LANGUAGE AND LINGUISTICS 11.3:469-501, 2010
2010-0-011-003-000144-1

Directional Complements in Taiwan Mandarin Natural Speech*

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This paper is concerned with a specific kind of resultative verb complement construction in Mandarin Chinese, the directional complement construction. Instead of using texts or controlled laboratory data, we utilized a corpus of Taiwan Mandarin natural speech annotated with three types of directional constructions and investigated their usage in conversation. Some of the structures of directional complement constructions predicted by theories or observations were empirically confirmed in our frequency analysis, but some were not. In particular, we conducted statistical screening tests to explore relevant acoustic-prosodic features which may reflect the acoustic representation of directional components. The analysis was carried out by using residuals calculated by fitting a linear model of effects of speakers and syllables on the measurements of duration and intensity. The results suggest that duration is the most reliable acoustic-prosodic feature signifying phonetic reduction. Specifically speaking, the metaphorical use of directional constructions is prosodically less prominent than their original counterparts. Potentiality terms are more reduced than the neighbouring directional components. Phonetic reduction associated with syntactic prominence and semantic loss is also found in the use of directional components in contrast with the use of other grammatical categories such as verbs and prepositions. This paper not only gives a comprehensive overview of the authentic use of directional constructions in natural speech. It also provides a new piece of acoustic-prosodic evidence suggesting that the more grammaticalized the lexical items are, the more reduced they would appear in speech production.

Key words: directional complements, natural speech, statistical analysis, acoustic-prosodic features, grammaticalization

1. Introduction

Directional complement construction is a syntactic structure consisting of a verb and a complement which adds a particular characterisation (directional, resultative, inchoative

* The author would like to thank an anonymous reviewer for thoroughly reading a previous version of this paper and kindly providing constructive comments. The author would also like to thank two anonymous reviewers of *Language and Linguistics* for their useful comments and

etc.) to the verb (Chao 1968, Li & Thompson 1981). Directional complements are originally verbs of direction, e.g. *lai*[1] (come) and *qu* (go). But they develop into grammaticalized complements, when used in combination with a verb to characterize the direction of the associated predicate, i.e. *lai* (hither) and *qu* (thither). Throughout the paper, we will use the term directional constructions to represent directional complement constructions. Directional constructions in Mandarin are an issue of interest to sinologists working on Chinese syntax and language typology. Syntactically, a consensus is achieved as to how directional constructions should be grouped and categorized (Chao 1968, Liu 1998, Lü 1999, Wu 2004). For discussion of language typology, directional constructions provide linguistic evidence for the conjecture that Mandarin is a satellite-framed language (Talmy 2000, Tai 2003, Lamarre 2004). But studies on their use in speech, e.g. their frequency and variation, are not yet available in the literature. Directional constructions are often investigated in terms of syntactic analysis and the materials used for analysis are often written documents such as novels and journals. Using a corpus of contemporary novels, in total four millions words, Liu (1998) lists all verb combinations and their frequency of directional complements in the corpus. Similarly, Lü (1999) calculates the frequency of different variants in a smaller corpus of three novels whose content is close to colloquial use of Chinese, in total a hundred thousand words. By utilizing a corpus of Taiwan Mandarin natural conversation, this paper studies the authentic use of directional constructions in speech production and explores how their acoustic-prosodic features reflect the phenomenon of phonetic reduction.

In the literature, phonetic reduction is regarded as a kind of reduction of morphological boundaries and partly signifies the degree of grammaticalization. Hopper & Traugott (1993:145) mention that the erosion of morphological boundaries can be accompanied by a quantitative shortening of the phonological form or by a qualitative shrinkage of the set of phonological variants. More specifically, Hopper & Traugott (1993:103) indicate that decategorialization is a unidirectional change from a morphologically heavier unit to one that is lighter; a change from one that tends to be phonologically longer and more distinct to one that tends to be less distinct and shorter.

Yi Luo for his help with the statistical analysis. Part of the study presented in this paper was funded by the National Science Council in Taiwan, under Grant NSC 96-2411-H-001-067-MY2.

[1] Different Chinese dialects have different numbers of lexical tones associated with different melodic values (Duanmu 2000). Lexical tones in Taiwan Mandarin have four marked realizations: high level tone, rising tone, contour tone, and falling tone; plus an unmarked neutral tone. For notation, we use Hanyu Pinyin to transcribe the characters, omitting the tone sign. All the examples given in the Pinyin transcription are accompanied with a corresponding English translation.

Specifically for the grammaticalization process of directional constructions, Huang & Hsieh (2008) propose a sequence from the original spatial meaning to a non-specific spatial meaning, then to temporal implication, and finally to an indication of status. By studying clitics, Heine et al. (1991:233) suggest that loss in phonological substance is a way of looking at reduction of morphological boundaries and fusion/merger process in grammaticalization. Ansaldo & Lim (2004), based on a study of controlled speech data, propose that phonetic reduction is one of the main cues indicating syntactic prominence by examining acoustic-prosodic features of selected words and their grammaticalized counterparts. In speech production, the strength of a morphological boundary can be empirically identified with the help of prosodic features such as duration or intensity. Because Mandarin does not have an overt, morphological affixation to mark syntactic aspects, it is more likely that prosodic means make morphological boundaries salient. In this paper, we use acoustic measurements normalized across different speakers to study prosodic characteristics and stress pattern associated with directional constructions. Methodologically, acoustic measurements are normalized to eliminate individual effects of speakers and syllables. In terms of the normalized values, phonetic reduction of different types and components of directional constructions was studied.

2. Directional constructions in Mandarin Chinese

2.1 Types of directional constructions

Chao (1968:458) proposes a system of four types of directional constructions. But because the fourth type involves a special set of directional constructions, which cannot be coherently integrated into the system of the other three types, it is not considered in this study.

Type (1): *lai* (hither) and *qu* (thither), e.g. *jinlai* (come in) and *chuqu* (go out).
Type (2): *shang* (up), *xia* (down), *jin* (in), *chu* (out), *qi* (up), *hui* (back), *guo* (over), *kai* (apart) and *long* (get together), e.g. *zou jin* (walk into) and *kai hui* (drive back to).
Type (3): double complements formed with a type 2 followed by a type 1 complement, e.g. *reng guo qu* (throw over there).
Type (4): verbs of motion which can form single complements but not double complement with type 1, e.g. *peng dao le yizi* (have knocked down a chair).

Unlike Chao (1968), Liu (1998:2-32) classifies the directional constructions in terms of three semantically distinctive meanings: directional, resultative, and inchoative. In the use for directional meaning, spatial movement of an object or of a person is indicated through the directional construction. For instance, in the sentence *ta cong*

loushang zou xia lai (He comes down from upstairs), *xia lai* indicates the direction of the physical movement of the subject. In the use for resultative meaning, part of the movement indicated by the directional construction has come to a state or is completed. In *ta ba mingzi xie xia lai* (He has written down the name), *xia lai* indicates that the movement of writing has been completed. Compared with the directional and resultative uses, the inchoative use is relatively more grammaticalized because the directional construction in inchoative use indicates temporal extension, with no spatial association with the original movement. For instance, *xia lai* in *tian jianjian an xia lai* (It gets dark gradually) does not refer to any spatial movement, but the beginning of a change of state.

The classification of Liu (1998) is similar to that suggested by Chao (1968). The simple type takes *lai* (hither) or *qu* (thither) as the directional complement. The second type takes *shang* (up), *xia* (down), *jin* (in), *chu* (out), *qi* (up), *hui* (back), *guo* (over), *kai* (apart) or *dao* (to) as the directional complement. The third type combines *lai* or *qu* with *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai* or *dao*. The only difference between the surface form suggested by Chao (1968) and Liu (1998) is that Chao considers *long* (gather/together), but Liu (1998) considers *dao* in their set of directional complement candidates. In our later analysis, we include both *long* and *dao*.

When combined with a deictic directional *lai* or *qu*, the combination of a path verb and a deictic directional and the combination of a co-event verb and a deictic directional are distinguished by Lamarre (2003). Path verbs are *shang* (ascend), *xia* (descend), *jin* (enter), *hui* (return), *guo* (cross) etc., which indicate the route or direction of a movement. Co-event verbs are used for movements with no directional implication, e.g. *pao* (run), *reng* (throw), *zou* (walk), *la* (pull) etc.; they can only get a directional meaning when used with directional complements. In Type (2) and (3) of Chao's system (1968), path verbs in Type (1) are used as path directionals, whereas co-event verbs in Type (1) do not have this possibility. Thus, we adopt the sub-grouping of Lamarre (2003) in our classification system of directional constructions. In terms of the structural types of directional constructions, their use of derived forms and their acoustic-prosodic representation in natural speech production will be closely studied in this paper.

2.2 Classification of directional constructions in Mandarin Chinese

For the subsequent analysis, a classification system of directional constructions in Mandarin Chinese is proposed, oriented at the systems suggested by Chao (1968) and Lamarre (2003). Three types of directional constructions are distinguished: (1) **Type I**: V + deictic directional, (2) **Type II**: V + path directional and (3) **Type III**: V + path directional + deictic directional. They are shown in Table 1.

Table 1: Types of directional constructions in Mandarin Chinese

Type I: Verb + Deictic Directional					
	Path verb	Co-event verb	Other verb	Potential form	Deictic directional
Ia	***jin*** enter			*BU*/*DE*	***lai*** hither (come in)
Ib		***pao*** run			***qu*** thither (run to)
Ic			***xing*** awake		***lai*** hither (wake up)
Type II: Verb + Path Directional					
	Verb	Potential form	Path directional	Locative NP	
IIa	***chong*** rush	*BU*/*DE*	***jin*** into	(rush in)	
IIb	***chong*** rush	*BU*/*DE*	***jin*** into	***xuexiao*** school (rush into school)	
IIc	***zhuang*** fill		***chu*** out	(pretend)	
Type III: Verb + Path Directional + Deictic Directional					
	Verb	Potential form	Path directional	Locative/ Object NP	Deictic directional
IIIa	***chong*** *rush*	*BU*/*DE*	***jin*** into		***lai*** (rush towards the speaker)
IIIb	***chong*** rush ***na*** take	*BU*/*DE*	***jin*** into ***chu*** out	***xuexiao*** school ***qian*** money	***lai*** (rush into school; the speaker is in the school) ***lai*** (take out the money)
IIIc	***kan*** look		***qi*** up		***lai*** (it looks like, it seems)

Deictic directionals are *lai* (hither) and *qu* (thither). **Type I** is divided into three sub-types: (**Ia**) path verb + deictic directional, (**Ib**) co-event verb + deictic directional and (**Ic**) other verb + deictic directional which has an extensive meaning beyond the scope of physical directions. Path verbs are *shang* (ascend), *xia* (descend), *jin* (enter), *chu* (exit), *qi* (rise), *hui* (return), *guo* (cross),[2] *kai* (open up), and *long* (get together) (Chao 1968). Co-event verbs mark a concrete, physical movement with a possible association with direction, e.g. *pao* (run), *zou* (walk, go) and *na* (take) etc. From the syntactic point of view, **Type Ia** and **Ib** need to be distinguished because the syntactic construction of a path verb and a deictic directional is parallel to a verb-complement structure. The potential form "path verb + *bu* + deictic directional" (negative) and "path

[2] Aspectual marker such as the (experiential) past aspect (*guo*) is not taken into account.
Ni chi guo yuchi mei you? (Chao 1968:251)
You eat cross shark fin NEG?
'Have you ever eaten shark's fin?'

verb + *de* + deictic directional" (positive) is grammatically well-formed, but the potential form (both negative and positive) is in general not possible with the structure "co-event verb + deictic directional" for verbs expressing self-agentive motions such as "walk", "run", "rush", etc. (Liu 1998:53).[3]

Ia and **Ib** characterize a physical direction, e.g. *jin lai* (come in) and *pao qu* (run to). But **Type Ic** indicates a metaphorically extended meaning of an inchoative, successive or resultative use (Klein et al. 2000), such as *xing lai* (wake up). The same criteria are applied to **Type IIa**/**IIb-IIc** and **Type IIIa**/**IIIb-IIIc**. The inchoative aspect (*qi lai*) and the resultative aspect (*chu lai*), as mentioned in Liu (1998) as well as the successive aspect (*xia qu*) as shown below are considered as metaphorically extended use originated from the canonical form of directional complements. They are counted in the subsequent corpus-based study.

Tamen wan zhe wan zhe turan ku qilai le. (Chao 1968:251)
'They were playing and playing and suddenly started to cry.' (inchoative)

Ta kanchulai wo bu gaoxing.
'He realized that I am unhappy.' (resultative)

Ni nayang zuo xiaqu, jieguo yiding bu hao. (Chao 1968:252)
'If you go on doing (it) like that, the result will certainly be bad.' (successive)

For a verb-complement construction to be classified into **Type Ia** or **Ib**, rather than **Ic**, it must satisfy three criteria. First, the verb should clearly indicate a concrete movement or action, e.g. *zou* (walk). Second, the object associated with the movement or the action of the verb has to be a concrete entity, e.g. *ta paojin nage fangzi* (he ran into that house). Third, the object associated with the verb has a spatial movement indicated by the directional complement, e.g. the spatial movement from outside to inside the house in *ta paojin nage fangzi*. If a verb-complement construction satisfies these criteria, it is grouped to **Type Ia** or **Ib**. If not, it is classified into the metaphorically extended use.

The second type considers combinations of a verb and a path directional: (**IIa**) with no locative NP, (**IIb**) with a locative NP and (**IIc**) the metaphorically extended use. Path directionals include the same set as the path verbs. But here, these nine words are not used as a freestanding main verb, but as a complement. For instance, the main verb *chong* (rush) and the path directional *jin* (into) can be used with or without a locative

[3] The author would like to thank Christine Lamarre for pointing out this reference.

NP, e.g. *chong jin* (rush in) and *chong jin xuexiao* (rush into the school). The extended use, **Type IIc**, is for example *zhuang chu* (pretend), where *zhuang* originally means "to fill" and the path directional "out". The original meaning of this compound-like word is apparently lost, and there remains an extended, metaphorical meaning only.

Similar to **Type II**, the third type has three sub-types, but with an additional deictic directional: (**IIIa**) the combination of a verb, a path directional, and a deictic directional with no NP; (**IIIb**) the combination with an object NP/locative NP following a path directional; and (**IIIc**) the same combination as **Type IIIa**, but with a metaphorically extended meaning. In principle, verbs used in **Type I** can also be used in **Type III**. The difference between *chong jin lai* and *chong jin xuexiao lai* as well as between *chong jin* and *chong jin xuexiao* lies in the directional indication associated with the speaker by using *lai* (hither). In the example *chong jin xuexiao lai*, *xuexiao* is a locative NP. Another variant is *chong jin lai xuexiao*, where the locative NP follows the path and deictic directionals. With an object NP, there are three variants: *na chu qian lai*, *na chu lai qian* and *na qian chu lai*. They have sophisticated meaning differences. In praxis, these three variants are all used in spoken Chinese. The variant *na chu lai qian* is relatively seldom used in Taiwan Mandarin. Later in the annotation, all the variants of locative NP and object NP are annotated as **IIIb**, regardless of word order. Moreover, *kan qi lai* (literally "look + up + hither") means 'it looks like, it seems'. The action of "up" is not directly related to the physical movement of looking. It is a metaphorical use of **Type III**.

We do not distinguish affined, semantic sub-types of verbs used in **Type Ic**, **IIc**, and **IIIc**, because it would involve a complex consideration of verb semantics, which is not the main concern of this paper. In addition, the number of occurrences of these three types is too few to make an empirically reasonable sub-classification. Please note that metaphorically extended uses as defined in the classification system in Table 1 are non-idiomatic. Idiomatic uses involving directional constructions in Taiwan Mandarin are not considered in this study, for instance V-*lai*-V-*qu*, meaning repeating some kind of movement; e.g. *pao lai pao qu* (run around) and *tiao lai tiao qu* (jump around). Another construction which is also excluded is the V_1-*dao*-NP-*qu*/*lai*-(V_2) construction. The V_1-*dao*-NP-*qu*/*lai*-(V_2) construction includes occurrences such as "send someone or something to Taipei" *song* (send) *dao* (to) *taibei* (Taipei) *qu* (*thither*) and "travel to Kaohsiung" *zuo* (travel) *dao* (to) *gaoxiong* (Kaohsiung) *qu* (thither). The locative NP in this case seems to be obligatory. Cases with an object NP such as "talk about the topic of education" *qianche* (talk) *dao* (to) *jiaoyu* (education) *lai* (hither) and "talk about the topic of Taiwanese Mandarin" *jiang* (talk) *dao* (to) *taiwan* (Taiwan) *guoyu* (national language) *qu* (thither) are not considered, either.

2.3 Stress pattern and prosodic boundaries of directional constructions

The term "stress pattern" as used in this study, does not refer to a phonological definition of stress, but a relative prosodic prominence in pronunciation. A syllable or a word is considered un-stressed, if it does not have full pronunciation and usually the tone is not a full lexical tone, but a neutral tone. For Beijing Mandarin, the notion that directional components are always un-stressed is widely accepted (Lin 1957:61, Lü 1981:38-41, Chao 1968:459). Fan (1963) lists a set of concrete rules for the stress pattern of directional constructions in Mandarin Chinese. When summarizing the rules, we follow our classification in Table 1, and give the original order of the rules in Fan (1963) in parenthesis. For convenience, the rules are ordered in two categories: basic forms and derived forms (positive/negative potential forms).

(1) Basic forms
   a. The deictic directional in **Type Ia** and **Type III** is un-stressed. (2.4-(4), 2.4-(1))
   b. The path directional in **Type IIb** and **IIIb** (with a locative NP) is un-stressed. (2.4-(3))
   c. The path directional in **Type IIa** has full pronunciation. (2.4-(5))
   d. "*Guo*" in **Type II** has full pronunciation. "*Kai*" in **Type II** is un-stressed. But "*kai*" has full pronunciation, when it denotes understanding. (2.4-(6))

(2) Derived forms (**p**: prosodic boundary)
   a. **Type Ia**, **IIa** and **IIIa** (V-**p-**de/bu-*x*): *De*/*bu* is un-stressed; the deictic/path directional (*x*) has full pronunciation. (2.3-(1))
   b. **Type IIb** (V-**p**-de/bu-*x*-*N*): Irrespective of what kind of noun *N* is, *de*/*bu* is un-stressed, and the path directional (*x*) has full pronunciation. (2.3-(2))
   c. Type **IIIb** (V-**p**-de/bu-*x*-*N*-**p**-*y*): Irrespective of what kind of noun *N* is, *de*/*bu* is un-stressed. The path directional (*x*) has full pronunciation, and the deictic directional (*y*) is un-stressed. (2.3-(3))
   d. In the derived form, the path directional (*x*) has full pronunciation. (2.4-(2))

Because we deal with spontaneous speech production data and did not control the contrast pairs for comparison (which is necessary in some of the cases), not all rules listed above are examined in the acoustic-prosodic analysis.

2.4 Directional constructions and syllable contractions

Syllable contractions often occur in natural speech of Mandarin Chinese and Chinese dialects (Cheng 1985, Tseng 2005). Contraction in Mandarin Chinese has a long history and sometimes it even directly influences the writing system in the sense that new characters are invented or existing characters are borrowed to represent the new contracted form of the syllable. The contracted syllable pairs are usually semantically less essential, phonetically reduced and they are seldom a proper noun or a verb. The pattern observed in a contraction pair is that one of the syllables may be more prominent, so its syllable structure is preserved more than the other syllable which is more reduced with a tendency to be merged with the more prominent syllable. The more prominent syllable is in a so-called contraction-strong position, the more reduced syllable in a contraction-weak position.

Tseng (2008) studies the distribution of directional constructions which are annotated as syllable contraction. That is, if any one of the words in a directional construction is contracted with its adjacent syllable(s), they are annotated for analysis. Tseng (2008) found that in **Type Ia**, the deictic directional occurrences in the contraction-strong position make up about 51% of all deictic directionals, whereas in **Type Ib** it is 65%. The result is not statistically significant, but it demonstrates that there could be a prosodic difference in the production of deictic directional, if further studies can be done to distinguish the use with a path verb or with a co-event verb. In **Type III**, only 38% of the deictic directional occurrences are realized as contraction-strong syllables. If we consider the deictic directional in **Type III** more grammaticalized than that in **Type I**, this result indicates that the more the semantic meaning is lost and the syntactic function is strengthened, the more phonetically weakened the item could be. The deictic directional in **Type III** loses part of its original meaning by sharing it with the path directional. But in **Type I** the deictic directional still preserves to a large degree its original semantic meaning conveying the direction.

Thus, the deictic directional appears more reduced in **Type III**, as predicted by Fan (1963). For path verbs in **Type I**, the deictic directional is equally often contracted with the preceding verb or the subsequent syllable. This may imply that there is no particular preference to produce the directional construction as a unit. But for co-event verbs, deictic directionals are more likely to be contracted with the subsequent syllable. In other words, **Type I** and **Type III** present different tendencies for locating unit boundaries in natural speech. However, these results are indirect implications obtained from contracted items involved in directional constructions. The acoustic-prosodic study presented in this paper will directly examine the phonetic evidence.

3. Directional constructions in a spoken corpus

3.1 Mandarin Conversational Dialogue Corpus (MCDC)

The Mandarin Conversational Dialogue Corpus (MCDC) was collected at the Institute of Linguistics, Academia Sinica from 2000 to 2001. It consists of eight orthographically transcribed conversations between strangers of approximately eight hours of recorded speech data in total (Tseng 2004). Corpus details are available at the website http://mmc.sinica.edu.tw. In this paper, 702 complete speaker turns containing directional constructions are used for the analysis. Because Chinese texts do not employ blanks to separate words, we need to segment the word boundaries before extracting the acoustic features. The transcripts of the conversations were processed by the automatic word segmentation and tagging system developed by the Chinese Knowledge Information Processing Group (CKIP) at Academia Sinica (Chen et al. 1996). Originally, the CKIP system was designed and trained for processing written texts in Mandarin. So, for our spoken data, we added a number of rules to deal with sentence fragments appearing in conversation. The segmentation and tagging results were subsequently manually post-edited before conducting the statistical analysis.

3.2 Directional constructions in the corpus

Nine hundred and thirty-four occurrences of directional constructions were identified in 702 speaker turns, and construction types listed in §2.2 were annotated in the transcripts. The results are summarized in Table 2. Individual items of **Types I**, **II**, and **III** can be found in Appendices A, B, and C.

Table 2: Summary of directional construction data in corpus

Type I: 331 tokens		Basic form	Derived form (Potential form)		Total
			Negative	Positive	
Ia	Path verb + deictic dir.	286	4	1	291
Ib	Co-event verb + deictic dir.	29	0	0	29
Ic	Other verb + deictic dir. (metaphorical)	2	6	3	11
Type II: 313 tokens					
IIa	Verb + path dir.	133	14	12	159
IIb	Verb + path dir. + NP	131	9	1	141
IIc	Verb + path dir. (metaphorical)	12	1	0	13

Type III: 290 tokens					
IIIa	Verb + path dir. + deictic dir.	178	29	6	213
IIIb	Verb + path dir. + NP + deictic dir.	18	0	0	18
IIIc	Verb + path dir. + deictic dir. (metaphorical)	47	12	0	59

In §2.2, we mentioned that for verbs expressing self-agentive motions like co-event verbs *walk*, *run*, and *rush*, it is not theoretically possible to have derived forms for **Type Ib** (Liu 1998:53). In our data, we actually did not find any occurrences of **Type Ib** of the derived form. Moreover, Lien (1997:392) mentioned that derived forms of **Type Ic** are only possible for *lai*, not for *qu* in Taiwan Mandarin, whereas both *lai* and *qu* are both eligible for the derived form of **Type Ic** in Taiwan Southern Min. In our data, more occurrences of the derived form than the basic forms of **Type Ic** are found. It includes: two occurrences of the basic form *xing lai* (wake up), *suan lai* (count); six occurrences of negative potential form *nian bu lai* (be incapable of studying), *shou bu lai* (cannot stand something), *hua bu lai* (not worth it); and three occurrences of positive potential form *hua de lai* (be worth it), *he de lai* (get along well). We did not find any occurrences of **Type Ic** associated with *qu*, which shares similar features with Southern Min, as predicted by Lien (1997).

To take *xia* (as a verb meaning "descend", as a complement meaning "down") as an example, *xialai* and *xiaqu* took different grammaticalization paths, as proposed by Han (2004). Using historical written materials, she found that *xialai* and *xiaqu* underwent the same from-concrete-to-abstract process, but with the grammaticalized forms having different meanings with respect to the result of the denoted movement and change. That is, both *xialai* and *xiaqu* can be grammaticalized from verbs denoting physical movement to aspect markers indicating temporal extension. *Xialai* is used, when the result is predictable, i.e. the extension has an end; e.g. *lan xialai* (to stop someone or something). *Xialai* has developed into a common compound component in modern Mandarin whose directional association has disappeared to some extent. Different from *xialai*, *xiaqu* is used, when the extension of movement or time is unbounded. *Xialai* is more frequently used than *xiaqu* in her corpus of old written texts. *Xiaqu* is used with a wider variety of words than *xialai* and the speed of grammaticalization process is faster than *xialai* in terms of the increase of usage in her old written texts. This argument presents a different aspect from the hypothesis proposed by Bybee (2003) that grammaticalization is driven by token frequency, then resulting in phonological fusion. We cannot exclude the possibility that grammaticalization can be triggered at different linguistic levels, and can develop into different final forms eventually. Both token frequency and semantic generalization initiate a grammaticalization process, which usually result in phonological fusion in the phonetic representation in the spoken language. In our data, the use for physical movement in **Type Ia** is more frequently combined with *xialai* (17 occurrences)

than *xiaqu* (7 occurrences). This tendency is shown in the use as a directional complement in **Type IIIa**, 20 *xialai* occurrences and 6 *xiaqu* occurrences. As a whole, we observe an apparent dominance for *lai* over *qu* in **Type IIIa** (167 over 46). However, in the metaphorical use in **Type IIIc**, more *xiaqu* (20 occurrences) is used than *xialai* (11 occurrences). Whether this result has to do with the faster grammaticalization process of *xiaqu* as suggested in Han needs further study.

Liu (1998:38) mentioned in the statistical result of a corpus analysis of written data that directional constructions of **Type II** and **Type III** have different preferences with regard to the use of locative or object NP. She took *shang* as an example to illustrate the fact that **Type II** constructions tend to be used with an NP (354 with an NP, 11 without an NP), whereas **Type III** are more likely to be used without an NP (66 with an NP, 449 without). This observation is only partially confirmed in our data. Our spoken data shows that the use without an NP is preferably produced in the form of **Type III** (18 with an NP, 213 without). However, the preference for using an NP or not is similar for **Type II** (141 with an NP, 159 without). With regard to the use of *qu* and *lai*, **Type IIIa** combinations with the deictic directional *qu* are less frequently found compared with *lai* (46 *qu* occurrences, 167 *lai* occurrences). This was not the case for **Type I** occurrences. In **Type Ia**, the number of occurrences with *lai* and with *qu* is about the same (151 *qu* occurrences, 140 *lai* occurrences). The result of the chi-square test shows that the difference between **Ia** and **IIIa** with regard to the distribution of *lai* and *qu* is statistically significant, $\chi^2(1)=47.403$, $p=0.000$. Deictic directionals *lai* and *qu* are used equally often in **Type I**, but *lai* is much more often used than *qu* in **Type III**. The reason may be that in **Type III**, the path directional gives information about the path and as a result the information about the direction conveyed by the deictic directional turns to be secondary. Therefore, we would expect that the deictic directional of **Type III** may not be as substantial as that of **Type I**, because the directional meaning can get linked up to both the path and deictic directionals in **Type III**. Thus, a consequence to expect is that the morphological boundary between the path directional and the deictic directional of **Type III** becomes weaker than the boundary between the verb and the deictic directional in **Type I**. As the prosodic prominence pattern of a linguistic structure and the strength of a morphological boundary may share similar representation in their acoustic-prosodic features, we undertake an acoustic-prosodic analysis of directional construction in the next section to study this issue more closely.

4. Acoustic-prosodic characteristic of directional constructions

Ansaldo & Lim (2004) used vowel quality, F0, duration, and intensity to measure the degree of reduction. Shen (1993) also mentioned that stress in Mandarin Chinese

can be identified on the basis of duration and intensity. To look for relevant and representative acoustic-prosodic features, we initially measured four groups of acoustic-prosodic features to analyze the directional constructions annotated in our corpus: (1) the syllable duration (duration); (2) F0 (pitch_max, pitch_min, pitch_range, pitch_mean, pitch): the maximum, minimum, range, and mean of the measured F0 values as well as the F0 values measured at the maximum intensity within a syllable; (3) the intensity (intensity_max, intensity_range, intensity_mean): the maximum, range, and mean of the measured intensity values within a syllable; and (4) the first and second formants (F1, F2):[4] F1 and F2 values measured at the maximum intensity within a syllable (this measurement method may not correctly reflect the essential feature of diphthongs).

Before we analyzed the data, all tokens which appear only once were removed from the data set, because they cannot be used for statistical analysis. We primarily applied a linear model to calculate the residuals of each acoustic-prosodic feature above by eliminating individual differences across speakers and syllables under the assumption that the effect of all speakers, all syllables and each syllable produced by individual speakers is linear. Using the residuals, we did the Kolmogorow-Smirnov (K-S test) and the Levene tests to check whether the distribution (normal distribution) and variance (comparable variance of each group of data) across the data can be considered for further ANOVA tests. In the case of not passing either one of the above tests, we used the non-parametric Kruskal-Wallis test instead to see if there is a significant difference across the directional components as defined in Table 1: *lai*, *qu*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*, *dao*, and *long*. The results are summarized in Table 3. The number shown to each acoustic feature is the number of directional components which passed the respective test. Please note that because this is a screening experiment, the significance level of the K-S and the Levene tests was loosened to 0.04; the ANOVA and the Kruskal-Wallis test to 0.1.

[4] Although the vowel qualities may be different across directional components, we cannot exclude the possibility that vowel reduction may appear in the form of changes in F1 and F2 values, which are the most essential acoustic characteristic of vowel production. Thus, in the screening tests, we included F1 and F2 features, too.

Table 3: Results of statistical tests

	K-S test	Levene test	ANOVA test	Kruskal-Wallis test
Duration	**7**	**7**	**6**	**8**
	shang, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*	*qu*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*	*lai*, *shang*, *xia*, *qi*, *guo*, *dao*	*lai*, *shang*, *xia*, *qi*, *hui*, *guo*, *kai*, *dao*
Pitch_max	**2**	**9**	**0**	**1**
	jin, *qi*	*lai*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *dao*		*dao*
Pitch_min	**4**	**11**	**1**	**3**
	shang, *jin*, *qi*, *hui*	*lai*, *qu*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*, *dao*	*lai*	*lai*, *qu*, *shang*
Pitch_range	**1**	**8**	**0**	**3**
	jin	*lai*, *shang*, *xia*, *chu*, *qi*, *hui*, *guo*, *dao*		*xia*, *qi*, *dao*
Pitch_mean	**4**	**11**	**0**	**1**
	shang, *jin*, *qi*, *hui*	*lai*, *qu*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*, *dao*		*jin*
Pitch	**6**	**11**	**0**	**1**
	shang, *xia*, *jin*, *qi*, *hui*, *dao*	*lai*, *qu*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*, *dao*		*kai*
Intensity_max	**10**	**11**	**5**	**3**
	lai, *qu*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *kai*, *dao*	*lai*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*, *dao*	*qu*, *shang*, *xia*, *jin*, *dao*	*qu*, *shang*, *dao*
Intensity_range	**10**	**9**	**9**	**9**
	qu, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*, *dao*	*lai*, *qu*, *shang*, *jin*, *qi*, *hui*, *guo*, *kai*, *dao*	*lai*, *qu*, *shang*, *xia*, *chu*, *qi*, *guo*, *kai*, *dao*	*lai*, *qu*, *shang*, *xia*, *chu*, *qi*, *guo*, *kai*, *dao*
Intensity_mean	**10**	**8**	**5**	**3**
	lai, *qu*, *shang*, *xia*, *jin*, *chu*, *qi*, *hui*, *kai*, *dao*	*lai*, *xia*, *jin*, *chu*, *qi*, *hui*, *guo*, *kai*	*lai*, *qu*, *shang*, *jin*, *dao*	*lai*, *shang*, *dao*
F1	**4**	**8**	**3**	**4**
	lai, *jin*, *qi*, *kai*	*lai*, *qu*, *xia*, *jin*, *qi*, *hui*, *guo*, *dao*	*shang*, *chu*, *dao*	*lai*, *xia*, *guo*, *dao*
F2	**8**	**8**	**3**	**1**
	lai, *xia*, *jin*, *qi*, *hui*, *guo*, *kai*, *dao*	*lai*, *qu*, *xia*, *jin*, *qi*, *hui*, *guo*, *dao*	*lai*, *shang*, *dao*	*lai*

The results illustrate that duration, intensity_range, and intensity_mean are the three most closely related acoustic-prosodic features of the phonetic representation of directional components in natural speech. Pitch values are not sensitive to the types of directional constructions, neither are the formant values. This may be due to the imbalanced number of syllables, lexical tones and vowels. Based on these results, the rest of the analysis will be carried out with respect to syllable duration, the range of intensity within each syllable, and mean intensity within each syllable. Because we are also concerned with the acoustic-prosodic features of the items of directional components, when they are *not* used as a directional, but as a verb, a preposition, or a past tense particle, we annotated these occurrences in our corpus, too. For example, *guo* and *shang* can be used as independent main verbs without directional complements such as cross a bridge (*guo qiao*) and go to Taipei (*shang taibei*). *Xia* in *kaoliang xia* (under consideration) is a preposition; *guo* is a past tense particle in *kan guo* (saw). Table 4 explains the notation used for presenting the results.

Table 4: Notations

1d, 1d_BU, 1d_DE	1d: deictic directionals in basic form of **Type I** 1d_BU: deictic directionals in negative potential form of **Type I** 1d_DE: deictic directionals in positive potential form of **Type I**
2p, 2p_BU, 2p_DE	2p: path directionals in basic form of **Type II** 2p_BU: path directionals in negative potential form of **Type II** 2p_DE: path directionals in positive potential form of **Type II**
3d, 3d_BU, 3d_DE	3d: deictic directionals in basic form of **Type III** 3d_BU: deictic directionals in negative potential form of **Type III** 3d_DE: deictic directionals in positive potential form of **Type III**
3p, 3p_BU, 3p_DE	3p: path directionals in basic form of **Type III** 3p_BU: path directionals in negative potential form of **Type III** 3p_DE: path directionals in positive potential form of **Type III**
1v, 2v, 3v, v, 1v_BU	1v: path verbs used in **Type I** 2v: path verbs used in **Type II** 3v: path verbs used in **Type III** v: used as a non-path main verb 1v_BU: path verb used in negative potential form of **Type I**
PREP	Preposition use
PAST	Past tense particle use

4.1 Acoustic-prosodic features in basic and derived forms

Residual values of acoustic measurements are calculated as described above for conducting statistical tests. Figures 1, 2, and 3 are drawn by taking the mean of the

respective residual values. Phonetic reduction is usually reflected in duration; i.e. the shorter the syllable, the more phonetically reduced it will be. The result in Figure 1 shows that deictic and path directionals are more reduced in the basic form than in the derived form, except for some cases due to lack of samples.[5] Also observed is that when the lexical items of directional components are used as a non-path verb, they are normally longer than as a directional component in the basic form.

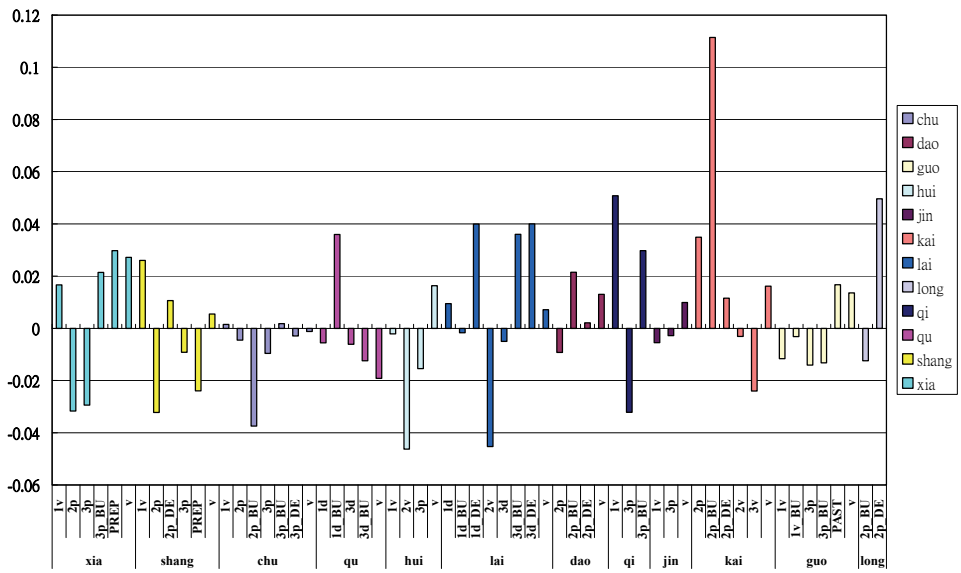

Figure 1: Duration residuals—individual directional components

In Figures 2 and 3, intensity range and means seem to be smaller for directional complements in the derived form than in the basic form, though not very consistently. But they are greater in the use as a non-path verb than as a directional complement in most cases. In the literature, phonetic reduction is usually observed in the form of

[5] For instance, the negative potential form of *chu* in **Type II** has only two occurrences *pai bu chu* (cannot catch the image properly) and *ting bu chu* (cannot understand). The negative potential of *lai* in **Type I** has four occurrences: *hua bu lai* (not worth it), *hui bu lai* (cannot come back), *shou bu lai* (cannot stand something), and *nian bu lai* (cannot study properly). The negative and positive potential form of *qu* in **Type III** have ten and one occurrences, respectively: *jingying bu xia qu* (cannot run the business any more), *zuo bu xia qu* (cannot do it any more), *nian bu xia qu* (cannot continue the study any more), *wan bu guo qu* (cannot bend over), *kan bu xia qu* (cannot stand something any more), and *you de guo qu* (can swim across), whereas the basic forms have 61 occurrences containing more variations of combinations.

shorter duration and weaker intensity. The tendencies observed in individual directional complements are not quite consistent. The cues found in our data are shorter duration and greater intensity in the basic form than in the derived form.

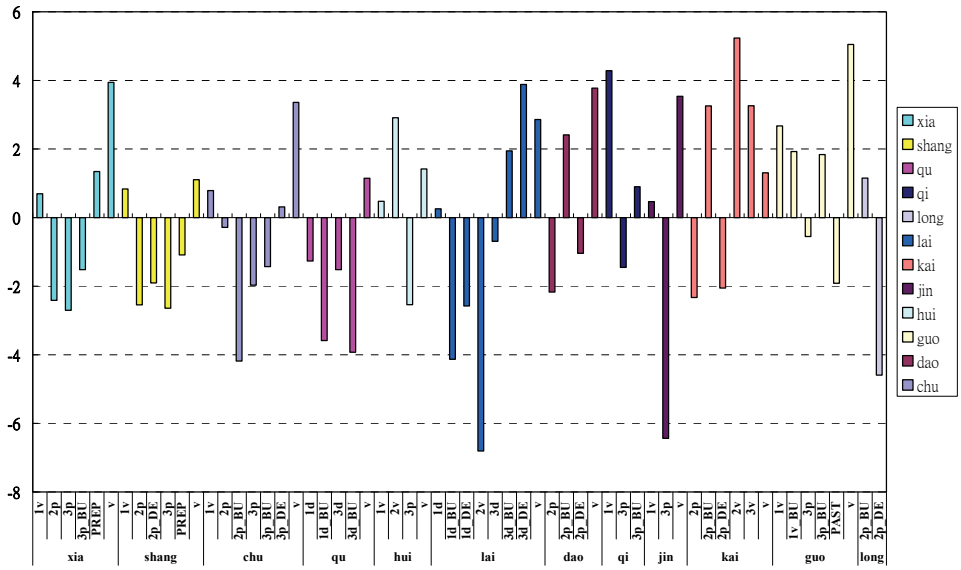

Figure 2: Intensity range residuals—individual directional components

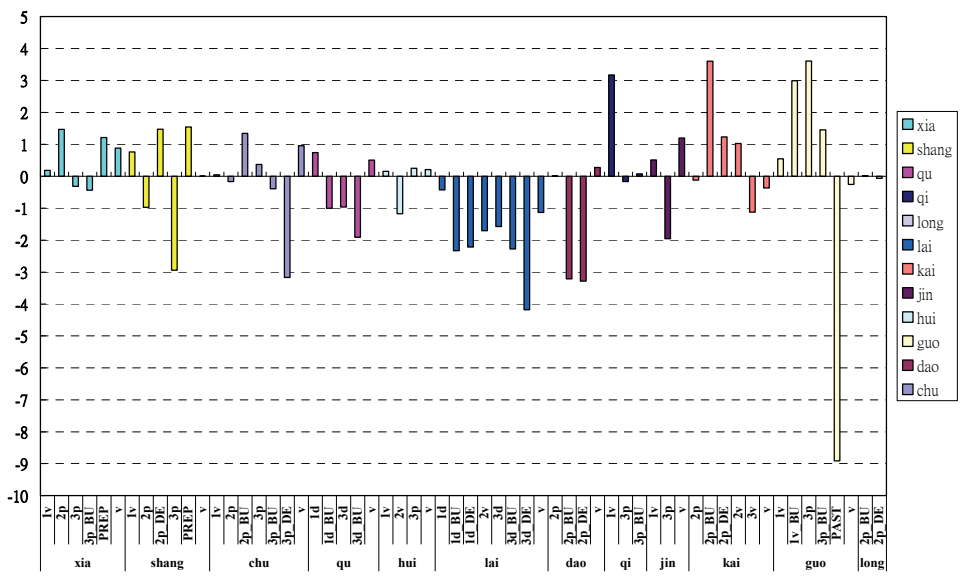

Figure 3: Intensity mean residuals—individual directional components

As duration, intensity range and intensity mean show potential correlations with directional components, we re-arranged the results in terms of directional types instead of individual directional components. We ran the ANOVA test to examine whether the difference is statistically significant, if the data distribution passed the above K-S test and the Levene test. Otherwise, we ran the nonparametric Kruskal-Wallis test. The results suggest that path directionals in **Type II** ($\chi^2(2)=12.457$, p=0.002) and both deictic and path directionals in **Type III** are significantly shorter in duration in the basic form than in the derived form (for deictic directionals F(2, 287)=3.435, p=0.034; for path directionals F(2, 287)=8.005, p=0.000). The tendency that directional components in the basic form are more reduced in duration than in the derived form is clearly illustrated in Figure 4. Intensity range and mean do not show a consistent tendency in the statistical analysis.

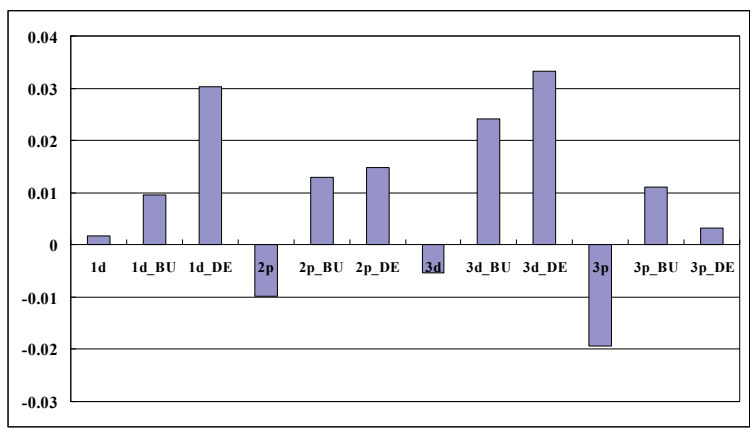

Figure 4: Duration residuals of directional components in basic and derived forms

4.2 Stress pattern—potential forms

The current analysis investigates the stress pattern of directional components and their potentiality terms (both negative and positive) *BU* and *DE* in the derived form. We conducted the 1-tailed t-test in the case of normal distribution and the nonparametric Mann-Witney U test otherwise on the duration, intensity range, and intensity mean of directional components and *BU*/*DE*. The result shows a significant difference between the directional components and *BU*/*DE*. Figure 5 shows that *BU*/*DE* is shorter in duration (Z=-2.122, p=0.034) and smaller in intensity range (Z=-5.401, p=0.000) than its directional component counterparts. This result is consistent with the rules suggested by Fan (1963) that *BU*/*DE* is always un-stressed relative to the directional components.

However, it is also possible that this result is a consequence of the utterance-final lengthening effect, when the directional components are utterance-final and *BU*/*DE* precedes it. Further analysis controlling the position of the directional components in sentence is needed to examine this issue more closely.

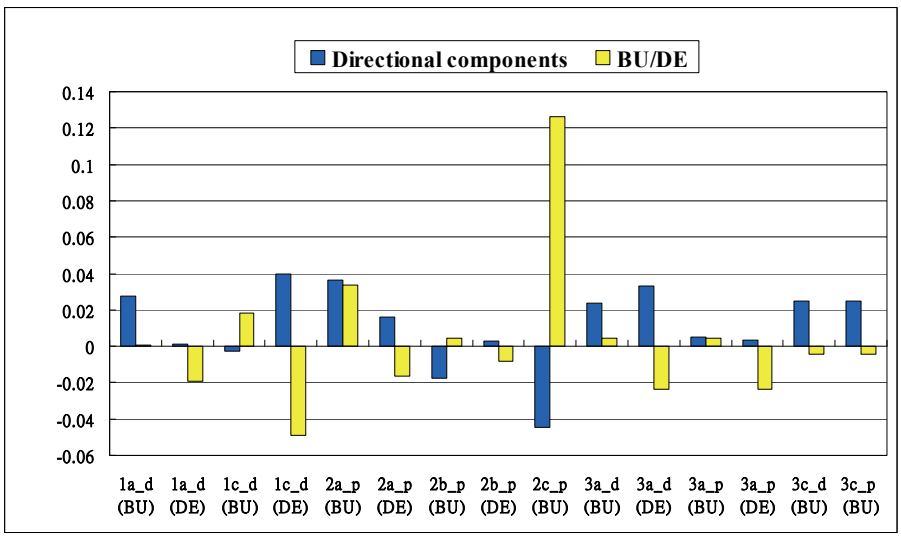

Figure 5a: Directional components-*BU*/*DE* (Duration residuals)

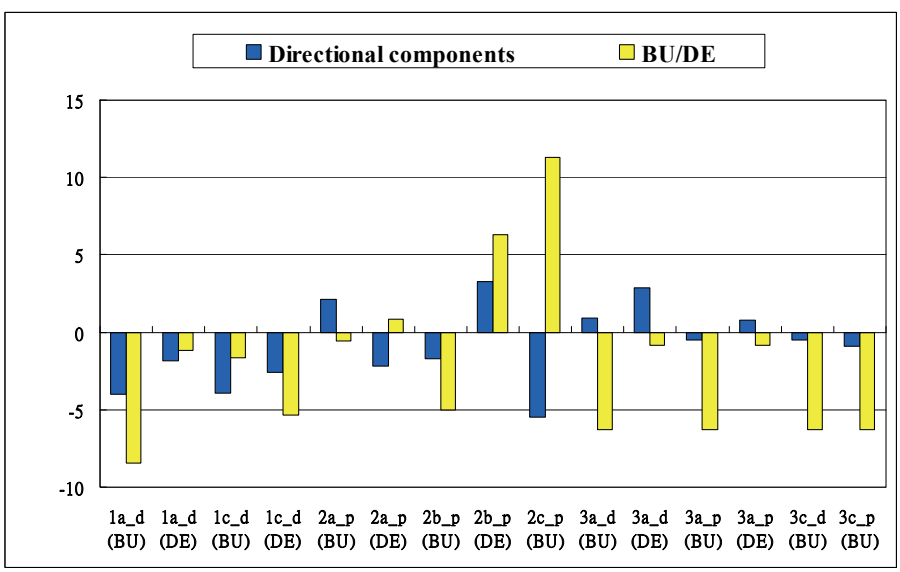

Figure 5b: Directional components-*BU*/*DE* (Intensity range residuals)

4.3 Directional components in each type

Ansaldo & Lim (2004) propose that reduction in phonetic form is one of the main cues for syntactic prominence. In an acoustic-prosodic study on *ho* (to give), *khi* (to go) in Hokkien and *gwo* (to cross), *dou* (to arrive) in Cantonese, they found that the more grammaticalized an item is, the more phonetically reduced it will be in the spoken use. They also suggest that shorter duration and weaker intensity are indications of phonetic reduction. Similarly, Hopper & Traugott (1993:145) also suggest that forms become shorter as the phonemes that comprise them erode. So, we studied the acoustic-prosodic features of directional components in each type.

We ran the ANOVA and Kruskal-Wallis tests on the deictic directionals in **Type I**, on the path directionals in **Type II**, and on the deictic and path directionals in **Type III**. In the analysis of path directionals, **2b_p** has 123 occurrences of *dao*, but **3b_p** has no occurrences of *dao*. But this should not affect the credibility of the analysis, because we have already eliminated the individual effects of syllables and speakers. The tests were intended to investigate whether differences in the use of directional components in each type can be found.

The statistical results show that for **Type I**, there is no difference in the use with a path verb or with a co-event verb, and in the metaphorical use in terms of all three acoustic-prosodic features. For **Type II**, there are statistically significant differences in 2a_p, 2b_p, and 2c_p in duration and intensity mean (for duration $\chi^2(2)=20.341$, $p=0.000$; for intensity mean $\chi^2(2)=9.433$, $p=0.009$). The post hoc multiple comparisons (LSD test) show that 2a_p is longer than 2b_p, and 2a_p is also longer than 2c_p in duration, and 2a_p is weaker than 2b_p in intensity mean. For **Type III**, there are also statistically significant differences in the group of 3a_d, 3b_d, and 3c_d (for duration $F(2, 287)=5.875$, $p=0.003$, for intensity range $F(2, 287)=4.512$, $p=0.012$) and in the group of 3a_p, 3b_p, and 3c_p (for intensity mean $\chi^2(2)=9.363$, $p=0.009$). The post hoc multiple comparisons on deictic directionals in **Type III** show that 3a_d is longer than 3c_d in duration and 3a_d is also greater than 3c_d in intensity range. The results on path directionals in **Type III** show that 3a_p is greater than 3b_p and 3c_p is also greater than 3b_p in intensity mean. Figure 6a and 6b illustrate the results of duration in **Type II** and **III**. The statistical results suggest a tendency that the metaphorical use may appear phonetically more reduced than the original use. This will be further verified in the next section.

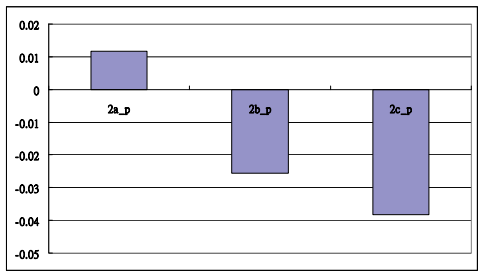

Figure 6a: Duration residuals in **Type II**

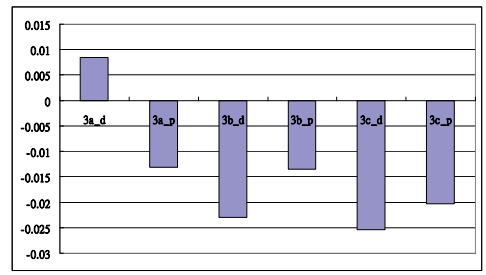

Figure 6b: Duration residuals in **Type III**

We ran statistical tests on the deictic and path directionals in each sub-type of **Type III**. The results of 1-tailed t-test show that only 3a_d is significantly longer than 3a_p in duration, t(348)=3.577, p=0.000, as also shown in Figure 6. But for **Type IIIb** and **IIIc**, no difference was found. Fan's rule that the path directional has full pronunciation and the deictic directional is un-stressed was not empirically confirmed in our data.

4.4 Original directional use vs. metaphorical use

We specifically examine the acoustic-prosodic features of directional components in original and metaphorical uses in this section. As **Type IIa** and **IIIa** represent the majority of each type, we only study three pairs: 2a_p-2c_p, 3a_d-3c_d, and 3a_p-3c_p. Figure 7 illustrates the results of duration mean of these three pairs. The results show that 2a_p is significantly longer than 2c_p, and 3a_d is significantly longer than 3c_d (statistical results please see §4.3). No significant difference was found for the pair 3a_p and 3c_p. However, the tendency that directional components in metaphorical use appear phonetically weaker than in original use is clear.

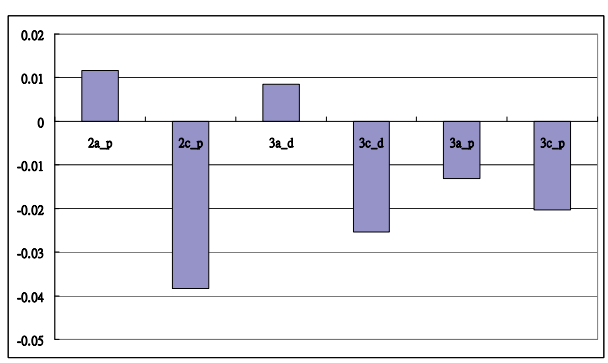

Figure 7: Duration residuals of contrast pairs:
original directional use vs. metaphorical use

4.5 Different grammatical categories of directional complements

In §4.1, we observed that acoustic-prosodic features of directional components and their uses of different grammatical categories show a certain degree of correlation, so we ran further statistical analysis on different grammatical uses of directional components. The nonparametric Kruskal-Wallis test (due to the failure to pass the normal distribution test) was conducted to see if there is any difference in the acoustic-prosodic features of various uses of the lexical items as a past tense particle (PAST), a preposition (PREP), a verb (v), and as a directional component in the basic form including 1d, 2p, 3d, and 3p. Significant differences were found in duration ($\chi^2(7)=22.998$, $p=0.002$), intensity range ($\chi^2(7)=109.482$, $p=0.000$), and intensity mean ($\chi^2(7)=21.687$, $p=0.003$). In order to examine individual directional components more closely, we ran the ANOVA and the Kruskal-Wallis test as well as the post hoc tests on individual items of directional components, notations following those in Table 4. Pairs having a statistically significant difference are summarized in Table 5 (the values ordered on the left-hand side are smaller than those on right-hand side).

Table 5: Acoustic-prosodic features of different grammatical categories (* results from the Kruskal-Wallis test, otherwise the ANOVA test)

Duration	*shang*	2p-1v, PREP-1v, 2p-v, PREP-v
	qi	3p-1v
	hui	2v-1v
	*dao**	2p-v
Intensity range	*qu*	1d-v, 3d-v
	jin	3p-1v, 3p-v
	qi	3p-1v
	guo	PAST-v, 3p-v, 3p-1v, PAST-1v
	dao	2p-v
	*xia**	3p-v
	*chu**	3p-1v, 3p-v
Intensity mean	*shang*	3p-1v, 2p-PREP, 3p-v, 3p-PREP

5. Discussion

5.1 Use of directional complements in natural speech

In written data of Mandarin, Liu (1998) observed that the simple construction of verb-path directional pattern is not frequently produced, but often followed by a locative

NP or by a direct object. Our data do not support Liu's observation. Two variants of **Type II**, with and without an NP, occurred similarly often in our Taiwan Mandarin speech data. But when combined with a deictic directional in **Type III**, there were different tendencies for using an NP: 178 occurrences without an NP, but only 18 occurrences with an NP. Surely, sixteen subjects' data cannot be representative for the common pattern of directional constructions. We need more data to determine whether this discrepancy is caused by language use difference (written vs. spoken) or by dialectal difference (Beijing Mandarin vs. Taiwan Mandarin). Furthermore, the data also provide an overview of the authentic use of derived forms of directional constructions in natural spoken discourse. We did not find any co-event verbs used in the derived potential form, conforming to the theoretical prediction that they express self-agentive motions and cannot be used in the potential form.

Moreover, different tendencies for using *lai*/*qu* and *xialai*/*xiaqu* may be an empirical indication of different development of grammaticalization paths within directional constructions, as proposed by Han (2004). *Lai* and *qu* have asymmetric distributions of combinations in **Type IIIa**. A number of directional constructions only appear with *lai*, but not with *qu*, for instance *qilai*, but not **qiqu* (Lien 1997). Nevertheless, in **Type I**, occurrences of *lai* and *qu* are found similarly often in our data and the number of their combination types is about the same. The preservation of physical quality of direction of deictic directionals in **Type I** may strengthen the independent, original uses of *lai* and *qu*. But in **Type III**, deictic directionals to a certain degree become an attachment to the preceding path directional and the original directional implication is weakened. Thus, different linguistically extensive uses of deictic directionals are derived such as *xialai* and *xiaqu*. The result concerned with *xialai* and *xiaqu* in our data supports Han's observation (2004) that *xialai* is used more often than *xiaqu*. Further acoustic-prosodic analysis could be done to examine if there exist any differences in the phonetic representation of different types of *xialai* and *xiaqu* to gain insights into the development of grammaticalization paths in the spoken use.

5.2 Finding acoustic-prosodic cues for examining phonetic reduction

What is the phonetic representation of the so-called "phonologically shorter and less distinct" notion as mentioned in Hopper & Traugott (1993). Duration is a good acoustic-prosodic cue for identifying whether the pronunciation is a full one, and whether there is a reduction in the pronunciation (Ansaldo & Lim 2004, Heine et al. 1991). What else can we take into account? To find a feasible set of acoustic features, we went through four possible groups of acoustic-prosodic features concerned with duration, intensity, F0, and formant values. Among these features, duration, intensity range and

mean reflect more on the distinctiveness of different directional components and uses of different grammatical categories, as summarized in Table 3. However, intensity range and mean are not quite consistent in representing the reduction pattern in directional complements in our data. Possibly, due to the imbalanced data, different nuclei in each directional construction affect the extraction of intensity features. Another reason could be that shorter duration and weaker intensity are not the only strategies to make a reduced pronunciation in Taiwan Mandarin, as widely recognized in the literature.

In our study, we did not take into account the F0 contour of each syllable. Phonetic reduction normally correlates with the tone shape of the associated syllable, especially in distinguishing a full pronunciation from a reduced one. Stress pattern mentioned in Fan (1963), including notations such as "un-stressed" and "full pronunciation", needs specific definitions, such as how to quantify the quality in terms of acoustic-prosodic measurements. We have shown that duration is a stable cue for Taiwan Mandarin. We are currently working on the F0 stylization of syllables in natural speech for studying the relationship between reduction degree and tone shape.

5.3 Acoustic-prosodic features of directional complements

In the derived form, directional components are prosodically more prominent than their neighbouring negative/positive potential terms *BU*/*DE*. In other words, the duration is longer and the intensity range is greater. Again, duration is the most reliable cue to represent the degree of phonetic reduction. Intensity range and mean are sometimes indicative of the prosodic characteristic, but not consistently. In the analysis of duration of individual directional components including deictic and path directionals, components appearing in the basic forms are shorter than those appearing in the derived forms. For example, in *chuqu* (go out) and *chubuqu* (cannot go out), the former *qu* is shorter than the latter one. Phonologically, this can be explained by clash avoidance, assuming *chu* is stressed. This implies that the stress pattern in the basic form may be strong-weak, whereas in the derived form it is strong-weak-strong.

Because the words used within the directional constructions are different, we were not able to verify the rules related to the basic form, mentioned in §2.3, except for the rule predicting that the deictic directionals in **Type III** are un-stressed. This was not supported by our results. The deictic directionals in **Type IIIa** are significantly longer than the path directionals. In Taiwan Mandarin, the deictic directional is prosodically more prominent than the path directional in **Type IIIa**. It would be interesting to investigate whether it is due to the difference between Beijing Mandarin and Taiwan Mandarin, if we had proper comparable corpora of both Mandarin variants. For the derived form, the acoustic-prosodic study of directional components and the potentiality

terms *BU*/*DE* clearly illustrates that the potentiality terms are shorter in duration and weaker in intensity range. Fan (1963) mentioned that in the derived form the deictic/path directional has full pronunciation, where *BU*/*DE* is un-stressed. This is empirically supported by our acoustic-prosodic analysis.

Moreover, we ran statistical tests on each directional construction type to examine whether there is any regularity within each type. The results suggest that directional components tend to be longer in duration when used without an NP (2a_p, 3a_p, 3a_d) than with an NP (2b_p, 3b_p, 3c_d). This may be to do with the stress pattern of the entire directional constructions. When the NP has the prominent stress, the adjacent directional components may be weakened.

Comparing directional components in the original and metaphorical uses, we found that the metaphorical uses are produced in a prosodically less prominent form. The deictic directionals in **Type IIIa** are significantly longer than those in **Type IIIc**; the path directionals in **Type IIa** are significantly longer than those in **Type IIc**. This shows a close relationship between phonetic reduction and syntactic prominence, as in the metaphorical uses, the original spatial meaning is mainly lost, so they are regarded more grammaticalized than the original uses. In this paper, we only distinguished the original use from the metaphorical one due to the small size of our data body. Thus, we did not manage to identify the phonetic representation of different grammaticalization processes proposed by Huang & Hsieh (2008), from the original spatial meaning to non-specific spatial meaning, then to temporal implication, and finally to an indication of status.

5.4 Phonetic representation of different grammatical categories

Compared with text corpora, the speech data we used for the analysis presented in this paper is rather small. However, the statistical results we presented in §4.5 clearly show that "verbs" are produced in a prosodically more prominent way than "directional components". They are longer in duration and greater in intensity. In order to better illustrate the systematic differences, examples of *shang* and *guo* taken from our data are illustrated.

Shang
Path directional (2p): *kai* *shang* *shan* (drive up mountain; translation: drive upwards to the mountain)
Preposition (PREP): *lu* *shang* (street up; translation: on the street)
Path verb (1v): *shang* *qu* (ascend thither; translation: go up)
Non-path verb (v): *shang* *shan* (ascend mountain; translation: go up to the mountain)

Guo
Past tense particle (PAST): *xiang guo* (think PAST; translation: thought)
Path directional (3p): *chuan guo qu* (penetrate over thither; translation: cross over)
Non-path verb (v): *guo qiao* (cross bridge; translation: cross a bridge)
Path verb (1v): *guo qu* (cross thither; translation: cross)

We found differences in the contrasting pairs of path directional vs. path verb, preposition vs. path verb, path directional vs. non-path verb, and preposition vs. non-path verb for *shang*, and past tense particle vs. non-path verb, path directional vs. non-path verb, path directional vs. path verb, and past tense particle vs. path verb for *guo*. That is, when *shan*g is produced in natural speech, the use of path directional and preposition is prosodically less prominent than the use of path and non-path verbs; for *guo* the use of past tense particle and path directional is prosodically less prominent than non-path and path verbs.

Different from Ansaldo & Lim (2004) who used controlled sentence data, we found very systematic contrast in acoustic-prosodic features for lexical items used for different grammatical categories in natural speech. Words carrying concrete meaning such as verbs are produced in a relatively heavier way than those used mainly for fulfilling syntactic functions such as directional components and prepositions. In spite of the small data size, we found statistically significant contrasts in these categories. These results suggest that in natural speech, phonetic representation, in our study the prosodic prominence reflects the different degree of gain and loss of lexical meaning and syntactic function.

6. Conclusion

This paper presents a corpus-based, quantitative study of the authentic use of directional components and their acoustic-prosodic features in Taiwan Mandarin conversation. Three types of directional constructions were defined and annotated in our natural speech data. Different from previous studies on directional complements, which used texts and novels as data to obtain observations and calculations, we examined how they are used in the context of speech communication. Various types of directional constructions were found in our data, including those predicted and not predicted by theory. This study has shown that authentic data bring stimulating insights into the relationship between linguistic patterns and real language use, different from controlled, laboratory speech data. The main contribution of this paper is that we conducted screening tests on the statistical significance of different groups of acoustic-prosodic features in search for relevant acoustic features to quantify phonetic reduction in directional constructions.

Conventionally, shorter duration and weaker intensity used to be the clearest acoustic indices used for phonetic reduction. However, for natural speech, this paper shows that duration is relatively stable in reflecting phonetic reduction. But intensity range and mean do not show consistent tendencies. In addition to directional components themselves, their original uses as verbs, grammatical particles, and prepositions in the corpus were also investigated. The results suggest that the metaphorical uses of directional constructions are more reduced than the original uses; directional components are more reduced than verbs and prepositions. This provides new piece of acoustic evidence supporting the notion that the more grammaticalized, i.e. the more syntactic role and the less semantic meaning is involved, the more reduced the word would be.

Issues like the effect of final lengthening and tone shape were raised in this paper, which may partly affect the phonetic representation of natural speech. The size of data we used for the study presented here is far from enough. More authentic data are necessary to help eliminate disadvantages of imbalanced data and to provide a reliable, quantitative description of linguistic patterns obtained from realistic language data.

Appendix A: Type I – verb + deictic directional

Ia		Ib		Ic	
下去	7	扒去	1	划不來	1
上去	9	抓去	3	划得來	2
出去	36	拿去	5	合得來	1
回去	42	送去	1	受不來	1
回學校去	2	跑去	5	念不來	4
進去	30	關去	1	算來	1
過不去	3	派一個首席顧問來	1	醒來	1
過去	22	拿來	2	**Total**	**11**
過得去	1	拿個蓮霧來	1		
下來	17	送來	1		
上台北來	1	帶來	4		
上來	11	帶相機來	1		
出來	46	移來	1		
回不來	1	跑來	2		
回來	37	**Total**	**29**		
起來	3				
進來	9				
過來	14				
Total	**291**				

Appendix B: Type II – verb + path directional

IIa						IIb				IIc	
放不下	1	接到	2	走開	1	比不上	1	帶到	1	剩下	7
留下	1	提到	2	放得開	3	加上	3	得到	4	考上	1
加上	3	游到	1	看很開	1	考上	3	接到	2	看上	1
考上	1	發現到	1	看得開	1	花上	1	接觸到	3	當上	1
帶上	1	發覺到	1	看開	1	講上	2	提到	2	裝出	2
跟得上	3	等到	4	想不開	1	賺上	1	換不到	1	比不過	1
選上	3	買不到	1	隔開	2	開上山	1	等到	2	**Total**	**13**
分得出	1	進入到	1	避開	1	找出	1	貼到	1		
付出	2	開到	4	談不攏	4	冒出	2	買到	1		
弄出	1	意識到	1	談得攏	1	跨出	1	跑到	2		
走出	1	感受到	5	**Total**	**159**	聽不出	1	進到	2		
趴不出	1	感應不到	1			切到	1	開到	4		
拿出	1	感應到	1			去到	1	傷到	1		
推出	1	感覺到	4			叫到	1	感受到	2		
播出	1	想到	17			打到	1	感受得到	1		
露出	1	溜到	1			用到	2	感應得到	1		
讀出	1	照顧到	1			回到	5	想到	1		
拿回	1	碰到	1			回想到	1	搞到	1		
刁到	1	達到	1			考量到	1	搭到	1		
生到	1	遇到	3			妨礙到	1	碰到	5		
用不到	1	撞到	4			找不到	2	載到	1		
抓到	1	聯想到	1			找到	4	遇到	5		
走到	3	講到	5			走到	10	靠到	1		
來到	3	賺不到	1			取到	1	學到	1		
取到	1	賺到	1			受到	2	描到	2		
受到	1	擴充到	1			注意到	1	講到	5		
省到	1	繞到	1			爬到	1	賺到	1		
看不到	1	轉到	1			玩到	1	繞不到	1		
看到	19	聽到	4			直射到	1	轉到	2		
看得到	1	聽得到	1			看不到	1	關到	1		
拿到	1	體會到	1			看到	14	聽到	5		
做不到	1	跟進	1			討論到	1	讀到	2		
做到	1	分開	2			送到	2	撞倒	1		
做得到	1	打開	1			問到	1	提不起	1		
問到	1	走不開	1			培養到	1	**Total**	**141**		

Appendix C: Type III – verb + path directional + deictic directional

IIIa								IIIb		IIIc	
切過去	1	切過來	1	穿過來	1	跑上來	1	冒出一個類似蔣經國那樣的人來	1	生存下去	1
加上去	1	反過來	2	突顯出來	2	跑出來	6	坐一部計程車出去	1	念不下去	1
打上去	1	付不出來	1	倒走回來	1	開出來	1	倒走回去捷運站	1	花下去	1
用上去	1	付得出來	1	修起來	1	傳回來	1	拿錢回去	1	持續下去	1
立下去	1	刊出來	1	拿出來	2	匯過來	1	買那些傢俱回去	1	看不下去	2
丟下去	1	加起來	3	拿回來	1	塞下來	1	經營這個行業下去	1	做下去	4
坐回去	1	左轉進來	1	拿起來	1	想不大出來	1	跨出去	1	做不下去	1
沈下去	1	打過來	1	捐贈出來	1	搭過來	1	轉進去工地	1	搞下去	1
拖出去	1	生出來	2	浮上來	1	搬上來	1	跨出去那一步	1	經營下去	2
直升上去	1	吐出來	1	留下來	1	滑下來	2	訓練一批人出來	1	經營不下去	3
穿過去	2	吃進來	1	站出來	1	照出來	1	掏一大筆錢出來	1	演變下去	1
飛出去	2	存下來	1	站起來	1	經營上來	1	掏那麼多錢出來	1	維持下去	1
拿回去	2	坐回來	1	記下來	2	綁起來	3	提一些想法出來	1	鬧下去	1
送回去	1	扶起來	1	退伍下來	1	補發回來	2	買電腦回來	1	上起來	1
偷跑過去	1	抓回來	2	逃難過來	1	跟上來	2	開了一百家店出來	1	反問回來	1
帶他們出去	1	抓起來	1	鬥下來	1	跳出來	3	搬東西出來	1	回想起來	2
帶回去	2	改革下來	1	做出來	3	漲了起來	1	裝一袋起來	1	作不起來	1
掉下去	1	走下來	1	堆起來	1	種出來	1	蹦個什麼東西出來	1	坐起來	1
排下去	1	走上來	1	寄過來	1	認得出來	1	**Total**	**18**	流行起來	1
游得過去	1	走出來	2	帶起來	3	說出來	2			省下來	1
給出去	1	防禦起來	1	帶過來	4	寫下來	1			看起來	14
跑出去	1	拉不起來	1	掉下來	1	寫出來	2			背不起來	2
跑過去	1	拉回來	2	推甄進來	1	寫回來	1			留下來	3
開出去	1	拖下來	1	救不回來	1	撞過來	1			停下來	1
塞上去	1	放下來	2	淹上來	1	撥接下來	1			停滯下來	1
搶了回去	1	放不下來	2	移民過來	1	模仿不過來	1			感覺不出來	1
補上去	1	沸騰起來	1	移過來	1	熬過來	1			感覺起來	1
跨出去	1	爬不起來	1	規劃出來	1	罵過來	1			想不起來	1
跨過去	2	爬起來	2	設計出來	1	衝出來	3			算下來	1
領回去	1	表現不出來	1	頂不起來	1	凝聚過來	2			擱下來	3
撞出去	1	長出來	1	圍起來	1	選出來	1			攤下來	1
踩下去	1	看下來	1	提出來	2	講起來	3			聽起來	2
橫叉過去	1	看不大出來	1	換算過來	1	繞回來	2			**Total**	**59**
擴散出去	1	看不出來	13	游得上來	1	翻譯過來	1				
轉過去	1	看得出來	1	發展不起來	1	蹦出來	1				
彎不過去	3	看過來	1	發展起來	1	騎出來	1				
彎過去	3	砍不下來	1	買下來	1	顯露出來	1				
切回來	1	穿出來	1	貶值下來	1	**Total**	**213**				

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[Received 25 January 2010; revised 7 May 2010; accepted 18 May 2010]

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趨向補語在自然語音的使用研究

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本文以台灣使用的國語語料探討趨向補語在自然對話的使用。口語語料先進行三種主要趨向補語語法結構的標記，再以詞頻的分析討論不同結構的使用狀況；結果與文本語料研究有相同也有相異之處。口語產製時語音表現可以反映結構特徵。因此，本文以統計方法測試有可能標示自然語音弱化的聲學參數。利用線性模型的殘差項進行的統計結果證實時長可以作為語音弱化穩定的量化指標。趨向補語保有原本空間表意的用法要比語法化的用法，在語音的聲韻標記上更為明顯。趨向補語的可能式，“得”與“不”的語音較相鄰的趨向補語為弱。同樣字詞用於趨向補語、動詞與形容詞，語法化的趨向補語用法明顯有語音弱化標記。

關鍵詞：趨向補語，自然語音，統計分析，聲韻聲學特徵，語法化