Typology of the Formation of "X-ER" Diminutives in the Hebei Dialects: An Optimality-Theoretical Perspective

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ABSTRACT— ***Previous research of the diminutives in the Hebei dialects usually lacks the connection of language descriptions to linguistic theories. For this reason, this study targets to explore the formation of X-ER diminutives in the Hebei dialects in terms of the framework of optimality theory (OT). The data analyzed in this study come from the fieldwork survey records of related literature and the author's fieldwork investigation. Four formational indexes (i.e., X-retroflexion, onset insertion, onset selection, and [ə^{r}]/[ə^{m}] alternation) play decisive roles in shaping the X-ER diminutives. Constraints are proposed to deal with the formation of X-ER diminutives. Research results show that OT well captures the four formational indexes by a common set of constraints, and well functions in the analysis of the formation of synchronic X-ER diminutives in the Hebei dialects. Furthermore, the interaction of the four formational indexes generates a factorial typology, which can be accounted for by reranking the same set of constraints and can be attested by the synchronic dialects in Hebei Province. To conclude, the formation of X-ER diminutives in the Hebei dialect is well analyzed in OT, and the strength of OT in typological prediction is well supported in this study.***

Keywords— diminutive, Optimality Theory, language typology, Hebei

1. INTRODUCTION

One of the distinctive characteristics among Chinese dialects lies in the wide distribution and immense variety of diminutives. For example, two prominent types of diminutives, glottalized and nasalized, can be extensively collected in south-eastern Chinese dialects, like Min, Wu, Gan and Hui. Both types of diminutives have a number of cross-dialectal alternations. These synchronic alternations always cast light on the issues of how Chinese dialects evolve diachronically and how they are typologized synchronically. This characteristic accounts for why Chinese diminutives have long been an intriguing issue in Chinese phonology, and why a great body of related literature has flourished in recent decades (Cao, 2002; Chen, 1992, 1999; Cheng, 2006, 2009; Fang, 1986, 1993; Kao, 2004; Li, 1996; Li, 1978; Liang, 1989; Lin, 2001, 2004; Tsao, 2006; Zhengzhang, 1980, 1981).

The remarkable characteristic in the diminutives in southeastern Chinese dialects is also observable from those in the Hebei dialects (i.e. the dialects distributed in Hebei Province). The diminutives in the Hebei dialects are generated by adding syllabic diminutive words (temporarily termed by ER(s) or er) after the bases (i.e., Xs). Like those in southeastern Chinese dialects, the diminutives in the Hebei dialects also underwent the developmental stages, as shown in Table 1.

Table 1: Developmental Stages of "X-ER" Diminutives

1st stage	2nd stage	3rd stage
X-ER	Xer	X^{r}

In the first stage, the ER in X-ER forms a separate syllable from the base it gets attached to. In the next stage (i.e. the *additive* stage), er in Xer becomes a degenerate suffix (because of losing lexical tones), and thus attaches itself to the end of X, with little influence upon Xs. At this time, Xer is a marked (i.e. long) syllable in Chinese dialects, given that the canonical syllable structure for Chinese dialects is CGVX. In the last stage (i.e. the *fusional* stage), er is simplified merely as a retroflex feature, and is added onto the bases (usually the vowels), forming X^{r}. All in all, the development of the diminutives in the Hebei dialects goes into the direction of syllable simplification.[1] However, as compared with those

[1] The developmental process is known as a grammaticalization process (Hopper & Traugott, 2003). Grammaticalization is always accompanied with sound loss or simplification. Besides, the syntactic/semantic functions are always widened

in southeastern Chinese dialects, the diminutives in the Hebei dialects are far more complicated because of the complex phonetic forms of ERs. According to Li (2007), the synchronic ERs in the Hebei dialects can be classified into three types: (a) retroflex type [ə^{r}, a^{r}, ɻ], (b) flat type [ə^{ɯ}, ɯ, ʌ] and (c) lateral type [l̩r, l̩, əl̩, l̩ə]. Some examples of the three types are given in Table 2 for simple demonstration.[2] Note that adding or suffixing ERs to Xs may sometimes give rise to sound changes on either Xs or ERs, and different developmental stages may be coexistent in one single dialect.

Table 2: Three Types of the Diminutives in the Hebei Dialects

	1st stage	2nd stage	3rd stage	Gloss
Retroflex type	[tau ə^{r}]	[tauə^{r}]	[tau^{r}][3]	'knife'
Flat type	[p^{h}o ə^{ɯ}]	[p^{h}oə^{ɯ}] or [p^{h}oɯ]		'slope'
Lateral type	[xua əl̩]	[xual̩]		'flower'

Though the diminutives in the Hebei dialects have been widely surveyed in a deal of related literature (Chen, 1986, 1988, 1998; Chen & Xu, 1997; Gao & Wu, 2010; Gao, 2006; Jiang, 2000; Li, 2004; Li, 1996; Li, 2008; Liu, 2003; Sun, 2004; Wang, 1999; Zhang, 2005; Zhang, 2003; Zhu, 2004), most of the literature concentrates mainly on synchronic data descriptions of individual dialects. Little attention has been directed toward the connection to linguistic theories, and, consequently, the gap to explanatory adequacy is rarely bridged. For this reason, the study targets to provide a synchronic typology of the diminutives in the Hebei dialects under the framework of optimality theory (OT). However, limited space precludes us from taking into account all types of the diminutives in Table 2, so this study will be devoted mainly to two types of diminutives (as marked in gray) because they show interesting cross-dialectal variations.[4]

The rest of this study has the following discussing organization. Section 2 reviews the typological differences of X-ER in the Hebei dialects, together with special attention to four formational indexes: X-retroflexion, [ə^{r}]/[ə^{ɯ}] alternation, onset insertion and onset selection. Section 3 introduces the framework of OT and its strength in the factorial typology or typological prediction. Section 4 provides the analysis of X-ER diminutives, and shows how well OT works. Section 5 offers a factorial typology by permuting the rankings of the proposed constraints. The grammars systematically predicted by OT can be attested by empirical supports from the synchronic Hebei dialects. Section 6 concludes this study.

2. THE X-ER DIMINUTIVES IN THE HEBEI DIALECTS

As stated previously, X-ER diminutives in the Hebei dialects are formed by adding syllabic diminutive words to the bases. Remarkably, four formational indexes play decisive roles in shaping these diminutives. To begin with, take a look at the examples in Table 3. The symbol ☑ stands for obligatory onsets, whereas the symbol ☒ indicates that onsets are forbidden.

under grammaticalization (i.e., normalization, from content words to function words, etc.). For the discussion of the expansion and extension of the functions of diminutives in the Hebei dialects, see Li (2007) for more details.

[2] Hereafter, the data used for exposition are extracted mainly from Li (2007). She conducted a large-scale survey of the diminutives in the Hebei dialects from 156 counties in Hebei Province, with around three hundred speech informants involved.

[3] The representative dialect of this stage is the retroflex suffixation in the Beijing Mandarin. A lot of literature (Bao, 1989; Chao, 1968; Cheng, 1973; Hsueh, 1985; Li, 1986; Lin & Wang, 1992; Lu, 1995; Ma, 2003; Xu, 1999) has discussed the retroflex suffixation from different viewpoints, such as acoustics, sociolinguistics, historical linguistics, and so on.

[4] Careful readers may have a question in mind. Why choose only two if there are seven types in Table 2? There are both synchronic and diachronic dimensions in Table 2. The focus of this study is on the former, but not on the latter. As for as the synchronic dimension of Table 2 is concerned, ERs rarely affect Xs in the additive stage. For this reason, the study places its main emphasis on the first stage, especially on X-ER formed by the retroflex and flat types because both ERs in these two types have vocalic status. Moreover, another reason for choosing these two types is that they are genetically related (see Section 2 for more details). As far as the lateral type of ERs is concerned, partly because of the distinctive sound quality (i.e., lateral fricatives) and partly because of the different route of historical development from the retroflex and flat types, it is excluded from the analysis in this present study. The remaining issues will be taken into consideration in other studies.

Table 3: Four Types of "X-ER" Diminutives in the Hebei Dialects

(a) Dingzhou: X^r-☑$ə^r$ (Li, 2007:15)			
[tau^r uə^r]	'knife'	[təu^r uə^r]	'bean'
[iəu^r uə^r]	'oil'	[tə̃^{r} ŋə^r] [5]	'stool'
(b) Xinyue, Yixian, Mancheng, Wangdu, Anguo: X-☑$ə^r$ (Li, 2007:15)			
[tau uə^r]	'knife'	[təu uə^r]	'bean'
[iəu uə^r]	'oil'	[təŋ ŋə^r]	'stool'
(c) Rongcheng, Baoding, Quyang: X^r-☒$ə^r$ (Li, 2007:16)			
[tau^r ə^r]	'knife'	[təu^r ə^r]	'bean'
[iəu^r ə^r]	'oil'	[tə̃^{r} ə^r]	'stool'
(d) Qingyuan: X-☒$ə^r$ (Li, 2007:16)			
[tau ə^r]	'knife'	[təu ə^r]	'bean'
[iəu ə^r]	'oil'	[təŋ ə^r]	'stool'

Obviously, the examples in Table 3 clearly illustrate the first two indexes: X-retroflexion and onset insertion. In Table 3, the bases are retroflexed as X^r in (a) and (c), but the bases remain unchanged in (b) and (d). Whether the bases are retroflexed relies on whether the retroflexion of [ə^r] is spread forward. Besides, the final segments of the bases (CV or CVX) can be spread to the onset positions of ERs when onsets are required, as shown in (a) and (b).[6] Nonetheless, even if onsets are required for ERs, not all final segments of Xs are capable of being spread to be the onsets of ERs. There exist some dialectal differences, as clearly shown in Table 4. This is the third formational index: onset selection.

Table 4: Onset Selection of ER in the Hebei Dialects

	[ʅ, ɿ]	[i, y,] [7]	[u, ŋ]	Dialects
a.	☑	☑	☑	Xingyue (North), Dingxing[8], Qian-an
b.	☒	☑	☑	Dingzhou
c.	☒	☒	☑	Mancheng, Anguo
d.	☒	☒	☒	Qingyuan

In Table 4, (a) and (d) represent the two extreme types with reference to onset selection. In (a), all final segments of Xs (i.e. [u, ŋ, i, y, n, ʅ, ɿ]) can be spread to fill in the onset positions of ERs, while coda-to-onset spreading is completely prohibited in (d).[9] (b) and (c) are two types located in-between. Close scrutiny of Table 4 reveals that there seems to be a

[5] When the rimes closed by [ŋ] are retroflexed, [ŋ] will get deleted and the nasality of [ŋ] will usually be spread to the preceding vowels.

[6] The onset position is always defined as [-syllabic]. Hence, as far as the CV bases are concerned, when the vowel endings of the CV bases are spread to fill in the onset positions of ERs, they will be reduced to their corresponding glides (e.g., [j], [w]) or obstruents (e.g., [z] or [ʑ]). However, in this study, the onsets of ERs will always be transcribed as [i], [u], [y], [ʅ] and [ɿ].

[7] According to Li (2007), most of the dialects in Hebei Province have rimes closed by [n], but spreading [n] to be the onsets of ERs (i.e., [nə^r] or [nə^{ɯ}]) only occurs in a minority of dialects. Synchronically, when the rimes closed by [n] are retroflexed, most of them surface as the forms in the second (additive) or the third (fusional) stage. What is worse, unlike [ŋ], [n] is sometimes deleted without the nasality left.

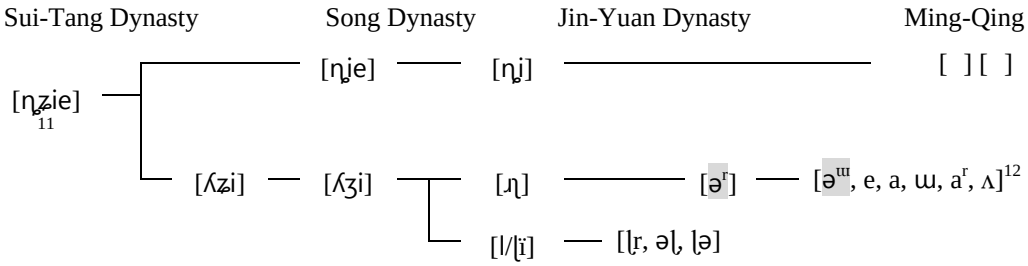
[8] In the Dingxing and Qianan dialects, when X is closed by [ʅ] or [ɿ] (e.g., [tsʅ^{51}] 'word', [sɿ^{55}] 'silk'), [ə^r] will become [ə^r]/[ʑə^r] and [ə^{ɯ}]/[ʑə^{ɯ}] respectively (Chen & Xu, 1997; Li, 2007).

[9] Every *prosodic* syllable (i.e., word) in Chinese dialects must always have an onset. If syllables have no onsets (known as *zero onset*), a glottal stop [ʔ] (or [ɦ], [ŋ], [ɣ]) will automatically fill into the onset positions (Duanmu, 2000, 2007). For example, the phrase /ɕin^{55} an^{55}/ 'peace of mind' in Mandarin Chinese is pronounced as [ɕin^{55} ʔan^{55}]. The prosodicity of the word /an^{55}/ ensures the occurrence of [ʔ]. However, onset insertion does not occur when the suffixes are non-prosodic. Taking the diminutive suffix [a] in Southern Min for example, [a] is not a prosodic word. It cannot

preference hierarchy for onset selection, sequentially arranged as [u, ŋ] > [i, y, n] > [ɳ, ɭ] where the symbol '>' stands for "better than." The higher the sounds are placed in the ranking, the easier they are chosen to be the onsets of [ə^{r}]. In addition, the preference hierarchy also shows a relation of implication. For example, if [ɳ, ɭ] can be the onsets of [ə^{r}] in one dialect, it seems that [u, ŋ, i, y,] will also be qualified for the onsets of [ə^{r}] in that dialect.[10]

The last formational index is the [ə^{r}]/[ə^{ɯ}] alternation. The retroflexed [ə^{r}] and the flat [ə^{ɯ}] are two variants of the ERs in X-ER. The former is diachronically prior to the latter, as in Table 5. According to Table 5, [ə^{ɯ}] and [ə^{r}] are genetically related to each other, with the former resulting from removing the retroflexion from the latter.

Table 5: The Diachronic Evolvement of the ERs (extracted from Li, 2007:112)



To summarize, four crucial indexes are involved in the formation of X-ER in the Hebei dialects: X-retroflexion, [ə^{r}]/[ə^{ɯ}] alternation, onset insertion and onset selection. The interrelation and interaction of these indexes, no doubt, will result in many dialectal varieties (i.e. a factorial typology). Apparently, this fascinating characteristic is completely suitable for the theoretical advantage of OT illuminated in what follows.

3. THE FRAMEWORK OF OPTIMALITY THEORY AND ITS STRENGTH ON LANGUAGE TYPOLOGY

Optimality theory (OT), a constraint-based approach proposed by Prince and Smolensky (1993, 2004) and McCarthy and Prince (1993), is a framework in which Input, Generator (Gen), Evaluator (Eval) and Optimal Output are involved

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stand alone, and must suffix itself to the bases, such as /kam^{33} a^{53}/ 'orange', /ap$^{\underline{55}}$ a^{53}/ 'box', /kaw^{53} a^{53}/ 'dog' and /ki^{13} a^{53}/ 'flag' (Chung, 1996). The fact that [a] is not prosodic makes it possible for the codas of the bases to spread into the onset positions of [a^{53}]. These diminutives, thus, are articulated as /kam^{33} mã^{53}/, /ap$^{\underline{55}}$ ba^{53}/, /kaw^{53} wa^{53}/ and /ki^{13} ya^{53}/. In those Hebei dialects where onset insertion is prohibited, whether the prosodicity of ERs plays a role is still unknown, and awaits further investigation. Besides, for a quick understanding of *zero onset* and its analysis under OT, please refer to Leo (2008).

[10] The preference hierarchy for onset selection seems to be a direct response to the compatibility degree of the retroflexion with other places of articulation. Take the formation of X^{r} in the fusional stage for example. Different rimes will have different ways for the retroflexion to combined or merge into the preceding syllables. Rimes closed by [u, ŋ, a] can be directly retroflexed, with slight rimal changes for nasal rimes (e.g., [ku→ku^{r}] 'drum', [yan→ya^{r}] 'yard' and [uŋ→ü^{r}] 'yard'), because these sounds' articulation is compatible with the retroflexion. However, more rimal adjustments are called for if rimes closed by [i, y, ɿ, ɭ] are under retroflexion. For [i, y], they will be deleted under retroflexion if they function as off-glides, like [p^{h}ai→p^{h}a^{r}] 'card'. If [i] and [y] function as syllable nuclei, [ə^{r}] will be directly attached to the involving syllables (i.e., bases), such as [tɕi→tɕiə^{r}] 'chick'. In term of the two apical vowels [ɿ, ɭ], they will be deleted under retroflexion, like [sɿ→sə^{r}] 'silk'.

[11] It has been a consensus that the retroflex suffix evolved from "li", "ri" or "er" from Middle Chinese; however, different reconstructed forms and different developmental processes about the earliest ER are proposed in the literature. Besides [ŋ̍ʑie] by Wang (1985), there are still other forms, such as [ŋ̍ʑiɛ], [ŋ̍ʑiɛ], [ŋ̍], [ŋ̍je], and [ŋ̍je]. However, no matter how diverse these forms are, they will not have an influence upon our analyses in this study.

[12] Careful readers may notice that, except for [ə^{ɯ}], there are still many other genetically-related variants of [ə^{r}] on the basis of Table 5. As far as the sound qualities are concerned, [ə^{ɯ}] and [ə^{r}] are the most similar among all the variants; they differ from each other only in one single feature. Other variants that are descended from [ə^{r}], by inference, must undergo some further quality-changing processes (e.g., fronting, lowering, etc.). According to OT, such changes are controlled by some other constraints. However, because this issue is not our concern here, we will not go into details.

(Archangeli, 1999; Archangeli & Langendoen, 1997; Kager, 1999; McCarthy, 2002). For a given input, the universal Gen emits all logically possible output candidates, and specifies a corresponding relation between the candidates and the input. The set of output candidates are then evaluated for optimality by Eval, a harmony-estimating function executed by a set of faithfulness and markedness constraints. The candidate that incurs the least violations of constraints is selected as the Optimal Output.

There are typically two major conflicting forces in OT: faithfulness and markedness.[13] Both forces are intrinsically conflicting in the sense that the satisfaction of one implies the violation of another. The Constraints in OT reveal not only the language-universal properties, but also the language-specific structural requirements. Each language (in our case, dialect) has its own ranking for these constraints. Different constraint ranking leads to different patterns among languages or dialects.

One of the key concepts in OT exists in the assumption of the *typological prediction*, that is, "the predictions...about clusterings of linguistic properties, on a broad cross-linguistic basis (Kager, 1999:34)." It is assumed in OT that total permutation of, say, three constrains will generate six possible grammars, each of which can precisely correlate with at least one language or dialect. Most important of all, such constraint rearrangements in OT can also tell which grammars are impossible, and predict which grammars are (logically) possible, as indicated by Tesar and Smolensky (2004:122).

> Systematic cross-linguistic variation is due entirely to variation in language-specific rankings of the universal constraints in Con. Analysis of the optimal forms arising from all possible rankings of Con gives the typology of possible human languages. UG may impose restrictions on the possible rankings of Con.

As a result, this theoretical advantage of OT, on the one hand, best matches language diversity, and, on the other hand, maximally restricts language generation. In what follows, the current study will show how this theoretical strength is manifested in X-ER in the Hebei dialects.

4. THE OPTIMALITY-THEORETICAL ANALYSES OF X-ER IN THE HEBEI DIALECTS

This section will apply OT for the formation of X-ER in the Hebei dialects. The four indexes involved in forming X-ER can be further divided into two groups. One group contains X-retroflexion and [ə^{r}]/[ə^{ɯ}] alternation, while the other covers onset insertion and onset selection. We will show the formation of X-ER in the Hebei dialects fall quite naturally in the prediction of OT in the subsequent sections**.**

4.1 X-Retroflexion and [ə^{r}]/[ə^{ɯ}] Alternation

The first two indexes, X-retroflexion and [ə^{r}]/[ə^{ɯ}] alternation, are interrelated in the formation of X-ER. The interaction between them will give rise to four logically possible types of X-ER, that is, [X ə^{r}], [X^{r} ə^{r}], [X ə][14] and [X^{r} ə]. However, only first three types are found synchronically. Apart from [X^{r} ə], how can the rest three types be put into the OT analysis? Close observation of the three types of X-ER suggests that the constraints in Table 6 should be in highly demand.

Table 6: The Constraints for X-Retroflexion and [ə^{r}]/[ə^{ɯ}] Alternation of X-ER

IDENT-IO[r]:	The [r] specification in input segments must be preserved in output correspondents. (No featural change)
MAX-[r]:	The [r] specification in the inputs must be preserved in the outputs. (No

[13] Faithfulness functions as a protector for lexical properties, "making it possible for languages to have sets of formally distinct lexical items to express different meanings (Kager, 1999:10)." Another function of Faithfulness is to restrict the shape between input and output (called *shape invariability*), requesting the outputs not to be different from their input forms. Markedness is a structural well-formedness requirement for output that help unmarked structures be presented. For illustration, "sonorants must be voiced (* Sonorant [-vd])" and "syllables must not have codas (No-Coda)." However, the pressure toward the unmarked structures is counterbalanced by Faithfulness, which enforces the output to preserve the properties of the input. Different from Markedness that does not take input forms into account, Faithfulness involves both input and output in the meanwhile, like MAX-IO (no deletion) and DEP-IO (no insertion). In OT, constraints that are exclusively involved in input are impossible (i.e., Richness of the Base: No constraints hold at the level of underlying forms.).

[14] When the retroflexion is removed from [ə^{r}], it will be realized as [ə^{ɯ}] (or further [ɯ]).

deletion of the retroflexed feature)
S-IDENT-σ-[r]: Adjacent syllables must agree in the [r] specification. (Agreement with or without the retroflexion)
*[r]: The specification of [r] is allowed at all. (No retroflexion)

IDENT-IO[r] and MAX-[r] are faithfulness constraints, whereas S-IDENT-σ-[r] and *[r] are markedness ones. Let us start from the two ones. IDENT-IO[r] prevents the segments from being featurally changed form INPUT to OUTPUT. For instance, the projection from /X ə^r/ to [X^r ə^r] will incur a violation mark on IDENT-IO[r] because of the retroflexion added on X.

As for MAX-[r], it is different from MAX-IO on account of their different targets. Form INPUT to OUTPUT, the former prevents featural deletion, while the latter prohibits segmental deletion. Take the projection from /X ə^r/ to [X ə] and [X^r ə] for example. The former, but not the latter, violates MAX-[r] because of the loss of the retroflexion. Unlike IDENT-IO[r], MAX-[r] only requires the presence of the retroflexion, even if the retroflexion was shifted to other segments. MAX-[r] has been used in Zhang (2000, 2001) to analyze Chinese diminutive suffixation, and fruitful research results have been achieved.

The presence of [X^r ə^r] suggests the retroflexion spreading from [ə^r] to X. Featural assimilation in OT (or featural spreading in our case) can be handled by SYNTAGMATIC-IDENT (S-IDENT) proposed by Krämer (1998, 2000). The definition of SYNTAGMATIC-IDENT is illustrated in Table 7.[15] The advantage of S-IDENT lies in its wide extension to many prosodic domains (e.g., a segment, a syllable, etc.).

Table 7: SYNTAGMATIC-IDENT[Feature] (S-IDENT[F]) (Krämer, 2000:5)

Let x be an entity of type T in representation R and y be any adjacent entity of type T in representation R, if x is [αF], then y is [αF].
Where T is a segment, mora, syllable or foot.
(A segment, mora, syllable or foot has to have the same value for a feature F as the adjacent segment, mora, syllable or foot in the string.)

S-IDENT-σ-[r] in Table 7, a constraint of the S-IDENT family, controls whether Xs are retroflexed when they are adjacent to [ə^r]. High-ranked S-IDENT-σ-[r] will ensure the presence of [X^r ə^r] and [X ə], in both of which Xs and ERs agree with each other in terms of the retroflexion.

As far as *[r] is concerned, a detailed explanation is required to support the existence of *[r]. *[r] is a negative markedness constraint which represents a cross-linguistic disfavor for the retroflexion. However, is there any phonetic evidence from language production or perception that can support this linguistic bias? The answer is definite. According to the cross-linguistic survey by Ladefoged and Bhaskararao (1983), the percentage of languages that contain retroflex sounds is not so high (only around 11%). The low-degree occurrence of the retroflexed sounds in languages probably results from their articulating complexity (i.e. the retroflexed tongue), as compared with other types of segments. Moreover, Ohala (1985, 1993) divided acoustic cues into two types, robust and weak, and [retroflex] is thought to be a weak cue. It is this characteristic that restricts the distribution of retroflexed segments in languages around the world.[16] Such a viewpoint, however, seems to encounter a great difficulty because Chinese dialects are full of such retroflexed segments as [tʂ], [tʂ], [ʂ], [ʐ] and [ɳ].[17] Yet, apart from the default retroflexed segments, the disappearance of [r] in diminutives is destined if we examine the diachronic evolvement in Table 5. Most of the diminutive words in the Ming-Qing Dynasty (i.e. ə^ш, e, a, ɯ, ʌ) remove the retroflexion from [ə^r]. Another obvious case comes from the development of the retroflexed diminutives in the Nanjing dialect (Huang, 2003).

[15] Other methods proposed to deal with the issue of assimilation (e.g., consonantal assimilation or laryngeal assimilation) consist of IDENTICAL CLUSTER CONSTRAINTS (Pulleyblank, 1997:64), AGREE (Lombardi, 1999:272), and ASSIM (Gnanadesikan, 1997:23).

[16] Steriade (1995, 2001) and Hamman (2003) have different viewpoints from Ohala (1985, 1993). Hamman (2003) argued that [r] was not a weak cue. In fact, [r] was as easy to perceive as other segments. Steriade (1995, 2001), based on her perceptual experiment, concluded the linguistic contexts had an influence on the perception of [r]. When [r] is located behind the vowels, the perception of [r] is the easiest to reach.

[17] According to Ohala (1985, 1993), the use of default retroflex segments seems to be related to the size of the phonemic inventory. Languages with large phonemic inventory will make use of the segments with weak cues (e.g., retroflexed ones).

Table 8: Developmental Stages of the Retroflexed Diminutives in the Nanjing Dialect

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
[X-ə^{r24}]	[Xə^{r}]	[X^{r}]	[X$^{r\ 24}$]	[X^{24}]
[ua$^{24\text{-}12}$ ər ^{24}]	[ts^{h}o^{24} ər]	[xuar^{31}]	[uər^{24}]	[tu^{24}] (←[tu^{11}])
'baby'	'yesterday'	'flower'	'bowl'	'belly'

The retroflexed diminutives in the Nanjing dialect undergo the five developmental stages listed in Table 8. Obviously, the retroflexion vanishes in the last stage, and the recognition of the diminutives depends solely on the diminutive tone [^{24}]. All the arguments above suggest that the existence of *[r] be justified.

So far, we have discussed the legitimacy of the constraints in Table 6. In the following, we will explore how they are ranked with respect to each other in order to account for the different types of X-ER. Table 9 lists the constraint rankings for the three types of X-ER.

Table 9: The Constraint Rankings for the Three Types of X-ER

[X ə^{r}] : IDENT-IO[r], MAX-[r] >> S-IDENT-σ-[r], *[r]
[X^{r} ə^{r}] : S-IDENT-σ-[r], MAX-[r] >> IDENT-IO[r], *[r]
[X ə] : *[r], S-IDENT-σ-[r] >> IDENT-IO[r], MAX-[r]

The rankings in Table 9 are reached on the basis of the following principles. First, whether [^{r}] occurs in X-ER decides the high or low ranking of MAX-[r]. When [^{r}] occurs on Xs, ERs or both, MAX-[r] is high ranked; losing [^{r}] in X-ER will lead to a low-ranked MAX-[r]. Second, *[r] and MAX-[r], by definition, are two conflicting forces. Ranking one high will lower the other. Third, when S-IDENT-σ-[r] is high ranked, Xs and ERs will agree with each other in terms of the retroflexion. Tables 10 to 12 help us to examine whether the rankings in Table 9 can evaluate the optimal outputs. The input assumed in Tables 10 to 12 is /X **ə^{r}**/. Such an input assumption conforms to the historical development of X-ER.

Table 10

	Input: /X ə^{r}/	IDENT-IO[r]	MAX-[r]	S-IDENT-σ-[r]	*[r]
☞	a. [X ə^{r}]			*	*
	b. [X^{r} ə^{r}]	*!			**
	c. [X^{r} ə]	*!*		*	*
	d. [X ə]	*!	*		

Table 11

	Input: /X ə^{r}/	S-IDENT-σ-[r]	MAX-[r]	IDENT-IO[r]	*[r]
	a. [X ə^{r}]	*!			*
☞	b. [X^{r} ə^{r}]			*	**
	c. [X^{r} ə]	*!		*	*
	d. [X ə]		*!	*	

Table 12

	Input: /X ə^{r}/	*[r]	S-IDENT-σ-[r]	IDENT-IO[r]	MAX-[r]
	a. [X ə^{r}]	*!	*		
	b. [X^{r} ə^{r}]	*!*		*	
	c. [X^{r} ə]	*!	*	**	
☞	d. [X ə]			*	*

Note that every occurrence of [ʳ] will violate *[r] once; so [Xʳ əʳ], for example, incurs two violation marks on *[r]. According to these tableaux, it is evident that the constraint rankings in Table 9 can correctly pick out the optimal forms. The suboptimal candidates in each type of X-ER are evaluated out by the high-ranked constraints.

4.2 Onset Insertion and Onset Selection

It has been stated in Section 2 that the ERs in some dialects require onsets, and not all final segments of Xs can be spread to be the onsets of these ERs. How can these issues be dealt with in OT? Let us start the discussion from the issue of onset insertion. Inserting onsets to [əʳ] or [əʷ] involves the OT constraints in Table 13.

Table 13: The Constraints for Onset Insertion of the ERs in X-ER

$ONSET^{ER}$:	*$_{\sigma}$[V (ER must have onsets.)
DEP-IO:	Outset segments must have input correspondents. (No epenthesis)

In Table 13, $ONSET^{ER}$ and DEP-IO are essentially in mutual competition. That is, ranking one high will lower the other. This is because an epenthetic onset in the output will naturally violate DEP-IO, owing to the lack of an input correspondent. Accordingly, $ONSET^{ER}$ will dominate DEP-IO (i.e. $ONSET^{ER}$ >> DEP-IO) when ERs require onsets. Contrarily, the reserve ranking (i.e. DEP-IO >> $ONSET^{ER}$) is preferred when the onsets of ERs are forbidden.

Next, a detailed account is called for to tackle the issue of onset selection. In reality, coda-to-onset spreading from Xs to ERs represents a total assimilation of all phonological features. This phenomenon involves an OT constraint, called S-IDENT-F/O-[All] (shortened from SYNTAGMATIC-IDENT-$FINAL^{X}$/$ONSET^{ER}$-[All]), as shown in Table 14, where [All] represents all phonological features.

Table 14: S-IDENT-F/O-[All] (SYNTAGMATIC-IDENT-$FINAL^{X}$/$ONSET^{ER}$-[All])
The final segments of Xs (V or C) and the onsets of ERs must be identical.

Two points are worth paying attention. First, the final segments of Xs can only be [ʔ, ɻ, i, y, n, u, ŋ] according to the phonotactics in the Hebei dialects, and, second, this constraint works only when the ERs (in candidates) have onsets. If not, these candidates will be immune to S-IDENT-F/O-[All]. Then, how does S-IDENT-F/O-[All] interact with other constraints? No matter whether the onsets are inserted in the ERs, S-IDENT-F/O-[All] is always undominated in the high ranking with respect to either DEP-IO or $ONSET^{ER}$ (i.e. S-IDENT-F/O-[All], $ONSET^{ER}$ >> DEP-IO or S-IDENT-F/O-[All], DEP-IO >> $ONSET^{ER}$).

Last, the issue of onset selection involves the significant concept of *hierarchical markedness relation* in OT (de Lacy, 2002, 2006). To capture the insights, let us first have a look at the markedness hierarchy of place of articulation (PoA) in Table 15.

Table 15: The Hierarchical Markedness Relations of Place of Articulation

a. *dorsal >> *labial >> *coronal >> *glottal (de Lacy 2006: 2)	
b. *dorsal, *labial >> *coronal >> *glottal	(CONFLATION)
c. *labial >> *dorsal >> *coronal >> *glottal	(**IMPOSSIBLE**)

The hierarchy in (a) of Table 15 suggests a universal tendency of the markedness degree of four PoAs.[18] According to de Lacy (2006), glottals are less marked than dorsals (*dorsal >> *glottal), but the reverse is scarcely observable cross-linguistically. Moreover, when the hierarchical markedness relations among those PoAs are strictly followed, the ranking *conflation* in a markedness hierarchy is permitted. For example, (c) of Table 15 is an illegal markedness hierarchy since labials cannot be more marked than dorsals. However, labials can be treated as equally marked as dorsals, and thus *dorsal and *labial are placed in an undominated ranking, as in (b) of Table 15. Let us go back to our issue of onset

[18] Note that not every language follows this tendency, and cross-linguistic differences still exist. Take for example the historical development of the nasal codas [m, n, ŋ] in Mandarin Chinese. Among these nasal codas, [m] was the easiest and the earliest to get lost in the course of diachronic change. If dorsals are more marked than labials, the earlier loss of [m] than [ŋ] is opposite to this tendency.

selection that has been procrastinated. As stated previously, empirical observation suggests a preference scale indicating which segments are able to be the onsets of the ERs. This scale can be embodied in OT by Table 16.

Table 16: The Markedness Hierarchy for ER Onset Selection in X-ER
*[ɳ, ɭ] >> *[i, y, n] >> *[u, ŋ]

The hierarchical markedness relations in Table 16 are easy to read. According to Table 16, [i, y, n] are less marked than [ɳ, ɭ] and more marked than [u, ŋ] to be the onset of ERs. If [ɳ, ɭ] can be the onsets of ERs, [i, y, n, u, ŋ] can, too.

One obvious question emerges: How can the markedness hierarchy in Table 16 interact with the constraints for onset insertion of ER in X-ER? If no onsets are allowed, the ranking (i.e. S-IDENT-F/O-[All], DEP-IO >> $ONSET^{ER}$) will be ranked higher than those in Table 16, because the high ranking of DEP-IO will prevent any segments from being inserted. However, when onsets are required for ERs, onset requirement will give rise to interesting linguistic phenomena. DEP-IO will be ranked the lowest in order to make the onset epenthesis possible. S-IDENT-F/O-[All] controls the identity between $FINAL^{X}$ and $ONSET^{ER}$, and is placed in the highest ranking. In terms of the constraint $ONSET^{ER}$, it has three possible rankings, depending on what kinds of onsets are allowed, as displayed in Table 17. Now, let us see how the rankings in Table 17 can correctly select the optimal outputs, with [tsɻ ɻəʳ] 'word' in Table 18, [ly yəʳ] 'donkey' in Table 19, [ʂu uəʳ] 'tree' in Table 20 and [təŋ əʳ] 'stool' in Table 21 as illustrative examples.

Table 17: The Three Possible Rankings of $ONSET^{ER}$

a. S-IDENT-F/O-[All] >> $\boxed{ONSET^{ER}}$ >> *[ɳ, ɭ] >> *[i, y, n] >> *[u, ŋ] >> DEP-IO
(The onsets of the ERs can be [ɳ, ɭ, i, y, n, u, ŋ].)

b. S-IDENT-F/O-[All] >> *[ɳ, ɭ] >> $\boxed{ONSET^{ER}}$ >> *[i, y, n] >> *[u, ŋ] >> DEP-IO (The onsets of the ERs can be [i, y, n, u, ŋ].)

c. S-IDENT-F/O-[All] >> *[ɳ, ɭ] >> *[i, y, n] >> $\boxed{ONSET^{ER}}$ >> *[u, ŋ] >> DEP-IO
(The onsets of the ERs can be [u, ŋ].)

Table 18: Evaluation Table of Constraint Ranking (17a)

	Input: /tsɻ əʳ/	S-IDENT-F/O-[All]	$ONSET^{ER}$	*[ɳ, ɭ]	*[i, y, n]	*[u, ŋ]	DEP-IO
	a. [tsɻ əʳ]		*!				
☞	b. [tsɻ ɻəʳ]			*			*
	c. [tsɻ nəʳ]	*!			*		*
	d. [tsɻ wəʳ]	*!				*	*

Table 19: Evaluation Table of Constraint Ranking (17b)

	Input: /ly əʳ/	S-IDENT-F/O-[All]	*[ɳ, ɭ]	$ONSET^{ER}$	*[i, y, n]	*[u, ŋ]	DEP-IO
	a. [ly əʳ]			*!			
	b. [ly ɻəʳ]	*!	*				*
☞	c. [ly yəʳ]				*		*
	d. [ly uəʳ]	*!				*	*

Table 20: Evaluation Table of Constraint Ranking (17c)

	Input: /ʂu əʳ/	S-IDENT-F/O-[All]	*[ɳ, ɭ]	*[i, y, n]	$ONSET^{ER}$	*[u, ŋ]	DEP-IO
	a. [ʂu əʳ]				*!		
	b. [ʂu ɻəʳ]	*!	*				*
	c. [ʂu yəʳ]	*!		*			*
☞	d. [ʂu uəʳ]					*	*

Table 21[19]

	Input: /təŋ ər/	S-IDENT-F/O-[All]	DEP-IO	ONSET^{ER}
☞	a. [tsɿ ər]			*
	b. [təŋ ʅər]	*!	*	
	c. [təŋ nər]	*!	*	
	d. [təŋ ŋər]		*!	

From Tables 18 to 21, it is clearly shown that our proposed constraint rankings can correctly evaluate the optimal forms. So far, the constraints proposed in this study are summarized in Table 22.

Table 22: The Constraints for the Formation of X-ER in the Hebei Dialects

IDENT-IO[r]:	The [r] specification in input segments must be preserved in output correspondents. (No featural change)
MAX-[r]:	The [r] specification in the inputs must be preserved in the outputs. (No deletion of the retroflexed feature)
S-IDENT-σ-[r]:	Adjacent syllables must agree either with or without the [r] specification.
*[r]:	The specification of the diminutive [r] is not allowed at all. (No diminutive [r])
ONSET^{ER}:	*$_o$[V (Syllables must have onsets.)
DEP-IO:	Outset segments must have input correspondents. (No segmental epenthesis)
S-IDENT-F/O-[All]:	The final segments of Xs (V or C) and the onsets of ERs must be identical.
*[ʅ, ɻ] >> *[i, y, n]>> *[u, ŋ]:	The hierarchical preference for onset selection.

5. A FACTORIAL TYPOLOGY FOR THE X-ER DIMINUTIVES IN THE HEBEI DIALECTS

The discussion so far has clarified that OT works well to account for the formation of X-ER in the Hebei dialects. Different types of X-ER result from different rankings of the same set of constraints. As previously described, inherent to OT is a core notion of *factorial typology* (Kager, 1999; Ma, 2008; McCarthy, 2002; Prince & Smolensky, 1993). Constraint permutations can erect a factorial typology that will predict logically possible grammars, and that the grammar of every observed human language must be one of the constraint permutations. Factorial typology in OT makes a strong theoretical claim that every ranking should be tested for its typological consequence. Can our study also make such a typological prediction about X-ER? Prior to detailed discussion on this notion, let us take a look at Figure 1 first.

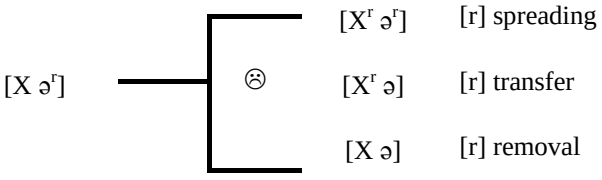

Figure 1: Typology of "X-ER" Diminutives in the Hebei Dialects

Figure 1 shows the development between [X ər], [Xʳ ərʳ] and [X ə]. The retroflexion in [ərʳ] can either be spread forward to form [Xʳ ərʳ] or be removed to form [X ə]. However, the lack of synchronic [Xʳ ə] seems to imply that the retroflexion cannot be transferred from [ərʳ] to Xs (as marked by ☹).[20] In Section 4.1, the three types of X-ER are analyzed under the OT framework by four constraints (i.e. IDENT-IO[r], MAX-[r], S-IDENT-

[19] Because onset insertion is forbidden, the markedness hierarchy is omitted for the sake of simplicity.

[20] In this case, [ə] is always deleted, leading to such retroflex diminutives as those in the Beijing dialect.

σ-[r] and *[r]) with different rankings. Following the central assumption of OT, if these four constraints are freely ranked and strictly dominated with each other, a factorial typology with twenty-four possible grammars will be constructed, as shown in Table 23.

Table 23: Types of "X-ER" in the Hebei Dialects

The Types of X-ER	Constraint Rankings in the Factorial Typology
[X ə^{r}] Percentage: 10/24	MAX [r] >> IDENT-IO [r] >> S-IDENT-σ-[r] >> *[r] MAX [r] >> IDENT-IO [r] >> *[r] >> S-IDENT-σ-[r] MAX [r] >> *[r] >> IDENT-IO [r] >> S-IDENT-σ-[r] MAX [r] >> *[r] >> S-IDENT-σ-[r] >> IDENT-IO [r] IDENT-IO [r] >> MAX [r] >> S-IDENT-σ-[r] >> *[r] IDENT-IO [r] >> MAX [r] >> *[r] >> S-IDENT-σ-[r] IDENT-IO [r] >> S-IDENT-σ-[r] >> MAX [r] >> *[r] IDENT-IO [r] >> S-IDENT-σ-[r] >> *[r] >> MAX [r] IDENT-IO [r] >> *[r] >> S-IDENT-σ-[r] >> MAX [r] IDENT-IO [r] >> *[r] >> MAX [r] >> S-IDENT-σ-[r]
[X^{r} ə^{r}] Percentage: 5/24	S-IDENT-σ-[r] >> MAX [r] >> IDENT-IO [r] >> *[r] S-IDENT-σ-[r] >> MAX [r] >> *[r] >> IDENT-IO [r] S-IDENT-σ-[r] >> IDENT-IO [r] >> MAX [r] >> *[r] MAX [r] >> S-IDENT-σ-[r] >> IDENT-IO [r] >> *[r] MAX [r] >> S-IDENT-σ-[r] >> *[r] >> IDENT-IO [r]
[X^{r} ə] Percentage: 0/24	None
[X ə] Percentage: 9/24	*[r] >> MAX [r] >> IDENT-IO [r] >> S-IDENT-σ-[r] *[r] >> MAX [r] >> S-IDENT-σ-[r] >> IDENT-IO [r] *[r] >> S-IDENT-σ-[r] >> MAX [r] >> IDENT-IO [r] *[r] >> S-IDENT-σ-[r] >> IDENT-IO [r] >> MAX [r] *[r] >> IDENT-IO [r] >> S-IDENT-σ-[r] >> MAX [r] *[r] >> IDENT-IO [r] >> MAX [r] >> S-IDENT-σ-[r] S-IDENT-σ-[r] >> IDENT-IO [r] >> *[r] >> MAX [r] S-IDENT-σ-[r] >> *[r] >> IDENT-IO [r] >> MAX [r] S-IDENT-σ-[r] >> *[r] >> MAX [r]>> IDENT-IO [r]

What kind of possible grammars does the typology of X-ER predict? Though 24 rankings are listed in Table 23, it only generalizes the already attested types of X-ER, because "many of the individual rankings in a factorial typology will produce identical surface patterns. The number of the predicted patterns is much smaller than the total number of logically possible rankings (Kager, 1999:35)." What's more, the exclusion of the nonexistent [X^{r} ə] from Table 23 also supports the view in OT that, although constraints are allowed to be freely ordered, some linguistic forms (i.e. rankings) seems unable to surface. Taking Table 23 for example, [X^{r} ə] is always regarded as *intrinsic suboptimal*, irrespective of the constraint rankings. This may result from either universal or language-specific restrictions. In brief, the typological result of Table 23, therefore, strongly supports the theoretical claim and typological goal of OT.

Furthermore, also assumed in OT is that every possible grammar can be instantiated by at least one attested dialect. To test if our study supports this notion, it is necessary to have in mind how many types of X-ER are predicted, and then attempt to attest these predicted grammars from the synchronic dialects. In addition to the three types of X-ER stated above, the onsets of the ERs in the Hebei dialects can also be divided into three types: (a) onsets are totally prohibited, (b) only [u, ŋ] are permitted or (c) all [ʅ, ɻ, i, y, n, u, ŋ] are allowed.[21] Accordingly, there should be nine subtypes of X-

[21] As previously stated, there is a preference scale [u, ŋ] > [i, y, n] > [ʅ, ɻ] for onset selection in the Hebei dialects. According to this scale, three, not two, subtypes should be reached: (a) [u, ŋ], (b) [i, y, n, u, ŋ] and (c) [ʅ, ɻ, i, y, n, u, ŋ]. Here, [i, y, n] and [ʅ, ɻ] are combined into a single group partly for explanatory simplicity and partly for dialectal supports. To be specific for the latter, a great number of synchronic dialects in Hebei Province (e.g., Mancheng, Dingxing, Anguo, Qinglong, etc.) group [ʅ, ɻ] with [i, y, n] in terms of onset selection in the formation of X-ER. Moreover, one dialect may have different formations meanwhile. Take the Mancheng dialect for example. When X is

ER, as in Table 24. The empirical dialects are attested, based mainly on Li (2007) and on such studies as Gao (2006), Sun (2004), Wang (1999), Zhang (2005), Zhang (2003), and Zhu (2004). Clearly, each subtype can be empirically supported by at least one synchronic Hebei dialect.

Table 24: Attested Dialects for Possible "X-ER" Types in the Hebei Dialects

X-ER Types	Onset Types	Attested Dialects
[X ɚ]	Onset Prohibited	Qingyuan
	Only [u, ŋ]	Mancheng, Dingxing, Anguo, Wangdu
	[ʅ, ɿ, i, y, n, u, ŋ]	Northern Xinyue
[X ɚ ɚ]	Onset Prohibited	Tangxian
	Only [u, ŋ]	Dingzhou (Old generation)
	[ʅ, ɿ, i, y, n, u, ŋ]	Dingzhou
[X ə]	Onset Prohibited	Laiyuan, Kuancheng
	Only [u, ŋ]	Qinglong, Raoning, Lulong
	[ʅ, ɿ, i, y, n, u, ŋ]	Qian-an

6. CONCLUSION

The success of any theory of grammar should be measured by its ability to characterize the notion of "possible grammars." Such a notion not only motivates the birth of OT, but also features the strength of OT. In this study, the OT analysis of X-ER in the Hebei dialects thoroughly catches this theoretical belief. The total rankings of the constraints give rise to only the possible grammars, and, in the meanwhile, cast aside the impossible one(s). Moreover, all the predicted types of X-ER prove their existence by the endorsement of at least one synchronic Hebei dialect.

However, there are several related issues, theoretical or empirical, that await further investigation. First, this study focuses itself on the synchrony of X-ER, and puts the diachrony aside. However, diachrony and synchrony are always two sides of a coin. As previously described, ERs have existed for a long history and undergone several diachronic stages. Can both diachrony and synchrony of the ERs be unified under the OT framework? If yes, how can it be achieved? This issue is not that easy to explain and, thus, is worth our constant efforts. Second, though classical OT can succeed in making categorical distinctions among the three types of X-ER (i.e. [X ɚ], [X ɚ] and [X ə]), it seems incapable of explaining the issue of probability.[22] Specifically, can the probability of each type of X-ER be interpreted by the number of constraint rankings that yields a particular pattern? To illustrate, the percentage of [X ɚ] is the lowest (5/24) among the three in Table 23. Whether the lowest percentage of [X ɚ] predicts a similar probability of [X ɚ] in the synchronic Hebei dialects? On the contrary, does the highest percentage of [X ɚ] (10/24) have the widest distribution and largest numbers of the synchronic Hebei dialects? Answering this question calls for more efforts in future research.

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closed by [u] or [ŋ], ER will stand alone as a syllabic diminutive word, while ER is incorporated into X when X is closed by [ʅ, ɿ, i, y, n].

[22] It is this weakness of classical OT that gives rise to the stochastic models of OT (Boersma, 1997, 1998).

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