**Language acquisition and phonological change**

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## 1. Introduction

One of the longest-standing maxims of linguistic thought is that children's language provides a source for language change. In a very early discussion of acquisition, Schleicher (1861) notes parallels between children's errors and diachronic changes in a range of languages. For example, his three year old son Ernst:

> "sometimes changed gutturals into labials, e.g. in *schnapen* for *Schnaken*, *schimpen* for *Schinken*. The same sound changes of the gutturals in individual Indo-European languages are well known." (Schleicher 1861 [1971: 19])

Similar generalisations are made by Grammont (1902: 61), who concludes:

> "[t]outes les modifications fonétiques, morfologiques ou sintaxiques qui caractérisent la vie des langues apparaissent dans le parler des enfants."[1]

Grammont discusses changes in the development of French from Latin, citing examples of similar patterns in the speech of one child. For instance, the child displayed vowel dissimilation in forms like *néni* for *fini* 'finished', paralleling historical developments such as Latin *finire* → Old French *fenir* 'to finish'.

While Schleicher and Grammont stop short of imputing direct causality, explicit comments on the role of children in effecting change date back at least to Paul (1886). He argues:

> "the processes of learning language are of supreme importance for the explanation of changes… they represent the most important cause of these changes" (Paul 1880: 34).[2]

Various explanations have been offered for the apparent role of acquisition in change. Sweet (1888) suggests that change results from imperfect learning, itself due to organic differences in children's vocal tracts relative to adult ones. He also identifies laziness and carelessness on the part of children. Sully (1896: 152) likewise concludes that "changes are due to imperfect imitation by succeeding generations of learners". In a discussion of morphological change, Müller (1890) ascribes the loss of irregular forms to children's natural tendency to simplify, which may be manifested in processes such as paradigm levelling. Meillet (1951) elaborates a similar line of argument, claiming that each child creates the language anew. He also highlights the important role of linguistic exposure in the child's environment:

> "Pour chaque individu, le langage est … une recréation totale faite sous l'influence du milieu qui l'entoure' (Meillet 1951: 74).[3]

The lines of reasoning that characterised discussion of acquisition and change in the nineteenth and early twentieth centuries have numerous echoes in more recent work. Generative linguists readily adopted the view that imperfect learning is a cause of change. For example, following Meillet, Halle (1962: 344ff.) hypothesises that the child "constructs his own optimal grammar by induction from the utterances to which he has been exposed." The child may arrive at a different grammar from that of adults in the same community, since a set of utterances may be generated by more than one grammar. Kiparsky (1965) continues this reasoning:

> "Imperfect learning is due to the fact that the child does not learn a grammar directly but must recreate it for himself on the basis of a necessarily limited and fragmentary experience with speech. It is in no way surprising that the grammar should change in the process of transmission across generations of speakers." (Kiparsky 1965: 4)

Similar comments continue to be expounded in contemporary textbooks. For instance, Fromkin, Rodman & Hyams (2011: 528) state:

> "A basic cause of change is the way children acquire the language. No one teaches a child the rules of grammar. Each child constructs the rules of her language alone, generalizing rules from the linguistic input she receives."

While the logic of the comments quoted above may seem sound, we nevertheless also find scepticism as to the role of children in causing change. Saussure (1915), for example, reflects on similarities between changes and children's errors, but considers the problem of change "undented" by a comparative approach. He continues:

> "what prompts a generation to retain certain mistakes to the exclusion of others that are just as natural is not clear. From all appearances the choice of faulty pronunciations is completely arbitrary, and there is no obvious reason for it. Besides, why did the phenomenon break through at one time rather than another?" (Saussure 1915 [1974: 149])

Bloomfield (1933: 386) also argues against the proposition that children are responsible for change, and, like Saussure, highlights the unresolved questions of 'why here?' and 'why now?': "no permanent factor … can account for specific changes which occur at one time and place and not at another."

A similar conclusion is reached by Drachman (1978): "[t]he role of primary acquisition in language change seems to have been exaggerated". Kiparsky (1988) found the arguments of Drachman (1978) and Vihman (1980; see below) sufficiently persuasive to state, with reference to Andersen (1973, 1978) but not to his own earlier claims, that "empirical study of child phonology gives little support for [Andersen's] theory [of a pervasive role for acquisition in sound change]", adding that "the class of typical or potential sound changes does not match the class of typical or potential child language processes" (p. 390). Other commentators go even further, completely dismissing the

potential role of children. For example, Aitchison (2003: 739) states bluntly: "babies do not initiate changes".

Debate on the relationship between acquisition and change, then, has persisted for 150 years – in effect, the lifetime of modern linguistics. However, it seems that no consensus has yet emerged. A fundamental reason for the lack of agreement, in our view, is the scarcity of attempts to assess the validity of the claim empirically (a point noted by Jespersen 1922, yet little has changed). Although some authors provide examples to illustrate similarities between patterns in child speech and language change, few do so systematically. Instead, most marshal anecdotal or cherry-picked examples, often from a single child (e.g. Schleicher 1861, Grammont 1902). More egregiously, numerous writers lay out their argument without reference to data. Remarkably few systematic empirical studies have been conducted to explore whether children's 'errors' are genuinely universal, whether these errors do indeed emerge as changes, or whether there are other types of change that do *not* appear in children's speech. Particularly lacking is cross-linguistic evidence to support the assumption that children everywhere make the same mistakes. Among the few exceptions are Greenlee and Ohala (1980), Vihman (1980) and Locke (1983), reviewed in section 3 below (see also Baron 1977 and Hooper 1980 on syntactic and morphological change).

A further problem for establishing agreement on the role of acquisition in change is the lack of unity on what is meant by the terms 'acquisition' and 'change' themselves. Few scholars offer any formal definition of their use of these terms. The problem of definition is further compounded in the case of phonological acquisition and change by the more general debates over the delimitation of 'phonology,' especially with respect to its relationship with phonetics (see also Scheer, Hale & Reiss, this volume).

Taking such matters into account, our aim in this chapter is to review the evidence that has been cited in arguments on the role of acquisition in promulgating change (section 3). Given the paucity of empirical studies we also present new data from our own studies, gathered within both sociolinguistic and developmental frameworks (section 4). We believe this is the largest dataset yet assembled to address the issue. However, we first consider in more detail the problem of definitions of terms, as this enables us to draw out various methodological and theoretical issues that underpin the debate.

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## 2. Terms of reference

### 2.1 acquisition and children

Few if any commentators explicitly define 'acquisition', or even 'children'. We infer that most refer solely to first language acquisition, and to developmental processes manifested by infants and children prior to the end of an assumed critical period (i.e. before puberty; Lenneberg 1967). This is therefore the frame of reference that we adopt when presenting our empirical data in section 4.

However, it is difficult to evaluate or compare studies without consideration of what the authors consider to be their objects of study. First, we should not treat children as if they form a homogeneous speech community. 'Child' is a very broad demographic category (Aitchison 2003: 738). The linguistic patterns of a two-year-old differ from those of a three-, six-, or twelve-year-old. Social influences vary across the age range, as

do knowledge and motor skills. Moreover, we need to consider variability within and across children. Children learning a language do not do so at the same rate or in the same sequence. It also goes without saying that generations of speakers do not arrive in well-organised, discrete groups like coach parties of tourists arriving at their destination (Manly 1930). Cross-generational comparison must therefore take account of the fact that any differences will be manifested gradually and perhaps over an extended period of time.

Secondly, we must ask the question: when does acquisition begin and end? We can ask specifically at what age the critical period ends, and even whether it is necessary to assume a critical period (Johnson & Newport 1989, Bialystok & Hakuta 1999, Birdsong 2005). It is certainly clear that an individual's first language may change over the lifespan (Harrington 2006, Yaeger-Dror this volume). To that extent it can be argued that acquisition is not solely restricted to childhood. Might adult language learning also shed light on change? To address the question of timescale also demands consideration of *what* is being acquired, which in the case of phonology is not straightforward (see further 2.2 below).

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Thirdly, in many societies acquisition of second and further languages is the norm rather than the exception, a process that may well extend into adulthood. For some individuals there may be learning of second dialects of the initial language. To what extent do L2 or D2 acquisition shed light on change?

Consideration of such issues is essential in order to gather appropriate evidence to fully assess the role of acquisition in change. However, due to restrictions of space we set such issues aside, and concentrate on evidence from infants and young children.

**2.2 phonology and phonological**

In discussions of acquisition and change, as in linguistics more generally, the terms 'phonology' and 'phonological' are used with variable meanings. For some writers the terms clearly refer to the abstract system of processes and the inventory of contrasts, at the cognitive level and/or referring to language as an abstract system, distinct from phonetic realisation. Blevins (2004: 91), for example, expressly limits her discussion of change to abstract categorical phonology, free of phonetic detail. Naturally there is also variability in the specific issues investigated and terms used, reflecting the theoretical position adopted. In the generative tradition, for instance, Halle (1962) and Kiparsky (1965, 1968) discuss children's learning of transformational rules and the effects acquisition may have on the rule inventory. Stampe (1969, 1979) sought evidence to support the hypothesis of innateness, while in Optimality Theory discussion of change focuses on reordering of constraints in the constraint hierarchy.

For other writers, however, the principal object of focus may instead be the phonetic realisation of phonological units, with arguably no clear division between what might be distinguished as 'phonetic' versus 'phonological'. In his detailed consideration of chain shifts in vowel systems, for example, Labov (2001) discusses phonemic mergers and splits. These are examples where the system of phonological contrasts undergoes reduction or expansion (see further Gordon, this volume). However, Labov also discusses changes in which there is no effect on the *number* of elements in the system, but rather in the orientation and coordination of their associated phonetic patterns. Through

examination of acoustic data, certain vowels are shown to be fronting, backing, raising, or lowering, sometimes in coordinated patterns that maintain the overall system of contrasts. In such cases the issue of change is clearly phonetic rather than phonological, in a strict sense. Also worthy of comment is the fact that discussions of acquisition and change invariably focus on matters of segmental contrast or realisation. Studies of variation and change in suprasegmental features are rare (but see Local 1982) and we are not aware of any comments linking developmental patterns to variation or change in aspects of suprasegmental phonology.

We do not highlight these differences in definition or approach in order to align ourselves with any particular position. In addressing the potential influence of acquisition on phonological change, though, it is imperative to delimit appropriate objects of study. Are we to claim that children are responsible for changes at the phonetic level, for those that affect abstract elements and processes, or for both?

**2.3 change**

What is a sound change? The answer to this question of course depends in part on one's conception of phonology. But what counts as change rather than variation? Again, answers differ through the literature. Many of the commentaries on acquisition and change from nineteenth century linguists were delivered in the context of discussions of the comparative reconstruction of Proto-Indo-European (PIE), itself sometimes couched in a broader frame of Darwinian evolution. The focus was therefore on differences between states of languages over very long time periods, perhaps millennia. For example, Schleicher considers parallels between children's errors and the relationship between PIE and modern Germanic, with reference to processes such as Grimm's Law. The changes involved are extreme enough for us to categorise the end points as different mutually unintelligible languages, in which the change has operated to a state of completion. For example, all speakers of modern German use [f] where PIE had */p/ (e.g. *Fuß* for *ped- , 'foot').

By contrast, more recent discussions of change often refer to ongoing and incomplete processes. Recognising synchronic variation as an essential stage in the development of any change was the first major contribution to historical issues from the emergent field of quantitative sociolinguistics (Weinreich, Labov and Herzog 1968). It is hypothesised that any historically complete change must have progressed through a period of synchronic variation where the old and new forms of the unit undergoing change coexisted (in the speech community if not necessarily in the minds and mouths of individuals).

This conception of change in general allows us to consider phonological change from rather different perspectives than did Schleicher and his contemporaries. It is possible to distinguish the linguistic constraints on a given form from the social constraints on its usage. We can identify change not in absolute terms but as statistical shifts whereby an old form reduces in currency relative to an incoming form. We can examine the phonological or phonotactic contexts of use of a form to assess whether it is spreading through the lexicon or grammar, by participating in new phonological processes, for instance. We can also consider differences in usage within subsections of a speech community rather than its entirety. Change may thus be conceptualised as the first

adoption of a linguistic form by a subgroup within a community (defined, for example, by social class, gender, or ethnicity), or as a form appearing in new (socio)linguistic domains (for example, when a traditionally vernacular form becomes acceptable in formal speech styles).

It is furthermore essential in discussions of change to distinguish *actuation* (or *initiation*, *innovation*) from *transmission* through both the speech community and the grammar (also referred to as *promulgation*, *spread*, *restructuring*). *Actuation* refers to the initial appearance of a new form, for example, a phonetic variant previously unrecorded in a particular language. All changes must start somewhere. In principle, the genesis of a change such as German /f/ from PIE */p/ could be traced back to a particular individual at a particular moment who was the first to utter [f] where his predecessors and peers had always used [p]. In practice, of course, such individuals are highly unlikely to be found, at least as far as phonological change is concerned. (Lexical changes, on the other hand, may sometimes be ascribed to particular individuals or incidences.) Efforts to explain actuation have therefore generally been experimental (e.g. Ohala 1989, Foulkes 1997). Such approaches are grounded on the principle that human vocal tracts and perceptual systems are essentially identical in all speaker-listeners of all languages and at all points in the history of fully-fledged languages. Observing consistent patterns of variation in pronunciation and perception can therefore shed light on how such variations may emerge and eventually become phonologised (see further Yu, this volume).

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In reviewing commentaries on the role of acquisition in change, it seems that most limit their discussion to actuation. Children's forms that differ from those of adults are cited as examples of variations that may in time crystallise as long-term change. But in order to explain change fully we must also address the issue of *transmission*: how, when and why is an innovation adopted by other speakers such that it can gain a permanent foothold in the language? In constructing an argument for the role of children in change it is therefore not enough to simply list forms used by one or more particular children: we also need to establish how and why other language users might adopt the innovations produced by the children. Furthermore, in explaining what we term historical and complete changes, we must acknowledge that it may take long time periods for such changes to reach completion. Therefore we must ask not only how phonological patterns for one generation differ from those of the previous generation, but also how successive generations happen to transmit the change in the same direction. For example, Labov (2001: 419) estimates that the current patterning of English (ing) has taken over a thousand years to emerge and settle into a state of stable variation (see also Keller 1994: 159). Sociolinguistic studies in particular offer insights into the transmission processes (see Tagliamonte & D'Arcy 2009, D'Arcy this volume).

**2.4 summary**

In consideration of the issues raised in section 2, it is clear that comparison of previous studies on acquisition and change is problematic. Studies may, explicitly or implicitly, have quite different conceptions of the key issues. They may therefore also adopt different methods in providing or examining evidence for a link between acquisition and change. However, we now turn to a more detailed review of previous empirical approaches.

## 3. Empirical studies of acquisition and phonological change

### 3.1 developmental studies

Three studies have made a systematic comparison of developmental patterns and regular sound changes: Greenlee and Ohala (1980), Locke (1983), and Vihman (1980).

#### 3.1.1 Greenlee & Ohala (1980)

Greenlee & Ohala (1980) adapt Ohala's well known approach to adult speakers, focusing on the physical constraints imposed by the perceptual system and vocal tract. They identify patterns in child language that may be explained with reference to natural dynamic properties of the vocal tract, aerodynamics, or varying perceptual responses to ambiguous speech signals. Such patterns are shown in some cases to parallel patterns found in sound change, and thus could constitute innovations that ultimately lead to change. For example, [n] and [l] are argued to show close acoustic similarity, such that children are predicted to confuse one for the other. Synchronic alternations and historical changes from /n/ to /l/ and vice-versa are also fairly common.

Greenlee and Ohala refrain from identifying children as a cause of change, arguing that the underlying physical causes – the vocal tract and perceptual systems – are effectively the same as those of adults, who therefore might themselves be responsible for innovations. It should be noted, however, that this line of reasoning is flawed in one crucial respect: the vocal anatomy and physiology of a child are not scale models of those of adults (Lieberman, Crelin & Klatt 1972). For example, the child's tongue is large in relation to the size of the oral cavity (Stark 1980; Kent 1981), making palatal contact in the articulation of dentals or alveolars a more likely outcome for the relatively young child than for the adult. Greenlee and Ohala also leave unanswered (as does Blevins 2004) the question of asymmetric sound changes, where two sounds are perceptually similar yet change invariably involves developments from one member of the pair to the other. An example of this is /θ/ and /f/, where cross-linguistic patterns almost always show /θ/ developing into /f/ (see also Foulkes 1997 on /f/ > /h/ changes).

#### 3.1.2 Locke (1983)

Locke (1983) is primarily interested in establishing similarities between child production and adult phonology, supported by some quantitative analyses but also by selected examples of similarities and differences between developmental processes and cross-linguistic patterns of change and allophony. Some of the processes he identifies as common to children and change are final devoicing, stopping, final deletion, final frication and cluster reduction. Locke notes the temptation to ascribe the origins of sound change to children, but declines to take an interpretable position on the matter:

> "It is clear that sound change ultimately involves both children and adults, and that many of the historically confirmed cases of phonological change are remarkably like the transient developmental changes of childhood. But... relatively little is

known about the relative contributions to sound change of children and adults... My own view is that the child is both an agent of sound change and a victim of sound change…" (p. 116)

Locke also notes a number of cases where child data are not mirrored by sound change (fronting of consonants) or vice versa (lenition of stop to fricative, where children are more likely to do the reverse).

3.1.3 Vihman (1980)

Vihman (1980) focuses on three developmental processes that are very common, especially in the first year of word use: consonant harmony, long word reduction, and consonant cluster reduction, comparing them to possible parallel cases among some well-established sound changes. Prefiguring her conclusions, she asserts at the outset that

> "though many disparate parallels may be found, some of the most common or typical child language processes are either virtually non-existent or totally different in detail in adult synchronic processes and in sound change." (p. 305).

Vihman provides a quantitative analysis of the recorded word forms of eleven children, each learning one of five languages: English, Spanish, Czech, Slovenian or Estonian. The sample is based on the availability of a full word list for the child, whether from a diarist parent (including Vihman herself in the case of two children acquiring Estonian) or from transcribed data based on recordings undertaken as part of a research project. The ages of the children providing the data ranged from about 1 year, for first word use, to 2;6. We summarise the findings briefly here.

Consonant harmony, although not a universal of child language as sometimes claimed (Smith 1973), affected an average of 14% of the words produced by the 13 children included in an earlier study (based only on target words presenting the challenge of a $C_1…C_2$ sequence: Vihman 1978) and as much as one-third of those words in the case of some children. The process is rarely found in adult grammars, however, and must therefore be rare as a diachronic process (Drachman 1978).

Long word reduction occurred in the word production of all 11 children included in Vihman's 1980 sample (see further Vihman 1996: 201ff.; Echols & Newport 1992). The analysis applied only to words of more than two syllables – a challenge for the child that is relatively rare in English but frequent in Spanish, for example. Omission of syllables is common in child speech (affecting a mean of 56% of the long words attempted in Vihman's sample, with a range from 26% to 90%) and is also a widely reported phenomenon in historical sound change. The details differ in acquisition as compared with the historical record, however. In the case of the children, although the number of long words attempted is relatively small, the overall tendencies are clear (where percentages are used to compare stressed and unstressed syllables across languages of differing accentual patterns). First, the stressed syllable is very rarely omitted. Secondly, the final syllable is typically retained even when unstressed (78% of all 3- and 4-syllable words) – a fact that can now be safely ascribed to the final-syllable lengthening that is characteristic of both adult and child production (Snow 1998, Vihman, DePaolis & Davis

1998). Thirdly, the children's data show that in the case of long-word reduction it is the full syllable, not only the vowel, that is generally lost (e.g., Estonian *muusika* > [mu:si]). Since the loss, especially of unstressed syllables, is well documented in the history of languages, we can consider how these patterns compare with those reported as sound changes. For this purpose Vihman (1980) consulted historical grammars for Germanic (Prokosch 1939), Slavic (Shevelov 1964) and Spanish (Menéndez-Pidal 1949) as well as a personal collection of Western Finnic cognates. Some of the factors affecting historical syllable loss are relative distance from the stressed syllable (possibly based on alternating stresses), syllable weight and vowel quality: none of these appear to be features of the process of long-word reduction as seen in the 11 children. On the other hand, final vowels are highly likely to be lost, at least in initial-stress languages like the Germanic languages and Estonian, again in contrast with the child data, regardless of stress pattern. Finally, in virtually every case in the historical record it is not full syllables that are lost but only the vowel (Latin *septimana* 'week' > Old Spanish *sedmana* > Modern Spanish *semana*).

Cluster reduction is again a prominent feature of child word production, typically until age 3 or later (Grunwell 1982). In Vihman's sample of relatively young children we find 52-100% reduction of the clusters present in words they attempted to say (mean 80%). A few patterns are again readily identifiable within the observed cases of cluster reduction. Where a cluster is constituted of stop+liquid (in either order), the stop – a sound type produced in the very first words of children, cross-linguistically, while liquids are rarely seen in those words – is far more likely to be retained. Similarly, fricatives or nasals are likely to be retained in the case of reduction of a cluster in which they are followed by a liquid, while stops are slightly more likely to be retained when a stop+fricative cluster is reduced and are considerably more likely to be retained when a fricative+stop cluster is reduced.

The only clusters more likely to be preserved as a whole than reduced are combinations of nasal+stop. Voicing is crucial in this case: a voiceless obstruent is most likely to be retained in the face of cluster reduction while a voiced obstruent is more likely to be lost, leaving only the nasal (Braine 1974 discusses the perceptual reasons for this asymmetry in child production). The strength hierarchy that emerges from these data conforms closely to the well-established facts of overall order of production for children (mainly based on the extent of motor control required), with stops and nasals – prominent not only in first words but also in babble – being followed by fricatives and with liquids coming last (Yeni-Komshian et al. 1980).

Turning now to the historical record, we again consider the trends observed in the sources mentioned above. For Slavic, where cluster reduction is most prominent, we find very different patterns of change compared with the child data: consonant+liquid tended to be preserved in Common Slavic, although /t,d+l/ was later reduced to /l/ in several Slavic languages; clusters of stop+fricative or nasal were reduced by loss of the stop in Common Slavic.

In the history of Spanish, Latin stop+/r/ tended to be preserved initially; voiceless stop+/l/ was palatalised in central dialects and reduced to /ʎ/ while /bl/ was preserved but /gl/ was reduced to /l/. Medially, liquid+stop clusters were preserved while voiced stop+liquid clusters were sometimes reduced to liquid only. Clusters of medial

nasal+stop were sometimes reduced to the nasal in Castilian, sometimes with palatalization of the nasal.

In Western Finnic, the few examples of cluster reduction are all medial. Loss of /n/ before /s/, with or without compensatory lengthening of the vowel, occurs here as in many other languages. Older loan words in Finnish and Estonian from either Russian or German consistently show loss of the first consonant of any word-initial cluster, regardless of consonantal type (e.g. Russian *gramota* 'reading and writing' > Estonian *raamat* 'book', Finnish *raamattu* 'bible'; German *Spiegel,* Estonian *peegel* 'mirror', etc). Finally, in Germanic, though cluster reduction is not common, liquids tend to be retained in cases of fricative+liquid or liquid+nasal while the nasal tends to be lost in cases of nasal+fricative (as in Finnic) or stop+nasal. Summarizing the historical data, then, liquids seem to be highly favoured in all four linguistic families, fricatives are more likely to be retained than nasals, and position in the cluster is sometimes relevant, especially initially. Each of these tendencies contradicts the observed child patterns. Vihman (1980) disregarded many processes reported in adult languages, such as vowel harmony, but this process is rare in child data, most likely because vowel production and planning are less problematic for the developing child than are consonant production and planning (Stoel-Gammon 1992). Similarly, interactions between consonant and vowel (e.g. nasalisation, pharyngealisation, palatalisation) play a large role in language change but are rarely reported for child language.

In conclusion, then, we see that although two of the three processes examined do play a role in both developmental and historical contexts, once we have considered the details of each of the subtypes we find it considerably less tempting to ascribe causality for historical change to the developing child, at least where the early stages of word production are concerned.

A final point made in Vihman (1980) is worth repeating: whereas contrast is a key principle in adult language and as such is often evoked as playing a role in change or resistance to change diachronically, for children the situation is very different. The child speaks largely of the here and now, to familiar interlocutors, whether at home or at nursery school; where communication breaks down (from the point of view of an adult observer), the child often seems to be willing to shift topics without missing a beat (for several illustrations, see Vihman 1981). Thus omission of an entire syllable, for example, is not likely to cause problems. At the same time, if clarity is not an issue for the child, recall is:

> What does pose a problem for the child is the burden placed on his capacities for storage and retrieval of units of information as his vocabulary increases exponentially (by literally hundreds of words a month, in some cases). (Vihman 1980: 315)

Here consonant harmony, for example, plays a useful role in limiting the bits of information per word that the child must retain (see also Vihman 1978, Menn 1983). The need for such constraints fades as the child's familiarity with the phonotactics of the ambient language increases (Storkel, 2001; Edwards, Beckman & Munson, 2004). Although aspects of the morphophonemics of a language may take several more years to

master, the processes analysed here are typically no longer part of productive phonology after age 3 or 4.

### 3.2 sociolinguistic studies

Sociolinguistic studies of language learners are relatively few in number (see Roberts 2002 for a review). However, a number of important issues emerge from these studies, in particular concerning the nature and type of input, and the social context in which learning unfolds.

#### 3.2.1 input and influence

Weinreich et al (1968: 145) criticise the simple model of acquisition and change described by Halle (1962) and others (discussed in section 1 above). They do so specifically because it relies on the "unexamined assumption that the children's grammars are formed upon the data provided by their parents' speech". That is, we should not assume that the primary input on which language learning is based is simply a sample of the adult language used in the community. Thus it may be methodologically inappropriate to focus solely on comparisons between the speech patterns of children and those of the adult community. Children also learn from other children, especially once they begin to interact with peers on a regular basis. Several studies show that children's phonetic and phonological patterns are closely aligned with those of their caregivers at an early age, but diverge later as the peer group becomes more important (Foulkes et al 2005, Smith et al 2007). Young children are also often diverse as a group. A particularly clear example is provided by studies in the new town of Milton Keynes, southern England, conducted by Kerswill and colleagues. A large number of in-migrants to the town had created a complex dialect contact situation. Kerswill (1995) and Kerswill and Williams (2000) tracked the linguistic development of three age groups of children and their parents: 4-year olds, who were still cared for in the family home, and school children aged 8 and 12. Analysis of a number of phonological variables revealed that the 4-year-olds' production patterns closely resembled those of their parents, and reflected the mix of dialects in the community. Older children, however, showed a more homogeneous, levelled dialect, with little influence of minority home dialects. Kerswill (1995) considers whether developmental patterns might lead to change, noting that Milton Keynes children displayed several processes that are also apparent as ongoing sound changes in many varieties of British English. These include vocalisation of /-l/, labiodental /r/, and [f, v] for /θ, ð/. He found that some developmental patterns were common for the youngest children, then gradually disappeared as their speech matured, but later re-emerged for pre-adolescents as dialectal features. These studies show that peer influence during adolescence exerts an especially strong effect on linguistic patterns, with non-standard forms transmitted most readily at this stage in life (Weinreich et al 1968, Labov 2001, Hazen 2002). Such findings suggest that differences between generations are less likely to be seen at the earliest stages of acquisition than they are during later development.

More recent studies shed further light on the nature of input, showing that it varies between children and according to social factors such as age and gender (of both child

and adult). Hazen (2002) reviews a number of studies of children whose parents speak different dialects, and for whom phonological learning therefore may involve multiple targets. Foulkes et al (2005) examined consonantal realisations in child-directed speech (CDS) by a group of women from Newcastle, north-east England (see further section 4.2 below). The main focus was on forms of intervocalic /p t k/, which are realised locally as voiced, laryngealised and lenited stops (typically transcribed [b̰ d̰ g̃]). Local variants occurred in around 90% of tokens in speech between adults, but only 36% of tokens in CDS. Mothers instead preferred plain oral stops, as in standard English. Individual mothers varied in their use of the local variants (occupying the full range from 0-100%). Moreover, variation was also observed within CDS as a function of child age. Standard variants decreased across the age range, and were statistically more frequent in CDS to girls. Input also varies according to style of speech. Labov (2001: 420) has argued that style variation is crucial for the transmission of sociolinguistic variation. Speech to children varies in formality, with more formal language typically associated with teaching and discipline, and characterised by greater usage of standard forms. Smith et al (2007) examined CDS patterns in Buckie, Scotland, and indeed found that mothers used standard forms more in formal interactions, and local variants in less formal ones (play, intimacy).

3.2.2 social variation in transmission of change

Sociolinguistic studies regularly show that sound changes are adopted by some sub-groups in a society earlier than others. Gender-based differences, for example, are found in almost all societies that have been investigated. Typically, females lead in the spread of changes, and are sometimes a generation ahead of males in the same community (Labov 2001: 306). If acquisition is the primary cause of change it would be next to impossible to explain why this should be so. Given essentially the same vocal tracts and overall developmental abilities, there is no reason why girls should create or adopt new forms earlier than boys. Similarly, Labov (2001) provides extensive documentation that changes generally originate in the middle of the socioeconomic hierarchy, while Milroy (1987) shows that changes are more likely to be transmitted in open social networks, where individuals enjoy physical and social mobility. These facts, too, are inexplicable if we examine only developmental patterns as a cause of change. It is clear that social context affects what is learned and when it is learned.

Finally, it has also been shown that transmission of change requires interaction, with influence typically flowing from more socially prestigious individuals or groups to less prestigious individuals or groups. Aitchison (2003: 739), in dismissing the role of children in promoting change, points out that babies do not form influential social groups. Their speech patterns are thus unlikely to be adopted by other speakers.[4]

3.3 summary

The studies reviewed above all show that there may be significant differences between the features of the target language being acquired and the raw materials upon which acquisition is based. Simple comparison of adult and child forms may therefore not be the optimal method for assessing learning or variation in developmental forms as a

route to change. Leaving such matters aside, however, we turn now to some new child data analyses.

## 4. Data

We present two relatively large datasets, first from a developmental study and then from a sociolinguistic investigation. Both are drawn from monolingual children learning British English. Our aim in both cases is to establish a systematic and accountable corpus of child speech. We have gathered our data from transcripts that were prepared for other purposes, as part of larger projects. Patterns evident from the corpora have been identified independently of (i) any prior expectation as to the sorts of developmental forms that we might expect to find, and (ii) types of phonological change that might display parallels with acquisition patterns.

The two datasets differ in several respects. The recordings were collected and analysed using frameworks and methods from different traditions. We also have different assumptions concerning the phonological targets to be acquired. The developmental data were collected as part of a longitudinal study comparing late talkers to typically developing children, with no specific attention to either the community or the phonetics of the parents' speech; they reflect a single developmentally based 'moment' for the entire group. The sociolinguistic data were collected to assess the nature and time-course of learning detailed phonetic and phonological patterns, based on previous sociophonetic studies of the adult community (Docherty et al 1997, Docherty and Foulkes 1999).

Ideally we would like to compare our child data against an inventory of sound changes reported cross-linguistically in a balanced sample of languages (akin to the phoneme inventory information provided by Maddieson 1984, for example). However, as noted by Ferguson (1990), no such inventory existed at that time, nor have the intervening years changed the situation. Blevins (2004) summarises a number of common changes from 99 languages, and we draw on her observations where appropriate. In addition we note various changes that are commonly reported in the literature on historical phonology. In so doing we acknowledge that such evidence is not ideal. It may not be based on empirically robust data collection, many of the same examples appear to have been borrowed across different texts, and data are often pre-selected to illustrate assumptions or theoretical claims.

### 4.1 data from a developmental study

The data summarised above from Vihman (1980) covered only the first year or so of word production and was restricted to three common phonological processes. To complement this, we now review data available from the transcribed recordings of a much larger set of typically developing monolingual English-learning children from North Wales (TDs; N = 11, 6 boys) and late talkers (LTs: children who had few words and no word combinations at 24 months; N = 21, 14 boys) from both North Wales and the York area (Vihman, Keren-Portnoy, Bidgood, McGillion & Whitaker, in revision). The children range in age from 2;4 to 4;2, with most between 3 and 4 years. The 30-minute recording sessions (a single session for each child, at home, with a familiar adult interlocutor) took place 14 months (± 2) after each child had been recorded as using

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about 25 words in a 30-minute session, a developmental point corresponding roughly to the end of the single-word period. Thus these children are all well into the production of longer utterances (mean length of utterance in words: 2.7).

Instead of focussing narrowly on three processes we consider the full range of processes seen in children who are producing relatively long utterances. We do not attempt to relate these data to historical data in any exhaustive way, since, as noted above, no convenient inventory of historical processes is as yet available. Instead, we provide a review of the full extent of process use by this larger sample of children, also expanding the age range covered by Vihman (1980) while restricting ourselves to English only. We offer some general comments on similarities to and differences from well-attested historical processes.

Whereas the children described in Vihman (1980) were all typically developing, some of the children in the present corpus were late to begin to talk. Since LTs tend to make more phonological errors at a later age, and thus do so while producing much longer sentences and conversing more frequently with interlocutors outside of their immediate family, the influence, if any, of 'imperfect learning' is at least as likely to be traceable to them as to the very young children whose phonological errors were described above.

Table 1 lists the 43 phonological processes identified as occurring in the 100-utterance sample of two or more of the 32 children. Processes that occur only once for a given child are taken to be speech errors and are disregarded. Processes that occurred more than once yet only sporadically in the speech of a single child are also omitted here.

[TABLE 1 ABOUT HERE]

It is apparent that in the spontaneous running speech of these children very few processes account for more than a small proportion of the errors – and some of the more common ones may reflect parental usage (e.g., stopping of /ð/, which reflects a fairly high level of occurrence in both TD and LT samples), although an attempt was made to take dialect differences into account. The LT sample is not quite twice as large but accounts for well over twice the errors. Nevertheless, each error type accounts for only a small proportion of the total, and the ordering of process use for the LTs is only marginally different from that of the TDs.

Consonant deletion is the second most common process, evidenced in some form by all but one child; this includes both initial and final positions. We provide examples in each case from the TD child who made the error most frequently (see Vihman et al., in revision, for examples of each process).

Final consonant deletion (1) occurs in the speech of many of the children, but the incidence is low. Initial consonant deletion (2) affects function words far more than content words, which may reflect adult casual speech usage (but could also be ascribed to misperception of non-salient syllables). No other process accounts for as much as 10% of the errors identified for the TDs; many, such as consonant insertion, appear to be one-off careless productions: e.g., Martin: *zip* [snɪp](possibly a lexical error).

(1) Owen: *like* [laɪ]

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(2) Owen: *yellow* [ɛləʊ]

Palatalization, which, as we noted above, might be expected as a natural consequence of the specific characteristics of the child vocal tract, accounts for 4% of the TD errors, 6% of the LT errors. In most cases it is the alveolar sibilants /s, z/ that are palatalized (3).

(3) Ali: *that is beans* [daçɪçbiːç]

'Palatal fronting' (i.e., /ʃ/ > [s]), which is more commonly mentioned in the child phonology literature, here accounts for only 1% of the errors in either group (4).

(4) Andy: *paintbrush* [peɪʔbɒs]

Consider the three processes detailed for the younger children in Vihman (1980). Weak syllable deletion is the most common of those, accounting for 3% of the TD errors and 4% of the LT errors and occurring in the speech of 21 of the 32 children (5). The most common occurrence is word-final unstressed syllable omission in words – or any position in phrases. The process is thus different from what we see in first words, but the occurrences are rare.

(5) Jude: *Barcelona* [baθəʊn] (said twice in this form)

Consonant harmony, however, is expected to be seen only rarely in children of this age (Grunwell 1982) and indeed it accounts for only 1% of the errors for the TDs, 2% for the LTs (6).

(6) Ali: *more* [mɔːm] (a case of consonant insertion as well as harmony).

Note that it is difficult, in running speech, to distinguish consonant harmony as a process from speech errors of the kind found in adults (see Jaeger 2005 for a discussion of the methodological issues involved in identifying what she calls 'kids' slips'). Virtually all of the errors are single occurrences, rather than the stable lexical use we see in younger children.

Finally, cluster reduction is divided here into a number of distinct processes (7-11). All five of the processes that affect clusters combined account for 9% of the TD errors and 10% of the LT errors. The type of reduction is the same as that described by Vihman (1980): retention of the non-liquid – and, in the case of 'other' cluster reduction, which generally involves nasals, retention of the nasal in most cases.

(7) *cluster reduction Cr:* Owen: *fried* [faɪd]

(8) *cluster reduction sC*: Tomos: *strawberry* [dɔːbiː]

(9) *cluster reduction Cl*: Tomos: *plate* [$p^h$eɪʔ$t^h$]

(10) *cluster blending*: Owen: *play* [feɪ]

(11) *other cluster reduction*: Ali: *milk* [mɪk], *stand* [tad]

In summary, taking an exhaustive account of all the mispronunciations made by children who are well out of the single-word stage, we find a wide range of different errors or phonological processes, none used consistently or with any great frequency by any of the children. What were pervasive errors for some children at the younger age (consonant harmony, syllable deletion) are now sporadic, with a suggestion of lexical rather than phonological errors in some cases. Where errors are still fairly common at this developmental point (consonant cluster reduction), they agree with the analysis of earlier child errors in being quite different in detail from those found in sound change. None of this appears to offer much in the way of support for the hypothesis that sound change has its roots in mislearning by children.

4.2 data from a sociophonetic study

Data are drawn from the *Emergence of Structured Variation* (*ESV*) corpus, comprising recordings from first-born children from Newcastle (Docherty et al 2002). The main aim of *ESV* was to track how children acquired sociolinguistic variants. Forty children (20 boys) were recorded in a cross-sectional design at ages 2;0, 2;6, 3;0, 3;6 and 4;0. Ten children were followed longitudinally over the same age range (yielding a further 52 recordings). Recordings varied in length from 15-45 minutes, involving free play and picture book tasks with the mother. The original transcriptions focused on words containing /t/ in several phonological and prosodic contexts (Table 2). Auditory transcriptions were supported by acoustic analysis.

[TABLE 2 ABOUT HERE]

The original transcriptions were reanalysed for the purposes of this chapter, in order to identify common deviations from adult target forms which might constitute innovations. We were also able to assess the children's role in transmission, comparing their use of variants known to be participating in ongoing changes in the dialect.

Since the *ESV* project was interested in variation, we took a sociolinguistically- and phonetically-informed view of the phonological targets and considered all variants of /t/ that are found in ordinary adult speech. Thus we did not consider the target necessarily to be [t]. Previous work on the adult community had revealed a range of variants associated with particular contexts, varying in voicing, pre-aspiration, glottaling/laryngealisation, and place and manner of articulation (Docherty et al 1997, Foulkes & Docherty 2006). Table 3 summarises the most frequently encountered phonetic forms in the child corpus, and the coding as accurate or inaccurate based on adult forms.

[TABLE 3 ABOUT HERE]

A search of sources on sound change revealed a number of common processes that affect /t/ or voiceless stops in general. These are summarised in Table 4, and thus form a set of predicted potential changes to be tested via the dataset.

[TABLE 4 ABOUT HERE]

Of the eight changes listed in Table 3, the first five were investigated as potential innovations. Glottaling and pre-aspiration are already present in the Newcastle dialect, and participate in ongoing change. They were therefore examined as transmission changes. Consonant harmony was not considered in detail as it is virtually unknown in language change (Blevins 2004), despite being very common in child language (Vihman 1980, section 4.1).

Examination of transcriptions was quantitative and fully accountable, i.e. all tokens of target /t/ were considered (N = 3,804) in the contexts listed in Table 2. 'Accuracy' was judged relative to known adult variants, again as shown in Table 2. In all cases phonological context was taken into account, since some processes are conditioned by context, and context-free sound changes appear to be unusual in adult languages (Blevins 2004). In the Newcastle dialect different phonetic variants of /t/ occur in initial, medial and final contexts, hence processes were examined only in appropriate contexts. For example, voicing was not considered for medial /t/, as statistically most adult variants are voiced. Frication/affrication of /t/ is also found for adults, so only certain fricative/affricate forms were considered inaccurate (e.g. [s, x]). Errors defined as 'release type' had [t] produced accurately but the following fricative release occurred at a different place of articulation from those used by adults (usually [tʃ]). We concentrate on data from the 40 children in the cross-sectional study. Longitudinal data showed essentially the same patterns.

4.2.1 potential innovations

Data are shown in Figures 1-3 (initial, medial and final /t/, respectively). In Figure 2 the various medial contexts shown in Table 3 are combined for simplicity. In each figure overall accuracy is shown via a dotted line oriented to the right-hand axis. Error types are aligned to the left-hand axis. Data are pooled from eight children at each age.

[FIGURES 1,2,3 ABOUT HERE]

Figures 1-3 all show a clear rising trend for accuracy by age, and a concomitant downward trend for errors. That is, error types are more frequent for younger children, gradually diminishing to low rates of appearance as the children get older (mostly under 2% of tokens per context for the 4;0 group).

In each context, however, we also see peaks in the distribution of some error types (voicing in initial context, affrication and stop place in medial context, and [h] in final context). These peaks are all due to one or two children showing high use of the process. For instance, the peak in final [h] is generated by one boy who contributes 40 of the 56 tokens to the 3;0 group. Moreover, [h] is also lexically restricted for him, with 37 tokens occurring on *what?* Interestingly, patterns for the children in the longitudinal study also

showed numerous peaks. We interpret such peaks as an indication that the children were experimenting with articulatory strategies at certain points in their development, eventually dispensing with phonetic forms that are not sufficiently good matches to adult usage.

The apparent rising trend in medial deletion can also be ascribed to two high scoring individuals, one each in the 3;6 and 4;0 groups. Both children mostly show deletion in just a small set of common words: *get, got, getting, what, not, it*. Although not previously reported for adults in Newcastle, deletion of /t/ in rapid connected speech has been noted for other dialects of English, especially with frequent words (e.g. Fabricius 2000: 85), and we have also since observed both this and final [h] in the speech of Newcastle adults. Deletion may therefore reflect advanced articulatory skills, emerging as the children develop rapid and fluent speech. Turn-final deletion, by contrast, is rare (as in the developmental data, section 4.1) and decreases across the age range.

For initial /t/ the most frequent error is release type. This mainly comprises realisations transcribed as [tʃ], with 33 of 37 such tokens preceding a close or close-mid vowel /iː eː uː oː ɪ ʊ/. This pattern is indeed predicted as a conditioned sound change. Ohala (2005), for example, hypothesises that alveolar stops are likely to affricate adjacent to close front vowels. The narrow channel created by the stop closure yields a higher volume velocity of airflow as the stop is released, which may generate fricative energy in the post-alveolar region. The release type error is also less frequent in medial and final contexts. This might be explained by the high incidence of initial stress in English words, resulting in greater airflow at word onset and thus a greater chance of generating turbulent airflow at stop release. Initial release type errors remain relatively stable across the age range, but still low in overall frequency (4-5% from 2;6 onwards).

Stop place errors in initial context are generally palatal (16/21 tokens), such as *tiger* [cʰ-]. This pattern appears at odds with what is expected for change: in sound change palatals usually arise via fronting of velars, not retraction of alveolars (Ohala 2005, Fox 1995: 82). However, differences in the shape and size of children's vocal tracts relative to adult ones predict a high incidence of [c] for /t/ (section 3.1.1). /t-/ > [k-] is vanishingly rare (2 tokens in 1016), as predicted in change. In medial context, by contrast, stop place errors are mostly [k] (38/49 errors, with 5 more transcribed as uvular, all by the same child). All [k/q] tokens occur in the two words *little* or *bottle*. This lexically-restricted error is commonly found for British children and might reflect lexical variants used in CDS. (We do not attribute the retraction of /t/ to the final /l/, since in Newcastle coda /l/ is not velarised, and no other /-l/ words are affected.)

In summary, these data, like those considered in 4.1, offer little support for the hypothesis that child errors are a likely source of innovations. The observation of peaks is difficult to reconcile as an indication of new forms emerging that might eventually pervade the whole dialect. They seem far too restricted, with respect to both individuals and time windows, to have much chance of being adopted and transmitted. Lexically-restricted patterns such as [k] in *little, bottle* might in principle indicate a lexical diffusion change, but in this case such forms are common for British English-speaking children and are not tolerated as acceptable adult forms. Finally, with the exception of initial [tʃ-], error patterns in the data appear to be counter to known patterns of change.

4.2.2 transmission changes

Both turn-final glottaling and pre-aspiration are sound changes in progress in the adult dialect, with both also statistically more common for females. Pre-aspiration is reported in detail in Foulkes & Docherty (2006). Overall there is considerable variability in the frequency of pre-aspiration for both children and mothers. Usage by younger children shows a statistically significant correlation with that of their mothers. Older children, however, produce pre-aspiration at high rates whether or not their mothers do so. Moreover, the girls produce more pre-aspiration than the boys at 3;6 and 4;0.

A comparable pattern is found for glottaling. Final glottal stops are fairly rare in Newcastle English, and are especially attracted to sentence tags (Docherty et al 1997). It was not possible to assess systematically whether tags affected the child data, but since tags are features of discourse we would only expect to see them in the speech of older children. In the cross-sectional data 13.5% of all turn-final /t/ were realised as glottals, with considerable variation between children (0-85% if we include children in the longitudinal sample). When examined by age group (Figure 4), the rate of glottaling increases significantly in line with age (Pearson's $r = 0.354$, df = 38, $p = 0.025$, 2-tailed), although much of this effect is due to the three high-scoring older children (all boys). Longitudinal data also show an overall rising trend, however. The gender pattern is not the same as that found for adults. Boys used more glottals than girls (18.9% versus 7.7%), and in all age groups except 2;6.

In sum, for both pre-aspiration and glottaling the children appear to be accelerating incoming changes. Note that the higher usage by older children, and for pre-aspiration the emerging gender differentiation, indicate that the forms have been acquired as learned sociolinguistic variants, not as the result of error by immature speakers.

[FIGURE 4 ABOUT HERE]

4.2.3 summary

As was the case with the data presented in section 4.1, we see little evidence for errors as the source of sound changes. We do see, however, that older children are participating in changes in progress.

5. Conclusion

We have reviewed previous commentaries on child language as a source of sound change, highlighting the fact that there has been little consensus and remarkably few systematic attempts to address the issue empirically. We therefore assembled two large datasets to assess impartially whether error data appear to be suggestive of change. We fully acknowledge that these datasets do not settle the debate definitively, being limited to a small set of phonological units and processes in one language. We also concur with Bloomfield (1933): no single explanation is likely to satisfy all nuances of what is a very complex question.

However, our conclusion from the data is that early errors are highly unlikely to lead to change. Errors diminish with time, and some early processes disappear by around

age 3. Others appear and disappear sporadically, and are limited to particular individuals. Initiation changes, if ascribed to vocal tract dynamics or perceptual factors (cf. Greenlee & Ohala 1980), are no more likely to be the responsibility of children than of adults. It is also imperative to acknowledge the extent of variation between individuals learning the same language, especially at younger ages, a fact largely ignored by previous commentators. For a new generation to recast a grammar would appear unlikely when members of that generation take so many paths to acquire it.

Children's role in transmitting changes in progress is more readily demonstrable. But it is to the performance of older rather than younger children that we must look, and it is more profitable to conceptualise child patterns as learned features than as errors. Understanding the social context in which learning takes place is crucial, to explain why certain individuals influence others linguistically, and why linguistic variants confer some sort of social or communicative advantage to language users.

The answers to many other questions about change remain partial. To what extent are innovations the product of vocal tract dynamics, and to what extent the product of forces internal to the grammar (cf. Jones, this volume)? In transmission, what factors are necessary for, or conducive to, new forms being transmitted? Finally, for both innovation and transmission, we can only ask with Saussure and Bloomfield: '*why here*? *why now*?'

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TABLES AND FIGURES

*Table 1. Phonological process use by children aged 2;4 to 4;2, based on a 100-utterance sample for each child and ordered by tokens with errors in the speech of the typically developing children (TD). '%' refers to proportion of all errors identified in sample.*

| | Typically developing (N = 11) | | | Late talkers (N = 21) | | |
|---|---|---|---|---|---|---|
| | tokens | % | children | tokens | % | children |
| stopping - ð | 108 | 11.46 | 10 | 280 | 12.13 | 19 |
| C deletion | 91 | 9.66 | 11 | 211 | 9.14 | 20 |
| velar fronting | 82 | 8.70 | 5 | 125 | 5.41 | 10 |
| gliding (r, l) | 67 | 7.11 | 9 | 168 | 7.28 | 17 |
| lisping | 58 | 6.16 | 7 | 115 | 4.98 | 14 |
| palatalisation | 41 | 4.35 | 7 | 128 | 5.54 | 11 |
| gliding (other) | 37 | 3.93 | 7 | 48 | 2.08 | 7 |
| C insertion | 32 | 3.40 | 8 | 81 | 3.51 | 16 |
| l-vocalisation | 32 | 3.40 | 6 | 36 | 1.56 | 5 |
| glottal stopping | 30 | 3.18 | 5 | 35 | 1.52 | 8 |
| weak syll. deletion | 26 | 2.76 | 6 | 84 | 3.64 | 15 |
| CC reduction - Cr | 25 | 2.65 | 6 | 61 | 2.64 | 8 |
| CC reduction - sC | 23 | 2.44 | 5 | 58 | 2.51 | 10 |
| ð-substitution | 20 | 2.12 | 5 | 26 | 1.13 | 5 |
| fricativisation | 20 | 2.12 | 6 | 71 | 3.07 | 14 |
| velarisation | 20 | 2.12 | 4 | 71 | 3.07 | 10 |
| affricate reduction | 16 | 1.70 | 5 | 64 | 2.77 | 11 |
| CC reduction - other | 15 | 1.59 | 5 | 53 | 2.30 | 15 |
| nasalisation | 15 | 1.59 | 2 | 48 | 2.08 | 8 |
| affricativisation | 14 | 1.49 | 3 | 54 | 2.34 | 9 |
| CC reduction - Cl | 14 | 1.49 | 3 | 39 | 1.69 | 8 |
| nasal-lateral alternation | 14 | 1.49 | 3 | 21 | 0.91 | 5 |
| lateralisation | 13 | 1.38 | 3 | 15 | 0.65 | 1 |
| syllable insertion | 12 | 1.27 | 2 | 27 | 1.17 | 8 |
| C harmony | 11 | 1.17 | 3 | 39 | 1.69 | 10 |
| blending | 11 | 1.17 | 3 | 19 | 0.82 | 4 |
| v-substitution | 11 | 1.17 | 4 | 9 | 0.39 | 1 |
| CC deletion | 9 | 0.96 | 2 | 11 | 0.48 | 2 |
| metathesis | 9 | 0.96 | 3 | 16 | 0.69 | 5 |
| palatal fronting | 9 | 0.96 | 2 | 13 | 0.56 | 2 |
| contiguous assimilation | 8 | 0.85 | 1 | 18 | 0.78 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| glide stopping | 8 | 0.85 | 3 | 9 | 0.39 | 3 |
| l-stopping | 7 | 0.74 | 2 | 7 | 0.30 | 2 |
| stopping - s | 7 | 0.74 | 2 | 39 | 1.69 | 6 |
| θ-substitution | 7 | 0.74 | 1 | 26 | 1.13 | 6 |
| labialisation | 5 | 0.53 | 0 | 56 | 2.43 | 11 |
| glottalisation | 4 | 0.42 | 1 | 13 | 0.56 | 2 |
| stopping - z | 4 | 0.42 | 0 | 17 | 0.74 | 3 |
| nasal-stopping | 2 | 0.21 | 0 | 26 | 1.13 | 7 |
| stopping - f | 2 | 0.21 | 1 | 46 | 1.99 | 5 |
| stopping - ʃ | 2 | 0.21 | 1 | 3 | 0.13 | 1 |
| degliding | 1 | 0.11 | 0 | 9 | 0.39 | 2 |
| stopping - v | 0 | 0.00 | 0 | 14 | 0.61 | 4 |
| | 942 | | | 2,309 | | |

*Table 2: phonological contexts included in /t/ analysis*

| *context* | *definition* | *examples* |
|---|---|---|
| initial | word-initial pre-vowel | *teddy, top, table* |
| medial | V__(#)V, foot-internal | *water, it is* |
| | __l | *little, bottle* |
| | T-to-R contexts | *put a, get on* |
| final | turn final; excludes consonant clusters | *cat, boat, what?* |

*Table 3:* variants of /t/ found in child corpus

| *context* | | *accurate* | *inaccurate (examples)* |
|---|---|---|---|
| initial | | t tʰ tˢ | ʧ ʈ ɬ tθ θ s c cʰ k x q h<br><br>deletion<br><br>consonant harmony |
| medial | V__(#)V foot-internal | t tʰ tˢ ɾ d ɖ ʔ | |
| | __l | t tʰ tˢ ɾ d ɖ ʔ | |
| | T-to-R contexts | t tʰ tˢ ɾ d ɖ ʔ ɹ ʊ | |
| turn-final | | t tʰ tˢ ʔ ʰt t̚ | |

*Table 4: common sound changes affecting /t/*

| *type* | *source* | *language(s)* | *notes* |
|---|---|---|---|
| 1. voicing/ deaspiration | Lavoie (2001) | Urubu-Kapoor | |
| 2. place change, e.g. /t/ > /k/ | Scheer (this volume)<br>Blevins (2004: 123)<br>Fox (1995: 82) | Hawai'ian<br>Austronesian | rare; mainly occurs where where /k/ is lacking in inventory |
| 3. frication/ affrication | Ohala (2005)<br>Lavoie (2001) | Mvumbo<br>West Greenlandic | mainly occurs pre-close vowel or intervocalically |
| 4. /t/ > /h/ | Gillies (2009: 251) | Scottish Gaelic | synchronic mutation |
| 5. deletion | Blevins (2004: 165) | 50 Australian aboriginal lgs | rare in initial position, more common elsewhere |
| 6. glottaling | Fabricius (2000) etc | English | |
| 7. pre-aspiration | Silverman (2003) | Icelandic | mostly in final contexts |
| 8. consonant harmony | Blevins (2004: 230) | ? | rare in sound change |

*Figure 1: accuracy and error types (%) by age group, initial /t/. Accuracy is plotted against the right axis, error types against the left axis.*

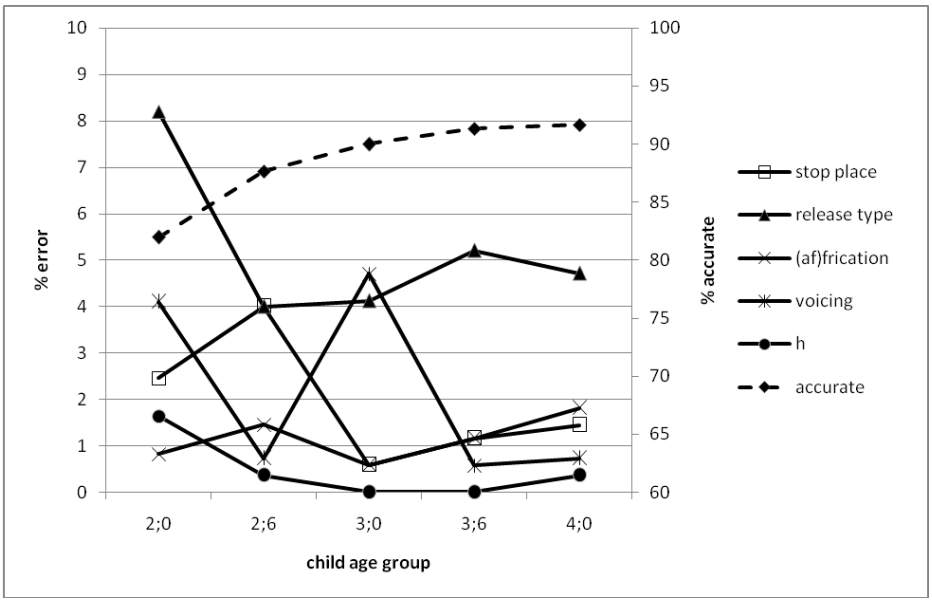


*Figure 2: accuracy and error types (%) by age group, medial /t/. Accuracy is plotted against the right axis, error types against the left axis.*

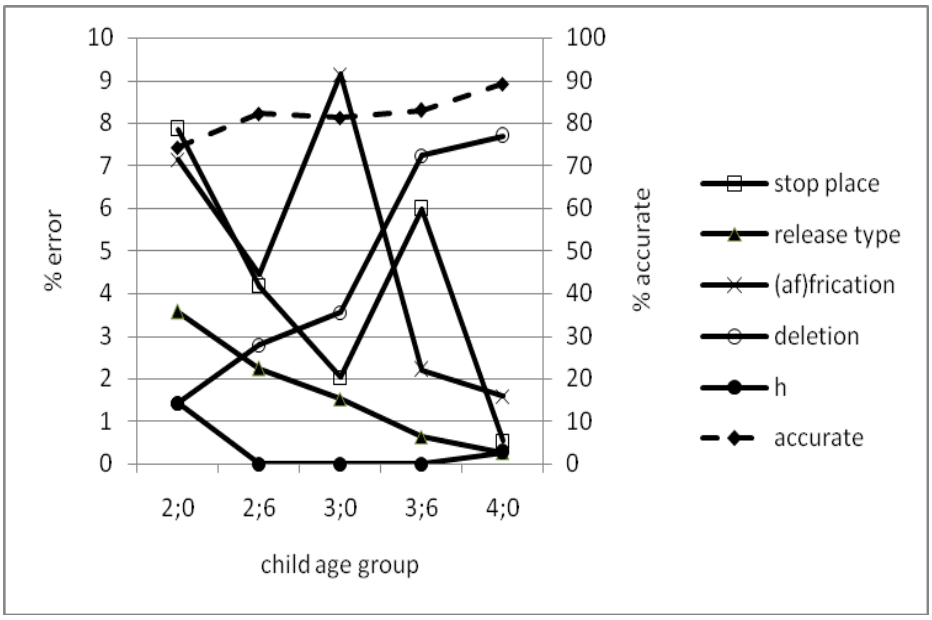


*Figure 3: accuracy and error types (%) by age group, final /t/. Accuracy is plotted against the right axis, error types against the left axis.*

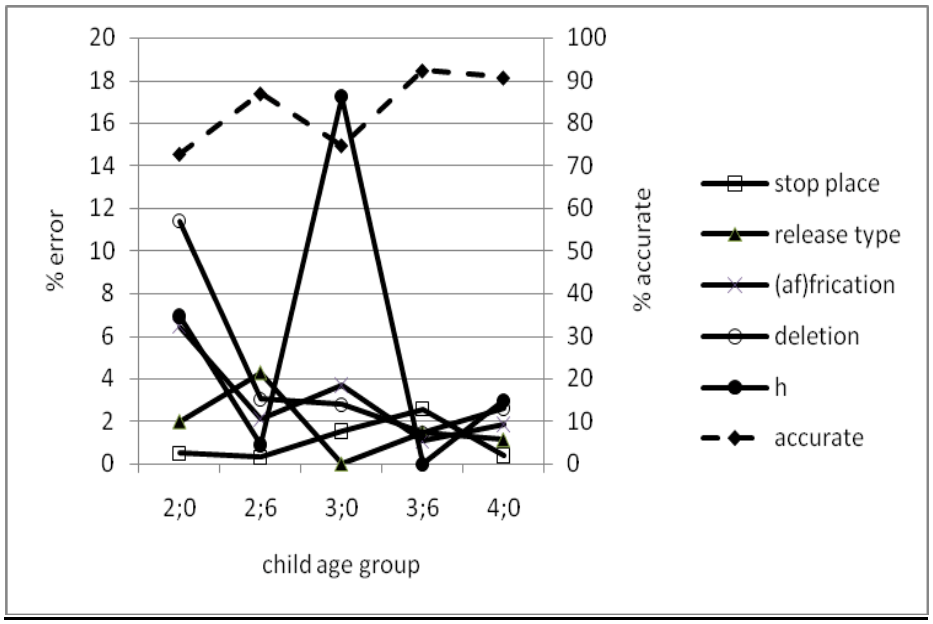
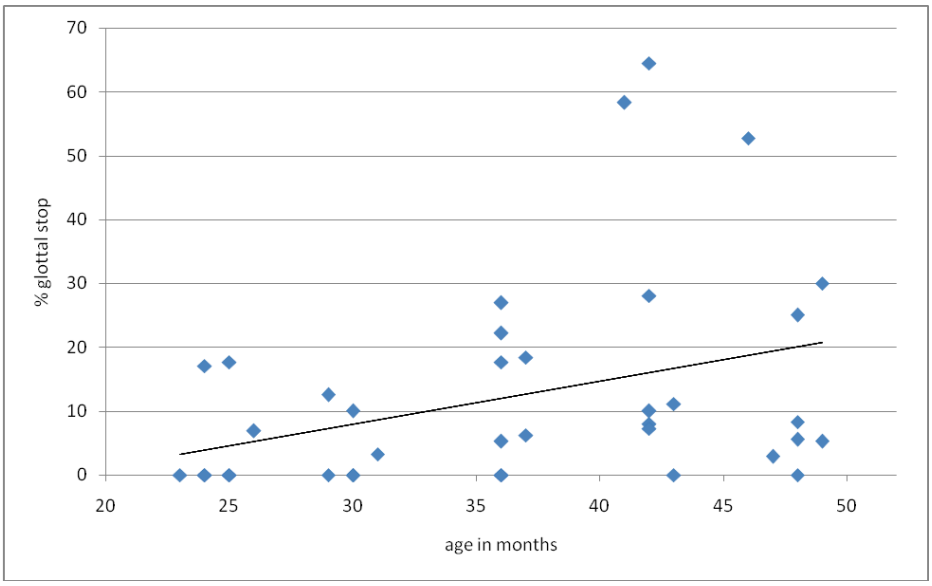


*Figure 4: glottal stop usage (%) by age group, final /t/. 8 speakers per age group. (Note that some data points are wholly overlapped.)*

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[1] '[a]ll of the phonetic, morphological and syntactic changes that characterise the life of languages are found in the speech of children'.

[2] Translation from Weinreich, Labov & Herzog (1968: 108).

[3] 'For every individual, language is ... a total recreation shaped through the influence of the surrounding environment.'

[4] Children might, however, play a key role in dialect contact situations. Trudgill (2004: 27) argues that children play a "pivotal" role in *tabula rasa* contact situations such as the one that gave rise to New Zealand English from the broad mix of dialects originally brought by settlers to New Zealand. He claims that second generation children shape the formation of the new dialect, generating "order out of chaos". They do so by following what he claims is a biologically-driven principle of accommodation, conforming to norms of peer behaviour. This leads children to "talk like the others talk", thus levelling the original dialect mix towards a new, unified dialect.