickering and Branigan 1999). This certainly suggests some involvement of higher level generalisations during speech production. Note too, however, that this priming is particularly strong when the phrases share a lexical item in common (Branigan, Pickering and Cleland 2000), suggesting that the priming does not operate entirely at an abstract level. Scheepers (2003), however, provides evidence of priming of purely phrasal attachment positions for relative clauses. A looming challenge for the field will to uncover the relationship between phrasal storage and computation in syntactic processing. However this is resolved, the current evidence suggests that storage plays some role. And if phrasal storage plays some role, this raises many interesting questions with respect to the relationship between stored phrases, and emerging results from work in exemplar theory in phonetics.

2.2 Exemplar Theory in Phonetics

Within linguistics, the exemplar approach is perhaps most developed in the literature on speech perception and production. Many models of speech production and perception have conceptualized the representation of lexical items as underlying, abstract forms (see, e.g. Klatt 1979, Levelt 1989, Hawkins and Warren 1994, Lahiri and Marslen-Wilson 1991, Marslen-Wilson and Warren 1994, Eulitz and Lahiri 2004). In such models, producing and/or perceiving lexical items involves mapping between underlying forms, the phonological grammar and a set of phonetic implementation rules. Because there is no subphonemic detail stored in the lexical entry, models with abstract underlying representations predict that there should not be any variation in production or perception reflecting stored phonetic detail of particular words.

However much recent evidence demonstrates there is, in fact, word-based variation in both speech production and speech perception. This evidence comes largely from speech

production and perception experiments, and studies of sound change. Together, the evidence seems to provide support for exemplar theories of lexical representations, in which the representation of a word is a distribution of remembered exemplars, complete with phonetic detail (see, e.g. Johnson 1997, 2006, Pierrehumbert 2001, 2002, Hawkins 2003, Foulkes and Docherty 2006). Thus, every time we encounter a particular word, we store the phonetic memory of that word (complete with 'non-linguistic' detail including pitch, intonation, voice quality, etc). The representation for the word *dog* consists of a distribution of memories of past encounters with the word *dog*. These memories decay over time.

Speech production proceeds by speakers generalizing over stored items. Perception proceeds by identifying the stored distribution which best matches the acoustic signal. In this way, exemplar-theoretic approaches have a significant advantage over more traditional models in being able to account for effects of variability in the signal caused by co-articulation.

These models have also been of interest to sociolinguists because they are able to account for within-speaker variability such as style-shifting and speech accommodation, and provide a principled account of why variation within the individual reflects variation across society. The crucial additional assumption here is that individual exemplars are not only phonetically rich, but are also indexed with a variety of social information (the identity of the individual, their gender, regional origin, approximate age, what they are wearing, their hairstyle ..., anything that could be perceived as sociolinguistically or sociologically relevant)[1].

This social indexing is what enables us to understand speech produced by different individuals as representing the same linguistic meaning. If you are listening to a Maori male in his 20s, the exemplars indexed with appropriate social categories receive greater activation than exemplars which are less socially relevant, enabling you to more accurately identify the vowels intended by the speaker. An emerging body of results demonstrates that speech perception is affected by the speaker's perceived gender (Strand 1999, Johnson et al. 1999), age (Drager in press, Hay et al. 2006), social class (Hay et al. 2006) and dialect region

[1]It is worth noting, that exemplar accounts of stereotype formation are well developed outside of linguistics (see, e.g. Smith and Zarate 1992) and may provide a way forward for understanding the complex ways in which social meaning emerges from and is created by phonetic variation.

(Niedzielski 1999, Hay et al. this volume). Likewise, in production, a speaker can position themselves as young and hip or old and mature, by favoring exemplars indexed to relevant social meanings. Thus, exemplar theory, more than any other previous account, provides an avenue forward for the unification of results from phonetics and the study of language variation and change.

Work on on-going sound change has documented many cases of so-called 'lexical diffusion', in which individual words appear to lead sound change. This phenomenon is well-predicted by models in which representations of individual words are phonetically rich. Pierrehumbert (2001) provides a convincing account of how exemplar theory predicts a role of frequency in sound change. The essential element is that frequent words are encountered more frequently, and so the distribution is dominated by recent exemplars (and hence, exemplars which are reasonably advanced in any ongoing sound change).

It has also been shown that there is a strong link between individuals' accumulated experience of individual words and their perception of those words. For example Warren et al. (in press) and Hay et al. (2006) conducted studies on the perception of two phonemes which are undergoing merger in New Zealand English. Recordings of New Zealanders reading word-lists reveals that some minimal pairs are more advanced in this merger than others. In speech perception tasks, New Zealanders are less accurate at distinguishing between word pairs that are highly merged in the population. That is, the more an individual has experienced a particular word pair as distinct, the more easily they are able to discriminate between members of that pair in speech perception.

In short, the weight of the evidence from speech production and speech perception suggests that our representations for lexical items consist of distributions of remembered exemplars. These exemplars are phonetically rich, and indexed to a variety of social factors.

2.3 Toward a Combined Approach

Our goal in this paper is to examine the potential joint consequences of exemplar theory in phonetics and exemplar theory in syntax. These literatures in speech and in syntax are

currently almost entirely separate. However if we put these two lines of inquiry together, it raises the question of whether stored phrases are phonetically detailed. Do we also store these phrases as complete phonetic memories? Or does storage of phrases work differently from storage of words, leading to a more abstract representation – perhaps a set of probabilities about co-occurrences between lexical representations (or between subparts of the lexical distributions). There is also the question of social indexing – is social information also stored with these syntactic memories?

Many results in the sociolinguistic literature are consistent with the idea that syntactic memories are socially indexed. Decades worth of work from language variation and change shows that syntactic variables, like phonological variables, can come to be associated with particular social groups (see, e.g. Labov 1969, Macaulay 1991, Cheshire 1987). In the variable rule tradition of sociolinguistics, these differences between speaker groups tend to be modeled either as differences between speaker groups in terms of their propensity to use a particular structure, or as differences in the probabilistic weight that particular speaker groups associate with particular conditioning factors (see Bayley 2002).

The existence of this gradient syntactic variability across speaker groups broadly supports the exemplar view that human language processing involves representations of previous language experiences, and not abstract rules. To the degree that the language experience of different speakers and speaker groups varies, we would straightforwardly expect gradient differences in the grammar to emerge.

Moreover - we observe within-speaker syntactic variation which echoes societal variation (Rickford and McNair-Knox 1994). This is not news to sociolinguists. Individual speakers are highly skilled at selecting syntactic structures which are aligned with the social message they wish to portray. Style-shifting exists in syntax, just as it does in phonetics/phonology. Just as phonetic style-shifting has received an persuasive account within exemplar theory, syntactic style-shifting could also be accounted for in a parallel manner. The ability of individuals to associate particular structures with particular social groups could be well accounted for in a syntactic model which included storage of phrases, and social indexing of

these phrases. If we store not only the linguistic information associated with encountered phrases but also the speaker information, this would provide a straightforward account of how social meaning comes to be associated with particular syntactic structures.

Individuals have some sense of the social distribution of phrases, and are also able to recreate this - positioning oneself as more or less formal, more or less "hip", by the use of particular syntactic structures. That syntactic structures can carry social meaning strongly suggests that they are, at some level, socially indexed with who produced them. Thus, our generalisations over stored phrases may include not only drawing higher-level syntactic generalisations and probabilities over them, but also extracting patterns relating to the kinds of people that use particular phrases or structures.

In addition to exploring the potential social indexing of phrases, we should also ask whether they are phonetically detailed. That is, perhaps exemplars of 'phrases' are no different from exemplars of 'words' in that they are stored as complete phonetic memories. (Indeed, if this were the case, we might even explore whether words exist only as emergent generalisations over stored phrases).

Some of the evidence for stored phrases in fact comes directly from phonetic evidence. There is a literature investigating the phonetic characteristics of idiomatic phrases. It finds that prosodic cues such as timing and intonation can be sufficient for native speakers to distinguish idiomatic from literal phrases (Lieberman 1963, Van lancker, Canter and Terbeek 1981, Vanlancker-Sidtis 2003). That such 'prosodic shapes' are stored along with formulaic phrases seems likely. Vanlancker-Sidtis (2003) points out the existence of 'prosodic' speech errors from non-native speakers (e.g. "I wouldn't be in his SHOES").

There is ample evidence that frequent phrases tend to be shorter in speech (Ellis 2002, Krug 1998). There is also evidence that words tend to be more reduced in a syntactically more predictable environment (Gahl and Garnsey 2004).

Bybee and Scheibman (1999) demonstrate that the word *don't* is more reduced in frequent phrases such as *I don't know* and *I don't think* and *why don't you* than in less frequent phrases, arguing that this is evidence that the frequent phrases are processing units. Krug

(1999) demonstrates that cliticization is more common with common word pairs, and Bush (2001) demonstrates an increase in palatalization at word boundaries with high conditional probabilities (e.g. the /d/ is more palatalised in 'did you' than 'good you'.)

That there are phrasal effects relating to phonetic reduction suggests that there may also be phrasal participation in sound change. While there is a long-standing discussion in the study of sound change about whether individual lexical items can participate in sound change (see extensive discussion in Labov (1994)), there does seem to be good evidence that at least some sound changes are lexically gradual – affecting some words more rapidly than others.

Many reported cases of lexical diffusion involve lexical frequency, with frequent words more advanced in the change. These cases tend to involve ongoing sound changes which are reductive (i.e. the incoming variant requires less articulatory effort). For this reason, it can sometimes be difficult to disentangle the effects of lexical diffusion, from those of stable, frequency-based reduction. This is because there is a well-documented phonetic effect in which speakers produce frequent words with less articulatory effort (Fidelholz 1975, Hooper 1976, Bybee 2000, Gregory et al. 2000, Jurafsky et al. 2001), presumably because the listener requires less phonetic information for successful lexical access. Thus if a reductive sound change seems to be more advanced in frequent words, this may, in fact, simply be a matter of a stable effect of articulatory effort.

Nonetheless, the weight of the evidence is that there are lexical effects in sound change. These are often frequency-based, but not always. For example Yaeger-Dror (1994) and Yaeger-Dror and Kemp (1992) report a case of "old-timer" words being slow to participate in a sound change in Montreal French. And Gordon et al. (2004) report that words relating to mining and farming lagged behind a change involving loss of rhoticity in early New Zealand English.

As discussed in section 2.2, exemplar theories being developed in phonetics can provide a good account for why lexical effects should be observed in sound change. Our question is: if *words* participate to different degrees in sound changes, is there any evidence that *phrases*

may also participate to different degrees?

There is some existing evidence of units beyond the word participating in sound change. For example Bybee (2000, 2002) has conducted a study of the loss of liaison in French. She found that relatively frequent phrases were relatively robust to this change, and retained liaison consonants longer. Frequent phrases, claims Bybee, are stored. Boundaries between words within frequent phrases are therefore not as prone to edge-effects as word boundaries in less frequent phrases.

Similarly, Hay and Sudbury (2006) demonstrate that during the development of /r/-sandhi in New Zealand, frequent phrases were relatively conservative. Thus, when linking /r/ was on the decline, frequent phrases retained high rates of linking /r/(such as *for a*). And when intrusive /r/ was emerging, it appeared less likely to manifest in high frequency phrases (such as *idea of*). These results provide further evidence that stored units are relatively resistant to sound changes which occur at edges. These types of results seem to provide strong evidence for the existence of stored phrases.

Note that the fact that frequent phrases appear to be lagging behind here does not provide counter-evidence to the claim that frequent items generally lead sound change. Sandhi processes are unusual sound changes in that they crucially involve processes which occur at the boundaries between words. Frequent phrases lag in these changes because the changes are occurring at boundaries, and a boundary inside a stored, frequent, phrase is in some sense less available for the change (i.e. it is not particularly boundary-like).

We were interested in whether there was evidence that stored phrases also participate in other more common types of sound changes. Can we find evidence of within-word variation which occurs when that word is in different syntactic or semantic positions? This is the type of evidence we looked for in our analysis of the phonetics of *giving a hand* in New Zealand English. We first examine phrases containing the word *hand* during a period in New Zealand English when the vowel in this word was undergoing rapid change. We then examine phrases containing the word *give* during a later period of change involving the /ɪ/ vowel. This specific choice of variables stems from the fact that we have been involved in a project examining the

syntactic properties of *give* over the history of New Zealand English, as a follow-up study to Bresnan, Cueni, Nikitina, and Baayen (in press). As we also had available to us some phonetic analyses which had previously been conducted on the same material we decided to examine the syntactic and phonetic analyses together, in order to establish whether there was any evidence for phrasal participation in sound change.

3 The phonetics of *giving a hand*

The data we will discuss come from the Origins of New Zealand English corpora (ONZE). ONZE is a collection of recordings housed at the University of Canterbury, New Zealand. It includes recordings of speakers born between the 1850s and the 1980s, and continues to grow every year. There are three subcorpora. The *Mobile Unit* contains recordings of early New Zealand English — speakers born between 1851 and 1910. These recordings originated as radio interviews conducted in the 1940s using a Mobile van, which toured New Zealand collecting reminiscences from New Zealand towns. The *Intermediate Archive* is a collection of recordings of speakers born between 1890 and 1930. Some of these are recordings made by historians for oral history projects, some are interviews for radio broadcast, and some are interviews of descendants of Mobile Unit speakers, conducted by members of the ONZE team. The *Canterbury Corpus* is a series of interviews conducted by students enrolled in a third year "New Zealand English" class. The Canterbury Corpus contains speakers born between 1930 and 1984, and is added to every year. When adding speakers to the Canterbury Corpus, an attempt is made to fill a sample stratified along the lines of age, gender and social class. See Gordon, Maclagan and Hay (in press) for further details about the ONZE corpora. The particular analyses discussed here are drawn from the Mobile Unit (section 3.1) and the Intermediate Archive (section 3.2).

3.1 Sound change and *hand*

The /æ/ vowel (as in *cat*, and *sad*) is more raised in New Zealand English than most other varieties of English. This raised variant can be traced back to the very first generation of New Zealand English speakers, who inherited some relatively raised variants from their British ancestors, and then continued to raise the vowel further. This sound change, which was demonstrably underway in speakers born in the second half of the 19th Century, still continues today - some 150 years later. The /æ/ vowel has been analyzed in 59 speakers from the Mobile Unit, born between 1857 and 1900. The analysis was conducted by Andrea Sudbury, who was a postdoctoral fellow with the ONZE project from 2000-2002. She analyzed 5579 tokens of /æ/ and the results, reported in Gordon et al. (2004), show that the vowel underwent considerable raising during this period. The binary analysis revealed a total of 3284 of these tokens to be raised variants of the vowel ([æ̝] or [ɛ̝]).

The analysis presented by Gordon et al. does not consider the potential role of lexical frequency. However, as discussed above, it is well established that many sound changes are led by frequent words.

We therefore attempted to fit a logistic regression model, adding lexical frequency as an additional predictor to other factors already known to have affected the sound change. We found a strong effect of lexical frequency. The Wald statistics for the logistic regression are shown in Table 1, and Figure 1 shows the model's predictions for speaker age and lexical frequency. In this model 'early' speakers are born before 1875, and 'late' speakers are born from 1875-1900. The effects of age and lexical frequency are shown in figure 1. These figures plot the log odds of vowel raising predicted by the statistical model - i.e. they plot the effect of age (left panel) and frequency (right panel) while all other effects in the model are held constant. The log odds expresses the relative likelihood of raising vs non raising - this value can range from negative infinity to positive infinity. A value of zero would mean that both raised and non-raised variants were equally likely. Because the log odds is positive for the late speaker group, this indicates that the vowel is more likely to be raised than not raised. The earlier speaker group has a negative log odds, indicating that non-raised variants are more

Table 1: Wald Statistics for `Raising`

	χ^2	$d.f.$	P
Age	101.72	1	< 0.0001
gender	252.85	1	< 0.0001
preceding manner	135.03	5	< 0.0001
following manner	118.71	3	< 0.0001
following place	183.47	2	< 0.0001
lexical frequency	58.02	1	< 0.0001
TOTAL	669.80	13	< 0.0001

likely. The dashed lines show 95% confidence intervals. The left panel of figure 1 therefore demonstrates that /æ/ is, indeed, raising during this period. The right panel indicates that there is a strong effect of lexical frequency, with frequent words ahead in the sound change.

Thus /æ/ is like many other sound changes in that frequent words are leading the change.

Of the tokens analyzed, 92 of them were from the word *hand*. We were therefore interested in whether the sound change was differently advanced in different realizations of this word—particularly, is the phonetics of phrases like *give a hand* different from the phonetics of *hand* when it refers to a limb? Phrases such as *give a hand* are relatively non-transparent, and so provide an obvious place to start looking if we suspect a relationship between stored phrases and the progression of sound change.

We coded the cases of *hand* into the following categories.

- Limb: Cases in which the word clearly refers to the limb, or to doing an activity with the limb, e.g. *he washed his hands, put one hand up, wash everything by hand*
- Give: Cases in which *hand* occurred in one of the following senses: *give a hand, lend a hand, try one's hand, turn one's hand to, have a hand in*
- Other: Other cases in which *hand* is used figuratively, e.g. *left-hand turn, in good hands,*

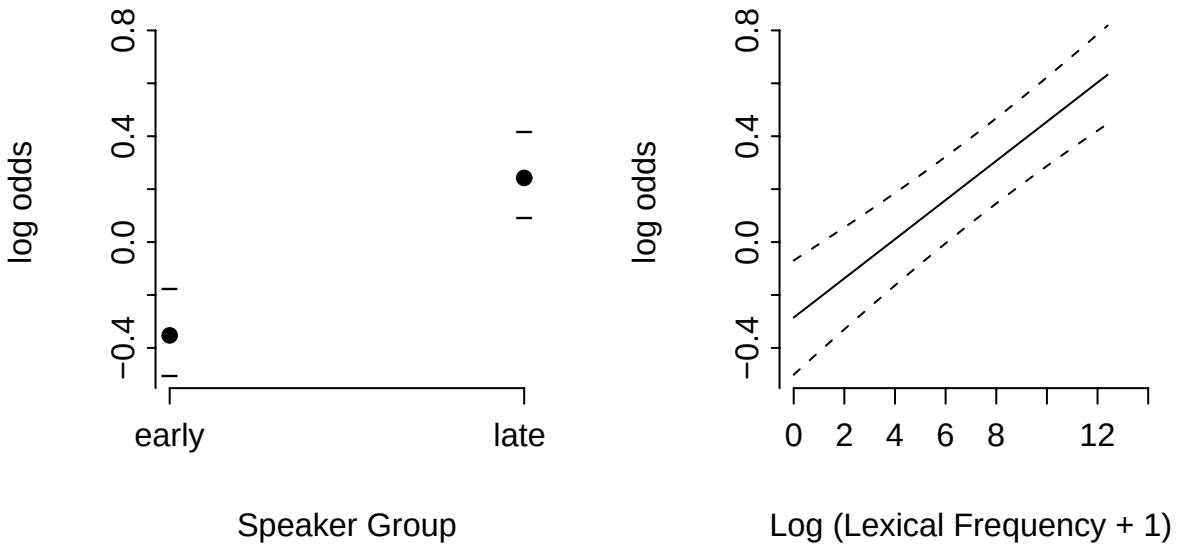

Figure 1: Log Odds of Raising

on the other hand, close at hand

We then attempted to fit a simple logistic regression model. The resulting simple model is shown in Table 2, and the co-efficients are in 3. Co-efficients range from negative infinity to positive infinity, and show the direction and extent of the effect on raising of values of the independent variables, relative to the default values which are not shown. E.g. the positive coefficient for *Age=late* indicates that the late speaker group shows more raising than the default early speaker group (which has a coefficient of 0 by default). The positive coefficients for both the 'limb' and the 'other' category of *hand* show that both of these show more raising than the default 'give' category. These effects are most easily seen in figure 2, which plots the predictions of the model. As with the full data-set, we see an effect of speaker age, with earlier-born speakers less likely to use a raised vowel in *hand* than later-born speakers. Comparing the left panel of Figures 1 and 2 reveals that *hand* is more likely to contain a raised vowel than the overall data-set is. This is likely to be a function of both the fact that

it is a relatively frequent word, and that the following nasal facilitates raising (see Gordon et al. 2004).

The right panel of Figure 2 reveals that the likelihood of raising in *hand* depends on the semantics of the token in question. It is highly likely to be raised in 'limb' meanings (the most frequent meaning), and much less likely in cases such as *give a hand*. Other figurative meanings such as *right-hand side* fall between these cases, but pattern more closely with the 'limb' meanings than the 'give' meanings. The 'give' cases are significantly different from the 'limb' cases ($p<.01$), and near-significantly different from the 'other' cases ($p<.06$). Recall that the data-set this is based on is relatively small (a total of 94 tokens) and so, while significant, this trend should nonetheless be treated with appropriate caution.

Note, too, that we have not distinguished between the frequencies of the different phrases in our different coding categories (e.g. *give a hand* is likely more frequent than *try one's hand*, and *an old hand* no doubt differs in frequency from *in good hands*). In a fuller study, one may want to tag such items with their frequency of occurrence in a very large corpus. We have not done this here for two reasons. First, our data set is small, and the introduction of further degrees of freedom into our model would be statistically problematic. Second, establishing such frequencies would actually be a substantial undertaking. Whether *hand* is being used to refer to a limb or not is not always establishable by form alone - one would need to inspect the context. And even then, a large amount of decision making would be involved in establishing what counts as the same 'phrase'. Are all tokens of *hand* referring to a limb tagged with the same frequency? Are *try your hand* and *tried one's hand* given the same frequency? What about *left-hand side* vs *right-hand door*? Many assumptions would be necessary in order to conduct such an analysis.

Due to the relatively small sample, the results here should only be regarded as suggestive. This is nonetheless a fairly marked difference in frequency of raising – 33% of the *give* tokens are raised, as compared to 90% of the *limb* tokens and 76% of the *other* tokens. This certainly suggests that a larger-scale study would be warranted. We return to a discussion of this result in Section 4.

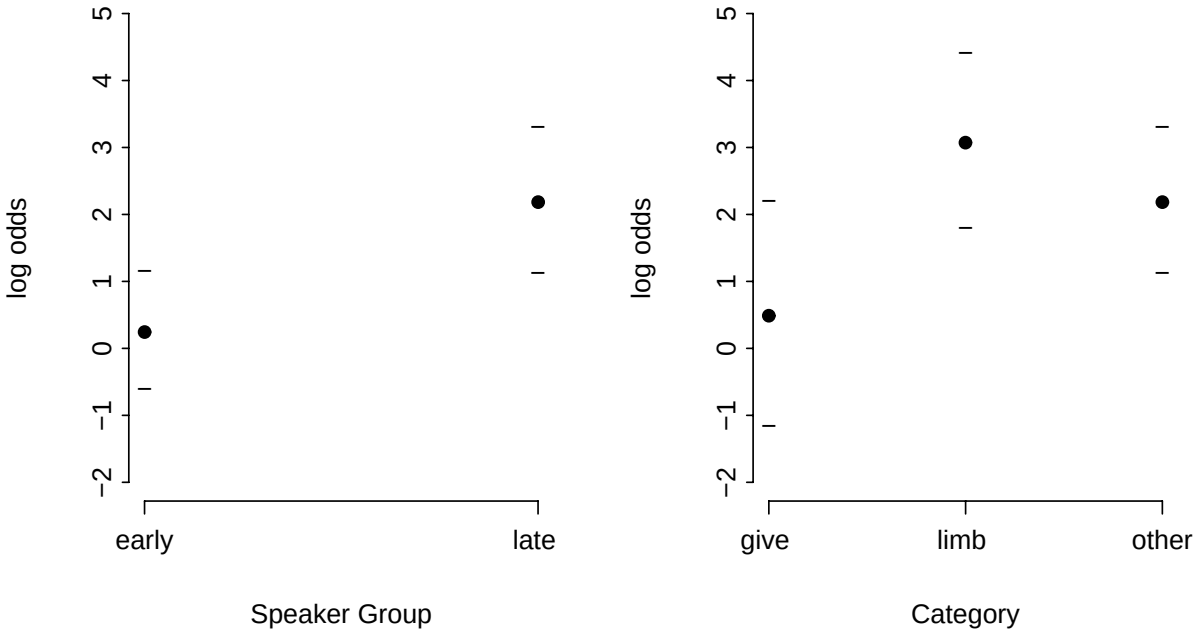

Figure 2: Log odds of Raising - 'Hand' only

Table 2: Wald Statistics for `vowel raising in 'Hand'` (based on 92 tokens)

	χ^2	$d.f.$	P
Age	9.97	1	0.002
category	7.28	2	0.026
TOTAL	16.79	3	0.001

Table 3: Co-efficients for `vowel raising in 'Hand'` (based on 92 tokens)

model	
Intercept	−1.45
Age=late	1.94
category=limb	2.59
category=other	1.69

3.2 Sound change and *give*

The raising of /æ/ had considerable consequences in New Zealand English. It lead to a chain-shift, in which /ɛ/ raised into the space of /ɪ/, and /ɪ/ consequently centralized (Gordon et al. 2004). The chain-shift is still in progress in NZE, with /ɛ/ now in the space of /i/, and /i/ diphthongizing as a result (Maclagan and Hay 2004). Both /æ/ and /ɛ/ continue to rise, and /ɪ/ continues to centralize. Between 1900 and 1930 was the time in which the /ɪ/ vowel shifted most radically (Langstrof 2003, in press).

We were intrigued to know whether there was any sign of variability in the centralization of /ɪ/ in *give* during this time. During his time as a post-doc in the ONZE project (2002-2003), Daniel Schreier conducted an auditory analysis of the /ɪ/ vowel in speakers from the Intermediate Archive. The full results of this analysis have not been published; however Daniel kindly agreed to let us examine his analysis of the vowel in the word *give*. He analyzed 53 tokens of *give*, from speakers from the Intermediate Archive, born 1896-1931. Centralized

tokens are realized as [ɪ̟] or [ɨ].

Before turning to an analysis of the *give* tokens, we checked the entire dataset of 3886 tokens in order to establish whether lexical frequency was involved in the sound change. As with /æ/ we found a significant effect of lexical frequency, with more frequent words more likely to contain centralization ($p < .05$ in a logistic regression model).

With this as background, we turned to the tokens of *give*, in order to establish whether syntactic context might affect the realization.

We classified these tokens into three categories:

- DA-transfer: cases of the dative alternation in which there was a transfer meaning, e.g. *sometimes he used to give us presents, she'd give us a plate full of food.*
- DA-abstract: cases of the dative alternation in which the meaning was not one of transferal, e.g. *they used to give the horses a spell there, he would give us the strap.*
- Other cases, including passives, preposed forms, phrasal verbs and cases in which the recipient or theme was implied. *we were occasionally given licorice, we wore what our parents could afford to give us, she had to give it away, the driver he said give it up.*

The reasoning behind this categorization is that our work on the syntactic realization of phrases involving *give* reveals that the difference between abstract and transfer meanings of *give* is syntactically relevant, with abstract uses much more often leading to the double object construction (e.g. *I gave him the idea*) rather than the use of a prepositional phrase (*I gave the idea to him*). This is true both in US and NZ English (Bresnan and Hay in prep). We wondered whether the importance of this factor was also reflected in the phonetic domain.

We fit a logistic regression model to the data, incorporating this factor, and also a factor for the speaker's age, with 'early' speakers born 1896-1915, and 'late' speakers born 1916-1931. The resulting model is shown in Table 5, and the coefficients are shown in 4.

The predictions of the model are shown in Figure 3. As expected, later-born speakers are considerably more likely to produce centralized tokens of /ɪ/ than earlier-born speakers.

Table 4: Co-efficients for `centralization` (based on 53 tokens)

model	
Intercept	0.87
category=DA-transfer	−3.55
category=other	−2.905
Age=late	2.505

Table 5: Wald Statistics for `centralization` (based on 92 tokens)

	χ^2	$d.f.$	P
category	8.84	2	0.012
Age	8.78	1	0.003
TOTAL	11.67	3	0.008

In addition, the syntactic/semantic categorization also proved significant, with cases of the dative alternation with abstract semantics considerably more likely to be produced with centralized /ɪ/. The number of tokens we are dealing with is relatively small, but the effect of the semantics does seem to be strong, with 70% of tokens with abstract themes displaying centralisation, as opposed to 15% of tokens with a transfer meaning.

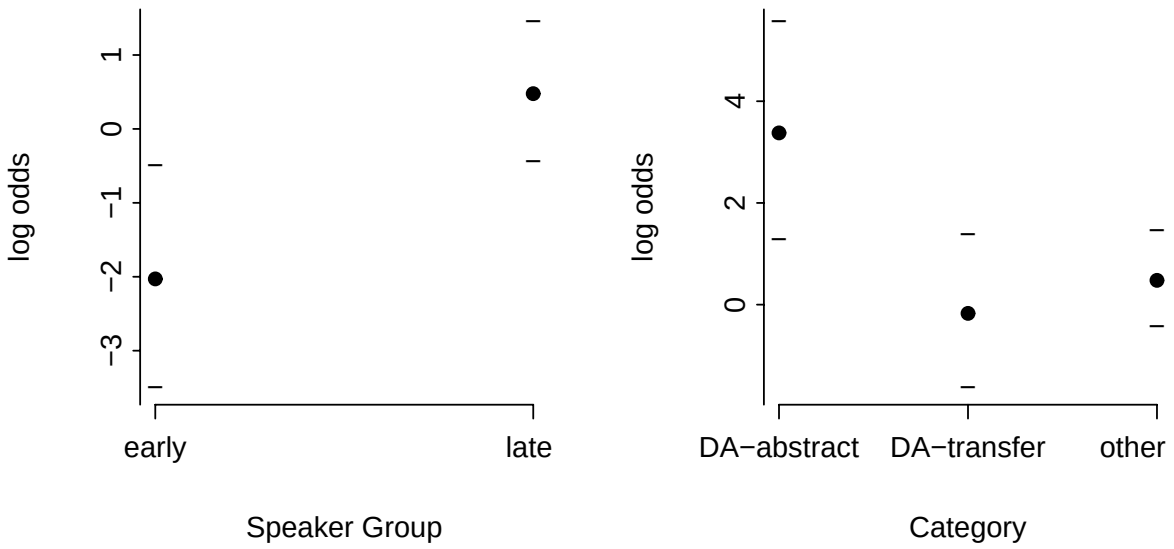

Figure 3: Log Odds of Centralization - 'Give' only

Taken together, the results for the phonetics of *hand* and *give* suggest that syntax/semantics may play an intriguing role in phonetic sound change. We now turn to a discussion of potential explanations for these effects.

4 Discussion

In a sound change involving /æ/, the word *hand* was more advanced when referring to a limb than when used in more metaphorical sense. In a subsequent sound change involving /ɪ/ the word *give* was more advanced when referring to abstract themes (such as *give a call*) than when referring to a transfer of possession. In the phrase *give a hand*, then, the vowel in *give* was quite advanced in its sound change, whereas the vowel in *hand* was quite retarded. How can we explain the directionality of these effects?

A combined phonetic/syntax exemplar approach would predict that more frequent phrases (or meanings) may tend to be ahead in sound changes. An obvious first place to look, then,

is whether the more advanced variants in these changes are occurring in the most frequent contexts. Of course, we need to be careful about what units we calculate frequency over. Should one calculate the combined token frequency of all *gives* with a transfer meaning, relative to *gives* with an abstract meaning? This would be relatively straightforward to calculate, and may give us some indication of which we should predict to be more advanced. However what may be more relevant is the average token frequency per type. Do phrases like *give a hand* and *give a call* tend on average to be more frequent than phrases such as *give a watch* or *give a present*? If we believe that these (or some of these) are stored separately, then the frequency of these individual phrases may be more relevant than the combined frequency of each of them.[2]

Starting with *give* – we find that tokens of *give* with abstract themes are the most frequent in our database of 2794 tokens of dative-alternation *give* from US and NZ English (Bresnan and Hay in prep). They consitute 60% of tokens. So in terms of token frequency, the more frequent type is indeed the most advanced in the sound change.

In order to investigate the frequency profile more carefully, we consulted our *give* database, defining types by identifying head words. That is *give a chance, give another chance* and *give one more chance* would all be counted as one type. There were 720 abstract types and 506 transfer types. The average token frequency per abstract type was 2.3. The average token frequency per transfer type was 2.2. The single most frequent type was the theme 'it', which occurred in a transfer context 138 times. The average token frequency per transfer type excluding *it* was 1.9. The individual token frequencies of abstract types are significantly greater than that of transfer types (wilcoxon test, $p<.05$). While 73 abstract types occurred

[2]For example, a combined count of 100 observed 'give-transfer' cases might theoretically consist of 50 observed tokens each of two different phrases, or of five observed tokens each of ten different phrases. Because the individual phrases tend to be more frequent in the former than the latter, we might also expect them to be more advanced in a sound change. While the combined token frequency of each is 100, the average token frequency per type is 50 in the former and 5 in the latter. The latter count therefore seems likely to be more revealing. The combined token frequency is likely to be relevant only to the extent that the 'give-transfer' category is cognitively real, and active during speech production.

5 or more times in the corpus (e.g. *chance*, *type*, *right*), only 28 transfer types did (e.g. *money*, *dollars*, *one*).

Thus, no matter how you conceptualize frequency, the abstract meaning is the more frequent. There are more abstract tokens, there are more abstract types, and the average token frequency of the abstract types is higher. Thus we are on solid ground in claiming that the more frequent form is more advanced in the sound change.

This data on the frequency of usage of *give* is more robust than we are able to rally for the usage of *hand*, as we have no comparably sized *hand* database. We can assess the token frequencies by investigating the small corpus of *hands* analyzed in section 3.1. There, the most frequent use of *hand* was that in which it literally referred to a part of the body (54% of our tokens). This usage was also the most advanced in the sound change. In terms of overall token frequency, then, the most frequent use is also the most advanced in the sound change.

We do not have available to us a large tagged database from which to assess the average type frequency or the average token frequency per type. However if we did have such a database, our guess is that we would find that despite the fact that *give a hand* is much less frequent than the use of *hand* as a limb, it is probably still more frequent than an average phrase containing the limb meaning (e.g. *hold out your hand, her hand was cold, her hand is bigger than her face...*).

Interpreting frequency purely at the phrase level, then, phrases such as *give a hand* are likely to be be quite frequent in the context of all phrases containing *hand*, i.e. we predict the average token frequency per type to be lower for 'limb' phrases than other phrases. If this turned out to be the case, we would need an account of why these relatively infrequent *hand*=limb phrases should actually be leading in the sound change raising /æ/.

How, then, to resolve this apparent conflict? The problem is that in absolute tokenwise terms, *give*-abstract and *hand*-limb are more frequent than their respective counterparts, but we suspect that only *give*-abstract also contains *types* which tend to be more frequent.

Our instinct is that the fact that *hand* is a noun and *give* is a verb may be important here.

Under a syntactic exemplar approach, one would assume that all phrases of a specific length would be retained in memory. However, because memories decay, only those phrases (or the subparts of those phrases), which occur with some frequency will accumulate a distribution which is robust, and utilized during production and perception. Thus, while a phrase such as *the microwave broke* may be stored when it is encountered, the memory of this phrase will decay over time in the absence of further reinforcement. However the memory of the word *microwave* is also stored in the *microwave* distribution, which is likely to be relatively robust (assuming mention of *microwave* has also been encountered in other phrases).

Because the association between verbs and their objects tends to be more restricted than, for example, between verbs and their subjects, one can assume this would lead to more frequent encounters of verb + object pairs than subject + verb pairs. This would lead to more robust storage of the former than the latter, leading nouns to have slightly more independent representations overall than verbs. More concretely, in the case of nouns (like *hand*), the independent 'limb' representation may tend to dominate access (because it sufficiently frequently occurs in subject position). Exceptions would include cases like *give a hand* or *lend a hand*, which, while not as frequent as *hand* (limb) are frequent enough to have their own representation play a role in access. This interpretation would predict that something like *take my hand* may also be somewhat retarded in the sound change, despite the 'limb' meaning, because it is frequent enough to have developed an independent representation.

Give, however, is a verb which will almost always be encountered with a theme. Because of the restrictions on the 'give+theme' pairing, most items which occur in the theme position are likely to do so with some level of frequency. So regardless of whether the meaning is abstract or transfer, relevant stored phrasal items are likely to be available for access. Of all stored *give* phrases, 'transfer' types tend to have lower token frequency, leading them to be more phonetically conservative in the context of the sound change.

In the phrase *give a hand*, then – *give* is advanced in its sound change, because *giving a hand* is more frequent than the giving of most other individual objects. But *hand* is

conservative in its sound change, because the representation of *give a hand* is less frequent than the highly frequent independent representation for *hand* = limb.

Regrettably, there is a slight catch-22 to the argumentation here. We would like to probe whether phrases are stored, and one way to do this is to look for a correlation between phrasal frequency and sound change. However in order to confidently calculate phrasal frequency, one already needs a relatively well-developed idea of exactly *which* phrases are stored, and *how* they are stored.

Note that phrases could be stored in distributed form, across several word-level exemplar clouds. Individual exemplars would be tagged with contextual information - this could include the linguistic context in which the word was encountered, as well as the real-world context. During retrieval, exemplars which are tagged with relevant contextual information would be most activated, leading different subsets of exemplars to be activated in different linguistic and real-world contexts. If a particular context was frequently encountered, this would lead the associated exemplars to be more advanced in an ongoing sound change than sets of exemplars which were associated with less frequent contexts. Under this interpretation, the phrasal storage - while still implicit in the representation, need not be primary. Rather, information about the syntactic context works together with storage of other semantic, contextual and social information.

The alternative to positing storage of contextual information is to attribute the results to different representations of the same lexical item. For example there could be two discrete lexical entries for *hand* – one entry with a 'limb' meaning, and one with a more abstract meaning relating to helping out. Similarly, *give* would contain an entry for 'transfer of possession' and one with a more abstract meaning. This explanation could potentially capture the result that there are phonetic differences between these different entries without recourse to storage of phrases. This would suggest that lexical storage involves a lot more syntactic analysis than often assumed (in accordance with most lexicalist theories of syntax - see Goldberg 1995; Rappaport Hovav and Levin 1998; Bresnan 2001, ch. 14). And it would require the exemplar theories currently developing in phonetics to give considerably more thought

to what should count as exemplars of the 'same' word.

Any one of the above interpretations raises intriguing possibilities for the study of the syntax-phonetics interface. Of course, a final possible interpretation is that there is some third factor which happens, co-incidentally, to correlate with both the meaning and the degree of advancement in each of these sound changes. For example, one might imagine that 'limb' meanings are more often in focus position than non-limb meanings, and that words with a pitch accent show more extreme variants of a sound change than those without. While we don't believe this to be true in the current data-set, something along these lines could be true in general. Work by Michael Kelly (1988, 1992) and Joan Bybee (2000a) shows that words tend to acquire the phonetic representation that reflects the environment in which they most often occur. If something along these lines were responsible for the results above, it would still require the different *hands* and *gives* to be in some way distinguished in the lexicon.

It is worth noting that some sociolinguists and historical linguists have argued that lexical diffusion does not exist (see discussion in Labov 1994). They would argue that reported lexical effects are artifacts of phonological conditioning and/or stable frequency-based phonetic reduction effects. Our results strongly parallel previous lexical diffusion results, but are very difficult to write off in the same ways. Phonological conditioning seems unlikely to be able to account for the difference in production of the different instances of the vowels in *hand* and *give*, as the vowel's immediately surrounding phonological context is, of course, identical. And vowel raising, at least, is not a reductive sound change. Analysts have argued that frequency effects in changes such as /t/-deletion do not reflect sound change, but rather an effect in which higher frequency leads to reduced articulatory effort. Indeed, one of our reviewers is concerned that many results cited as supporting an exemplar approach could in fact be accounted for by an approach in which contextual support and frequency jointly determine degree of reduction. They argue that greater predictability during production would lead to greater reduction, without any need to posit phonetic detail in the storage of syntactic phrases. While a relationship between predictability and reduction certainly exists,

it is difficult to argue that this is what is driving the differences in the articulation of *hand*. This change in /æ/ is not reductive, but rather involves slightly different articulations of the same vowel.

It could be argued that the sound change in *give* is reductive – the vowel is considerably centralized. For this reason, it is also worth entertaining the possibility that the semantic load carried by the verb may play some role. Part of the reason that frequent words tend to be phonetically reduced is that they are relatively predictable from their contexts, and carry a low informational load. Thus, they can be produced with less articulatory effort, and are also available to carry stylistic meaning (Hay et al 1999, Mendoza-Denton et al 2003). It is possible that this link between articulation and informativeness carries over to the phrasal level. We know from work in morphology that a morpheme which carries semantic load tends to be articulated more fully than one that does not (Hay 2003). We also know that the relative frequency of the whole and the parts plays a strong role in mediating the degree to which stored representations are decomposed into their parts (Hay 2001). We should predict these might also play some role in syntax. Indeed, consideration of the semantic load carried by *give* does present a possible interpretation of the effect.

Give is one of the 'light verbs' of English (Cattell 1984), which form composite predicates with their complements (*give a hug, have a look*). The meaning of a composite predicate with *give* is determined by the choice of theme; witness the widely varying meanings of *give a hand* ('help' or 'applaud'), *give a chance* ('let have an opportunity'), and *give a dirty look* ('look at in a hostile way'). The 'give' component can become attenuated to the mere sense of affecting the theme in some way. In contrast, when *give* is used to denote transfers of possession of concrete objects, the meaning remains relatively stable across the choice of theme argument: *give an apple*, *give a towel*, *give a pen*.

Hence, within its syntactic context *give* arguably carries less information in an abstract use like *give a chance*, but rather more information in a transfer use like *give a towel*. Perhaps, then, the former is more likely to be produced with less articulatory effort than the latter (and a centralized /ɪ/ is less articulatory effort than a front variant). Perhaps

the low semantic load of *give* in *give a chance* frees it up for stylistic use and the display of extreme phonetic variants. A similar account could be given of the reduction of *don't* in phrases such as *I don't know* reported by Bybee and Scheibman (1999). In this account, what's important is not that /ɪ/ is undergoing change, so much as one of its variants requires less articulatory effort than the other. Such an explanation cannot be offered for the results with *hand*, highlighting the importance of staying open to the possibility that the two effects reported here may not necessarily stem from identical processes.

Without further work, it is difficult to disentangle which of the above effects (or which combination of them) is driving our effects. However they certainly provide evidence in support of the notion that sound change can spread through the lexicon. Further, they suggest that the 'lexicon', in this context, may include units — or information about syntactic context — much longer than the word.

While we are not able to offer definitive answers to the questions raised by these results, they suggest many avenues for future research. We suspect that the issues can only be addressed by research which combines the efforts of phoneticians and syntacticians. While they may on the surface seem strange bedfellows, combining the assumptions of the exemplar theories which are separately developing in syntax and phonetics raises a myriad of open questions and possibilities for future research.

5 Spoken Syntax

As evidenced by the range of papers in this special issue, Exemplar Theory is gaining currency in a range of linguistic subfields. Our investigation into the phonetics of phrases in early NZ English has revealed some surprising results, which lend reinforcement both to the idea that phrases may be stored, and to the idea that this storage may be phonetically detailed. Understanding the exact nature of these effects will necessitates a precise theory about the relationship between syntactic storage and phonetic information. We don't pretend to have one on offer.

However, as inquiry into exemplar approaches develops, our preliminary results do suggest

that there may be some unexpected points of connection between traditionally quite distinct fields of linguistics.

Taking exemplar theory in syntax, and considering its implications when considered jointly with models of speech production and perception strikes us as a very interesting line of inquiry. If phrases were stored, but with no phonetic detail, then this would make them very different from lexical items, leading to potential insights into the nature of levels of representation. If they were stored complete with phonetic detail, then this would raise a huge raft of research questions and predictions which have not previously been investigated. And if some types of phrases/constructions appear to have phonetically rich distributions but others do not, then this would certainly provide some insight into the representation of different types of phrases. In short, if one hypothesizes that the exemplar view of syntax and the exemplar view of phonetics are approximately right, then putting them together raises some very interesting questions which could shed considerable light on a variety of fields.

From the perspective of phonetics, the storage of phonetically rich phrases would cause us to further widen the scope of study, to possibly reconceptualize the set of items over which phonological generalizations are drawn, and to entertain the possibility that speech perception proceeds by matching larger stored 'chunks' than just words.

From a syntactic point of view, phonetic detail could potentially provide a tool for probing the syntax—a phonetic mirror through which reflect to the storage units and underlying structure. From a sociolinguistic point of view, storage of phonetically rich phrases may require sociolinguists to massively widen the 'linguistic factors' that they investigate in the study of sound change. Lexical frequency is itself only investigated by a subset of sociolinguists, who tend to focus on social predictors of variation, and linguistic factors such as the immediately following and proceeding phonological environment. However if a much wider syntactic/semantic context is involved in conditioning phonological variation and change, this would certainly be a methodological consideration which sociolinguists should take into account.

There is also the question of social indexing. If a particular syntactic construction is

favored by a certain social group (e.g. younger speakers), will this cause that construction to sound more 'well-formed' when spoken by a younger voice than an older voice? If social indexing at the syntactic level functions as it seems to amongst words, then social factors may cause different levels of activation amongst distributions, which would presumably provide a different exemplar set on which to make a syntactic judgments. An experiment recently conducted at the University of Canterbury suggests that this may, indeed, be the case. Walker (2005) asked participants to rate the grammaticality of recorded utterances, and found that the identity of the speaker significantly affected participants' grammaticality ratings.

In addition, we might predict that, through the association of different phrases with different types of speakers, unexpected differences in sound change may be observed. For example the phonetics of *give* could potentially be less advanced in a sound change in phrases like *give a lecture* (perhaps used more by conservative speakers), than phrases like *give a damn*.

Further, uniting these lines of inquiry could encourage a more syntactically informed approach to investigating the storage of individual lexical items. Phoneticians working in exemplar theory argue that the representation of a lexical item is a distribution of stored encounters with that word. But what counts as the 'same' lexical item, exactly? Are singular and plural *sheep* the same? Is *jump* the same when a noun and a verb? Is *cool* the same when it refers to a temperature, as when it is an assessment of hipness? At the very least, if individuals remember items complete with phonetic and social detail, the linguistic context is also likely to be relevant. Contextual indexing of stored exemplars may lead us to activate contextually relevant exemplars in speech perception, predicting possible phonetic differences between, e.g. the two meanings of *cool*.

Our results suggest that different syntactic objects participate in sound change to different degrees, just as different lexical items do. But what kinds of syntactic objects, exactly? Are full phrases (e.g. *give him a call*) stored? Do nouns and verbs behave differently in terms of the amount of context stored?

These possible avenues for the study of 'spoken syntax', certainly suggest that exemplar-theoretic approaches to syntax and phonetics may benefit from investigations into their joint predictions. There is obviously much to be worked out - both on the 'syntactic' and the 'phonetic' side of the exemplar literatures, let alone in terms of how they may work together. Our small pilot studies are suggestive, but clear conclusions cannot be drawn without a series of further investigations along similar lines. What we can say, though, is that there seems to be evidence that explorations at the syntax-phonetic interface may bear fruit, and insights and consequences for both syntax and phonetics are likely to follow. The existence of such effects certainly lends support both to the idea (from syntactic exemplar theory) that phrases are stored, and the idea (from phonetic exemplar theory) that lexical representations are phonetically detailed.

6 Conclusion

We have examined various aspects of the phonetics of phrases in the history of New Zealand English, and demonstrated that the different syntactic/semantic constructions can be differently involved in phonetic change. In particular, frequent phrases appear to be most advanced in the sound changes we studied. There are a variety of possible interpretations of these results, and they point to the importance of future work considering the involvement in sound change of units higher than the word.

The involvement of phrases in sound change would not be predicted by exemplar theories of syntax, nor by the exemplar theories which are currently developing in phonetics. However if we put the assumptions of these theories together, some surprising predictions emerge. One of these predictions is that phrases may be stored in memory complete with phonetic detail. This would account for the results discussed in this paper, and would present a large number of questions for future research.

References

Anttila, Arto, & Vivienne Fong. 2004. Variation, ambiguity and noun classes in English. *Lingua* 114.1253–1290.

Bayley, Robert. 2002. The quantitative paradigm. In *Language Variation and Change*, ed. by J.K. Chambers, Peter Trudgill, & Natalie Schilling-Estes, 116–141. Mass.: Blackwell Publishers Ltd.

Bock, Kathryn. 1986. Syntactic persistence in language production. *Cognitive Psychology* 18.355–387.

——. 1989. Closed class immanence in sentence production. *Cognition* 31.163–186.

——, & Helga Loebell. 1990. Framing sentences. *Cognition* 31.1–39.

Bod, Rens. 1998. *Beyond Grammar: An Experience-Based Theory of Language*. Stanford: CSLI Publications, Cambridge University Press.

——. 2000. The storage vs. computation of three-word sentences. In *Proceedings of AMLaP 2000*.

——. 2001. Sentence memory: the storage vs. computation of frequent sentences. In *Proceedings CUNY-2001 Conference on Sentence Processing*, Philadelphia, PA.

——, & Ronald Kaplan. 2003. A data-oriented parsing model for lexical-functional grammar. In *Data-Oriented Parsing*, ed. by Rens Bod, Remko Scha, & Khalil Sima'an. Stanford: CSLI Publications.

——, Remko Scha, & Khalil Sima'an (eds.) 2003. *Data-Oriented Parsing*. Stanford: CSLI Publications.

Boersma, Paul, 2004. A stochastic OT account of paralinguistic tasks such as grammaticality and prototypicality judgments. On-line, Rutgers Optimality Archive.

——, & Bruce Hayes. 2001. Empirical tests of the gradual learning algorithm. *Linguistic Inquiry* 32.45–86.

Branigan, Holly P., Martin J. Pickering, & A.A.Cleland. 2000. Syntactic co-ordination in dialogue. *Cognition* 75.B13–B25.

Bresnan, Joan. 2001. *Lexical-Functional Syntax*. Oxford: Blackwell.

——, & Jennifer Hay, in preparation. Gradient grammar: the effect of animacy on the syntax of *give* in varieties of English.

——, & Tatiana Nikitina, 2003. On the gradience of the dative alternation. On-line, Stanford University: http://www-lfg.stanford.edu/bresnan/download.html.

Bush, Nathan. 2001. Frequency effects and word-boundary palatization in English. In *Frequency and the Emergence of Linguistic Structure*, ed. by Joan Bybee & Paul J. Hopper, 255–280. John Benjamins Publishing Company.

Bybee, Joan. 2000a. Lexicalization of sound change and alternating environments. In *Papers in Laboratory Phonology 5*, ed. by Michael Broe & Janet Pierrehumbert, 250–268. Cambridge: Cambridge University Press.

——, 2000b. Mechanisms of change in grammaticalization: The role of frequency. Manuscript.

——. 2002. Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change. *Language Variation and Change* 14.261–90.

Bybee, Joan L., & Joanne Scheibman. 1999. The effect of usage on degrees of constituency: the reduction of *don't* in English. *Linguistics* 37.575–596.

Cattell, Ray. 1984. *Syntax and Semantics: Composite Predicates in English*, volume 17. Sydney: Academic Press.

Chang, Franklin, Gary S. Dell, & Kathryn Bock. in press. Becoming syntactic. *Psychological Review* .

Cheshire, Jenny. 1987. Syntactic variation, the linguistic variable and sociolinguistic theory. *Linguistics* 25.257–282.

Cutting, J. Cooper, & Kathryn Bock. 1997. That's the way the cookie bounces: Syntactic and semantic components of experimentally elicited idiom blends. *Memory and Cognition* 25.57–71.

Drager, Katie. in press. From bad to bed: an investigation of vowel perception in New Zealand English. *Te Reo* .

Ellis, Nick. 2002. Frequency effects in language processing. *Studies in Second Language Acquisition* 24.143–88.

Eulitz, Carsten, & Aditi Lahiri. 2004. Neurobiological evidence for abstract phonological representations in the mental lexicon during speech recognition. *Journal of Cognitive Neuroscience* 16.577–583.

Ferreira, Victor S. 1996. Is it better to give than to donate? syntactic flexibility in language production. *Journal of Memory and Language* 35.724–755.

Fidelholz, James. 1975. Word frequency and vowel reduction in English. In *Papers from the 75th meeting of the Chicago Linguistics Society*, 200–213. University of Chicago.

Flores D'Arcais, Giovanni B. 1993. The comprehension and semantic interpretation of idioms. In *Idioms: Processing, Structure and Interpretation*, ed. by C. Cacciari & P. Tabossi, 79–98. Lawrence Erlbaum Associates.

Foulkes, Paul, & Gerry Docherty. 2006. The social life of phonetics and phonology. *Journal of Phonetics* in press.

Gahl, Susanne, & Susan M. Garnsey. 2004. Knowledge of grammar, knowledge of usage: Syntactic probabilities affect pronunciation change. *Language* 80.748–775.

Goldberg, Adele. 1995. *Constructions: A construction grammar approach to argument structure*. Chicago: University of Chicago Press.

Goldwater, Sharon, & Mark Johnson. 2003. Learning OT constraint rankings using a maximum entropy model. In *Proceedings of the Stockholm Workshop on Variation within Optimality Theory*, ed. by Jennifer Spenader, Anders Eriksson, & Östen Dahl, 111–120. Stockholm University.

Gordon, Elizabeth, Lyle Campbell, Jennifer Hay, Margaret Maclagan, Andrea Sudbury, & Peter Trudgill. 2004. *New Zealand English: Its Origins and Evolution*. Cambridge: Cambridge University Press.

——, Margaret Maclagan, & Jennifer Hay. in press. The ONZE corpus. In *Models and Methods in the Handling of Unconventional Digital Corpora. Volume 2: Diachronic Corpora*, ed. by Joan C. Beal, Karen P. Corrigan, & Hermann Moisl. Palgrave.

Gregory, Michelle, William Raymond, Eric Fosler-Lussier, & Dan Jurafsky. 2000. The effects of collocational strength and contextual predictability in lexical production. In *Proceedings of the 35th Chicago Linguistic Society 1999*, 151–166. Chicago: Chicago Linguistic Society.

Hawkins, Sarah. 2003. Roles and representations of systematic fine phonetic detail in speech understanding. *Journal of Phonetics* 31.373–405.

——, & Paul Warren. 1994. Phonetic influences on the intelligibility of conversational speech. *Journal of Phonetics* 22.493–511.

Hay, Jennifer. 2001. Lexical frequency in morphology: Is everything relative? *Linguistics* 39.1041–1070.

——. 2003. *Causes and Consequences of Word Structure*. New York and London: Routledge.

——, Norma Mendoza-Denton, & Stefanie Jannedy. 1999. Oprah and /ay/: Lexical frequency, referee design, and style. In *Proceedings of the 14th International Congress of Phonetic Sciences*, San Francisco.

——, & Andrea Sudbury. 2005. How rhoticity became /r/-sandhi. *Language* 81.799–823.

——, Paul Warren, & Katie Drager. 2006. Factors influencing speech perception in the context of a merger-in-progress. *Journal of Phonetics* in press.

Hintzman, Douglas L. 1986. Schema abstraction in a multiple-trace memory model. *Psychological Review* 93.411–428.

Hooper, Joan B. 1976. Word frequency in lexical diffusion and the source of morphophonological change. In *Current Progress in Historical Linguistics*, ed. by W. Christie, 96–105. Amsterdam: North Holland.

Jackendoff, Ray. 2002. *Foundations of Language*. Oxford: Oxford University Press.

Jäger, Gerhard. in press. Maximum entropy models and Stochastic Optimality Theory. In *Architectures, Rules, and Preferences: A Festschrift for Joan Bresnan*, ed. by Jane Grimshaw, Joan Maling, Chris Manning, Jane Simpson, & Annie Zaenen. Stanford: CSLI Publications.

——, & Anette Rosenbach. to appear. The winner takes it all – almost. *Linguistics* .

Johnson, Keith. 1997. Speech perception without speaker normalization. In *Talker variability in speech processing*, ed. by Keith Johnson & John Mullenix, 146–165. San Diego: Academic Press.

——. 2006. Resonance in an exemplar-based lexicon: the emergence of social identity and phonology. *Journal of phonetics* in press.

——, Elizabeth Strand, & Marianna D'Imperio. 1999. Auditory-visual integration of talker gender in vowel perception. *Journal of Phonetics* 24.359–384.

Jurafsky, Dan. 2003. Probabilistic modeling in psycholinguistics: Linguistic comprehension and production. In *Probabilistic Linguistics*, ed. by Rens Bod, Jennifer Hay, & Stefanie Jannedy, 39–95. Mass.: MIT Press.

Jurafsky, Daniel, Alan Bell, Michelle Gregory, & William D. Raymond. 2001. Probabilistic relations between words: Evidence from reduction in lexical production. In *Frequency and the Emergence of Linguistic Structure*, ed. by Joan L. Bybee & Paul Hopper, 229–254. Amsterdam: Benjamins.

Kelly, Michael. 1988. Rhythmic alternation and lexical stress differences in English. *Cognition* 30.107–137.

——. 1992. Using sound to solve syntactic problems: The role of phonology in grammatical category assignments. *Psychological Review* 99.349–364.

Klatt, D. H. 1979. Speech perception: A model of acoustic-phonetic analysis and lexical access. *Journal of Phonetics* 7.279–312.

Krug, Manfred. 1998. String frequency: A cognitive motivating factor in coalescence, language processing and linguistic change. *Journal of English Linguistics* 26.286–320.

Labov, William. 1969. Contraction, deletion and inherent variability of the English copula. *Language* 45.715–62.

——. 1994. *Principles of Linguistic Change, Vol.1: Internal Factors*. Cambridge, MA: Blackwell.

Lahiri, Aditi, & William D. Marslen-Wilson. 1991. The mental representation of lexical form: A phonological approach to the recognition lexicon. *Cognition* 38.245–294.

Langacker, Ronald. 1998. Conceptualization, symbolization and grammar. In *The New Psychology of Language: Cognitive and Functional Approaches to Language Structure*, ed. by Michael Tomasello, 1–39. Mahwah, New Jersey: Laurence Erlbaum.

Langstrof, Christian. 2003. The short front vowels in New Zealand English in the Intermediate period. *New Zealand English Journal* 17.4–16.

——. in press. Acoustic evidence for a push-chain shift in the Intermediate period of New Zealand English. *Language Variation and Change* .

Levelt, Pim. 1989. *Speaking: from intention to articulation*. Cambridge, MA: MIT Press.

Levelt, Willem J., & Stephanie Kelter. 1982. Surface form and memory in question answering. *Cognitive Psychology* 14.78–106.

Lieberman, Philip. 172-187. Some effects of semantic and grammatic context on the production and perception of speech. *Language and Speech* 6.

Macaulay, Ronald. 1991. *Locating Dialect in Discourse : The Language of Honest Men and Bonnie Lasses in Ayr*. Oxford: Oxford University Press.

Maclagan, Margaret, & Jennifer Hay. 2004. The rise and rise of New Zealand English DRESS. In *Proceedings of the Australian International Conference on Speech Science and Technology*, 183–188, Sydney.

Manning, Christopher. 2003. Probabilistic syntax. In *Probabilistic Linguistics*, ed. by Rens Bod, Jennifer Hay, & Stefanie Jannedy, 289–341. MA: MIT Press.

Marslen-Wilson, William D., & Paul Warren. 1994. Levels of perceptual representation and process in lexical access. *Psychological Review* 101.653–675.

Medin, Douglas, & Marguerite M. Schaffer. 1978. Context theory of classification learning. *Psychological Review* 85.207–238.

Mendoza-Denton, Norma, Jennifer Hay, & Stefanie Jannedy. 2003. Probabilistic sociolinguistics: Beyond variable rules. In *Probabilistic Linguistics*, ed. by Jennifer Hay Rens Bod & Stefanie Jannedy, 97–138. MA: MIT Press.

Niedzielski, Nancy A. 1999. The effect of social information on the perception of sociolinguistic variables. *Journal of Social Psychology (Special Edition)* 18.62–85.

Nooteboom, Sieb G. 1999. Sloppiness in uttering stock phrases. In *Proceedings of the XIVth International Congress of Phonetic Sciences*, San Francisco.

Nosofsky, Robert M. 1987. Attention and learning processes in the identification and categorization of integral stimuli. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 13.87–108.

Pickering, Martin J., & Holly P. Branigan. 1999. Syntactic priming in language production. *Trends in Cognitive Sciences* 3.136–140.

Pierrehumbert, Janet. 2001. Exemplar dynamics: Word frequency, lenition and contrast. In *Frequency and the emergence of linguistic structure*, ed. by Joan L. Bybee & Paul Hopper, 137–157. Amsterdam: Benjamins. (Downloadable from http://www.ling.nwu.edu/˜jbp).

——. 2002. Word-specific phonetics. In *Laboratory Phonology 7*, ed. by Carlos Gussenhoven & Natasha Warner. Berlin and New York: Mouton de Gruyter.

Rappaport Hovav, Malka, & Beth Levin. 1998. Building verb meanings. In *The Projection of Arguments: Lexical and Compositional Factors*, ed. by Miriam Butt & W. Geuder, 97–134. Stanford: CSLI Publications.

Rickford, John, & Faye McNair-Knox. 1994. Addressee- and topic- influenced style shift: A quantitative sociolinguistic study. In *Sociolinguistic Perspectives on Register*, ed. by D. Biber & E. Finegan, 235–276. Oxford University Press.

Scheepers, Christoph. 2003. Syntactic primining of relative clause attachments: persistence of structural configuration in sentence production. *Cognition* 89.179–205.

Schenkein, James. 1980. A taxonomy for repeating action sequences in natural conversation. In *Language Production (vol 1)*, ed. by B. Butterworth, 21–47. Academic Press.

Schmitt, Norbert (ed.) 2004. *Formulaic Sequences*. Amsterdam and Philadelphia: John Benjamins Publishing Company.

Smith, Eliot R., & Michael A. Zarate. 1992. Exemplar-based model of social judgment. *Psychological Review* 99.3–21.

Smith, Neil, & Annabel Cormack. 2002. Parametric poverty. *Glot International* 6.285–287.

Sosa, Anna V., & James MacFarlane. 2002. Evidence for frequency-based constituents in the mental lexicon: collocations involving the word of. *Brain and Language* 83.227–236.

Strand, Elizabeth. 1999. Uncovering the role of gender stereotypes in speech perception. *Journal of Social Psychology (Special Edition)* 18.86–99.

Tannen, Deborah. 1989. *Talking Voices: Repetition, Dialogue and Imagery in Conversational Discourse*. Cambridge: Cambridge University Press.

Tomasello, Michael. 2006. Acquiring linguistic constructions. In *Handbook of Child Psychology: Cognition, Perception and Language*, ed. by Robert Siegler & Deanna Kuhn. in press: Wiley Publishers.

Underwood, Geoffrey, Norbert Schmitt, & Adam Galpin. 2004. The eyes have it: An eye-movement study into the processing of formulaic sequences. In *Formulaic Sequences*, ed. by Norbert Schmitt, 153–172. Amsterdam and Philadelphia: John Benjamins Publishing Company.

Van Lancker, Diana, Gerald Canter, & Dale Terbeek. 1981. Disambiguation of ditropic sentences: Acoustic and phonetic cues. *Journal of Speech and Hearing Research* 24.330–335.

Vanlancker-Sidtis, Diana. 2003. Auditory recognition of idioms by native and nonnative sppeakers of English: It takes one to know one. *Applied Psycholinguistics* 24.45–57.

Walker, Abby, 2005. Well, when *you* say it: The effect of speaker identity on the grammaticality ratings of morpho-syntactic constructions in New Zealand English. Honours Extended Essay, University of Canterbury.

Warren, Paul, Jennifer Hay, & Brynmor Thomas. in press. The loci of sound change effects in recognition and perception. In *Laboratory Phonology 9*, ed. by Jose Hualde & Jennifer Cole. Berlin and New York: Mouton de Gruyter.

Yaeger-Dror, Malcah. 1994. Sound change in Montreal French. In *Papers in Laboratory Phonology 3: Phonological Structure and Phonetic Form*, ed. by Patricia Keating, 267–92. Cambridge: Cambridge University Press.

——, & William Kemp. 1992. Lexical classes in Montreal French (e:). *Language and Speech* 35.251–293.

Yang, Charles D. 2004. Universal Grammar, statistics, or both? *Trends in Cognitive Sciences* 8.451–456.