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ABSTRACT

A study investigated the relationship between language style and variability in the phonology of Japanese learners of English. The subjects were five adult native speakers of Japanese at the intermediate stage of English learning. Speech materials elicited three different speech styles of varying formality: reading of a word list, reading of a text, and free conversation. The phonological phenomena examined included selected English consonant clusters and final consonants. The results revealed systematic patterns in style and variability and an interaction of transfer and developmental processes. The amount and type of variability according to style was related to proficiency, which in turn was governed by markedness, native language transfer, and universal developmental processes. In some phenomena, native language transfer produced correct and incorrect productions. In other phenomena, developmental processes reflected markedness considerations and produced incorrect pronunciation. (MSE)

Variation in Japanese Learners of English

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ABSTRACT

This study investigates the relationship between style and variability in the phonology of Japanese learners of English. The data reveal that there are systematic patterns between style and variability and an interaction of transfer and developmental processes. The amount and type of variability according to style is related to proficiency, which in turn is governed by markedness, native language transfer, and universal developmental processes. In some phenomena native language transfer produces correct and incorrect productions; in other phenomena developmental processes, which reflect markedness considerations, produce incorrect pronunciation.

Rigorous study of sociolinguistic variation of native speakers has been going on for some time (cf. Labov, 1963, 1969). However, only in the last decade or so has the study of second language variation been undertaken systematically. Most studies are concerned with the relationship between style and correct or native-like production. In general, it has been found that second language learners achieve greater accuracy in the T[arget] L[anguage] as style becomes more formal (Gatbonton, 1975; Dickerson & Dickerson, 1977; Sato, 1985), although in some instance greater accuracy in the formal style might be due to positive transfer of the formal L1 variant which happens to be the target in L2 (Schmidt, 1977). On the other hand, occasional greater accuracy in informal styles may be due to transfer of the N[ative] L[anguage] casual speech variant which happens to coincide with native L2 production. Beebe (1980) found greater accuracy in word initial /r/ production in English for Thai speakers in casual speech as compared to formal speech. She claimed this indicated the influence of the NL was stronger in the most formal style because seemingly more NL variants were produced (a trilled /r/). However, in running speech in Thai a variant occurs which is very similar to American English /r/; therefore, the greater accuracy occurring in these Thai speakers' English casual speech utterances could have been the result of transfer of this Thai variant of /r/ into English. Although in general, accuracy increases as style becomes more formal, these last two studies (Schmidt, Beebe) illustrate that the transfer of a stylistically conditioned NL variant may either aid or hinder TL accuracy.

A proposal dealing with the relationship between L2 variation and general sociolinguistic theory is discussed by Tarone (1983). She argues that her Capability Continuum Paradigm accounts for L2 data better than those of Adjemian, (1976, 1981) and Krashen (1976, 1981). Her paradigm is based on Labov's axioms of the Observer's Paradox (1969): (1) variation occurs for every speaker as the topic and situation change; (2) there is a continuum of styles, which are defined according to the amount of attention given to speech; (3) the most systematic patterns occur in the vernacular; more variability occurs in other styles.[1] The first two assumptions seem axiomatic and are convincingly argued by Tarone to apply to L2 acquisition. However, the third axiom is contradicted by some of the data she presents. She notes Dickerson & Dickerson (1977) found Japanese speakers of English produced English /r/ nearly 100% accurately in word lists but approximately 50% accurately in free speech. It would be difficult to argue that 100% accuracy is less systematic than 50% accuracy. Sato (1985) further reports that some of her data support axiom (3) while some do not. Perhaps systematicity and variability are correlated with style and some other factor(s) or there are significant differences between the style shifting in native and nonnative speakers. Let us examine some hypothetical examples which are consistent with the generalization that accuracy increases as formality increases, ceteris paribus. Consider the following N[ative] S[peaker]s of English and their pronunciation of the Spanish trilled /r/ in three different contexts--reading a word list, reading a text, and free conversation:

Subject A has no success with the Spanish trilled /r/ and uses English /r/ in all contexts.

Subject B is partially successful (20%) but only in word lists. In other styles English /r/ is substituted.

Subject C has limited success in all styles. Word list: 70% accuracy; Text: 50% accuracy, Conversation: 10% accuracy.

Subject D: Word list 100% accuracy; Text: 75%; Conversation: 50%.

Subject E shows 100% success all styles.

The amount of variability according to style may be summarized as follows: Subjects A and E show no variation according to style. In Subject B there is more variation in the most formal style, although more accuracy. Subject C exhibits the most variation in the intermediate style (reading a text). Subject D's least formal style shows the greatest variation. The generalization observed for these subjects is that for any given style, as proficiency increases (from Subject A with no proficiency to Subject E with 100% proficiency), variation first is non-existent, then increases, and finally decreases. Thus, the amount of variability is not so much a function of style alone as it is a function of proficiency and style.

As it applies to NSs, the validity of Labov's axiom that the greatest systematicity occurs in the vernacular also can depend on proficiency with the non-vernacular target. A speaker whose vernacular is nonstandard and attempts the standard in a formal situation may show considerable variation and inconsistency, simply because of lack of competence in the standard. On the other hand, one who has mastered the standard dialect may be just as consistent with the standard as with the native vernacular. In contrast with the L2 cases above, in both these cases the vernacular remains consistent and no more variable than more formal styles, where more variation may occur. However, with extensive nonnative dialect contact and isolation from one's native dialect, there is the possibility of native dialect loss. If one is cut off for an extended period from speakers of one's native dialect or vernacular, the speaker may lose competence and may actually show more variation and less consistency when attempting to speak this vernacular once again.

There are further similarities and differences between L2 speakers and dialect/stylistic shifts in NSs. A speaker of a nonstandard dialect of English using the standard in formal situations and an L2 learner of English are similar because in both cases the target may be considered nonnative. The situations become different when the English speaker switches to informal speech because the target becomes the NL, but for the NNS the target for all styles is still nonnative. Furthermore, the target varies when a NS switches styles; for the NNS even though production varies with different styles, the target may or may not vary, depending on whether the speaker is aware of such variation in NSs.

A further concern of L2 researchers studying stylistic variation is not just the amount of variation but the different types of variation occurring in nonnative productions. A currently used system of classification recognizes that some errors (nonnative productions) are due to NL transfer while others are not; the former are negative transfer or interference errors and the latter are termed developmental errors because they are similar or identical to L1 acquisition but are not directly attributable to NL grammar (Johansson, 1973; Tarone, 1978, 1980; Macken and Ferguson, 1981; Wode, 1981; Hecht and Mulford, 1982). An example of a transfer error occurs when a German learner of English substitutes a uvular [R] for English /r/--[R] occurs in German but does not occur in L1 acquisition of English. A Japanese learner's devoicing of final obstruents in English is an example of a developmental error--the process occurs in L1 acquisition of English but not in Japanese, since although Japanese has voiced obstruents, they do not occur in final position.

The transfer/developmental distinction is incorporated into Major's model (1987), which claims that the amount and type of variability is a function of style. This Ontogeny Model claims that as style becomes more formal transfer errors decrease while developmental errors are at first infrequent, then increase, and finally decrease. The model does not state the percentage or relative proportions of each type of error or correct productions for any given style, but simply that this overall pattern can be observed as style varies. Because both types of errors are claimed to decrease in the most formal styles, the greatest percentage of correct productions would thus occur in these styles. At present the model remains an unconfirmed hypothesis because of the lack of strong empirical evidence. Major (1987) offers indirect evidence from studies of Wode (1981) and Dickerson and Dickerson (1977), and Major's 1986 study presents tentative evidence. Because the model includes important factors currently used in L2 and sociolinguistic research--variability and style, errors (transfer and developmental), and correct productions--it would seem useful to test such the model. The purpose of the present study is to test the claims of the Ontogeny Model, using data from Japanese learners of English.

METHODS

Characteristics of Japanese Phonology Relevant To This Study

Japanese syllable structure is characterized by open syllables (V and CV); the only closed syllables contain geminates or nasals. There are no consonant clusters except geminates. Loan words with consonant clusters and syllable final consonants (other than nasals or the first segment of a geminate) are systematically altered to fit the V or CV syllable structure by the addition of the vowels [u], [o], or occasionally [i]: [makudonarudo] MacDonald, [bifuteki] beefsteak, [kurabu] club (see Miura, 1979). There is one liquid, usually described as a flap or occasionally as a lateral flap (Bloch, 1950; Kohmoto, 1960; McCawley, 1968). Given these facts about Japanese, one would expect Japanese students of English to have considerable difficulties with English liquids, consonant clusters, and syllable final consonants.

Subjects

The five subjects, native speakers of Japanese, were intermediate learners of English (TOEFL scores 400-450) and had been in the

U.S. from two to four months. There were two females and three males. One subject was an exchange student enrolled in a low level college ESL grammar and writing course; the other four were enrolled at an intensive English institute.

Speech Materials and Phenomena Investigated

The speech materials used were designed to elicit three different speech styles varying in formality: reading of a word list (the most formal), reading of a text, and a free conversation (the least formal).

The phenomena investigated include English consonant clusters and final consonants. A limited number of consonant clusters and final consonants were selected in order to reduce the number of phenomena to a manageable size. To rigorously control for the possible influence of phonological environment,[2] minimal pairs or near minimal pairs were used whenever possible, and the same key words were used for both the word list and the text. A detailed list of the phonological environments and words is included in Table 1.

--Table 1 about here--

After these words were selected, a short text (one page) was created using all the key words in a modified randomized order, so that similar words (e.g. heart and hard) did not occur near each other (Appendix A). Next, a word list was made using the key words in this same order (Appendix B). Thus, the order of the key words in the Text and Word List was the same.

The conversation consisted of a 20-30 minute informal chat with each subject, with no attempt to elicit specific words or phonological environments. The limitations of this technique will be discussed later.

Procedure

A native speaker of American English (native of Washington state) was recorded, reading the Text five times and then the Word List five times. The native speakers of Japanese were recorded in the following fashion. Each subject was given the Text and asked to read it silently. Any questions the subject had on meaning and pronunciation were answered. Next, the subject followed the Text silently while listening to the recording of the native speaker of American English. Then the subject was recorded reading the Text five times. Recordings of the Word List were made in a similar manner: The subject looked at the Word List, listened to the native speaker, and then read the Word List five times. In order to prevent the subject from knowing what the key words were in the Text, the Text was recorded before the Word List. Finally, a 20-30 minute free conversation between the subject and investigator was recorded.

The phenomena investigated were transcribed and tabulated as either correct (native-like) or incorrect, and incorrect productions were further classified as transfer or developmental errors. Errors were classified as transfer if they are the direct result of Japanese phonology, e.g. vowel insertion between consonant clusters or after final consonants, substitution of a flap for /r/ or /l/. Developmental errors are those which cannot be directly attributed to Japanese phonology, e.g. consonant cluster simplification, word final obstruent devoicing, substitution of [w] for /r/, /r/ for /l/ and vice versa (a type of overgeneralization or category confusion). However, there are some pronunciations which can be considered errors from one point of view but target-like from another. Deletion of post-vocalic /r/ is a developmental error for an L2 learner of English if the target dialect has this /r/. However, in this study deletion was not considered an error because many Japanese learners of English have studied British English.

A further ambiguous situation is consonant cluster deletion involving suffixes, such as the plural, possessive, third singular, and past tense. A deletion of an ending was counted as an error in the Word List and Text because the subject was reading directly from them. However, in the Conversation such a deletion was not considered a phonological process because there is no way of knowing if the target contained the suffix. If the subject was not attempting to pronounce the morpheme, a failure to produce it is the result of the lack of the morphological process; if the subject was attempting to pronounce the morpheme but did not, the deletion is a phonological process. With these data there is no way of knowing which situation obtained. Other consonant cluster deletions are potentially problematic because they also occur in NSs, but only in limited contexts. Therefore, consonant cluster deletions for this study were considered errors unless they were the type that commonly occur in native speakers, e.g. [wɘsəmæ r] what's the matter is common but not *[pætkæs] Pat's cats.

After errors were categorized, the three different outcomes (C = correct, T = transfer error, D = developmental error) were tallied, percentages calculated, and these differences according to style were tested for significance using analysis of variance.

RESULTS

Tables 2-9 indicate the number of transfer errors, developmental errors, and correct productions for the phenomena investigated; Tables 10-11 show analyses of variance. Figures 1-9 plot the averages for the five different subjects as style changes. One type of analysis of variance tested whether changes in the outcomes (T, D, C) according to style were significant. Of these

24 analyses (three per table), seven were significant at $p < 0.05$ (Table 10). Another type of analysis of variance tested whether there was a significant interaction of T and D, i.e. if the shapes of the curves were significantly different. Four out eight (one per table) were significant at $p < 0.05$ (Table 11).

--Tables 2-11 and Figures 1-9 about here--

DISCUSSION

Individual Phenomena

Word Initial Fricative plus Stop. Figure 1 demonstrates nearly 100 percent mastery in all styles. On the basis of Contrastive Analysis one might expect Japanese speakers to have considerable difficulty because Japanese has no consonant clusters. Although there are no underlying clusters, surface consonant clusters occur especially in running speech, due to devoicing and deletion of vowels /i/ and /u/ between voiceless obstruents: /sukiaki/ --> [su̥kiaki] --> [skiaki] sukiyaki. Since English initial fricative plus stop clusters are all voiceless, the mastery of these clusters in English may presumably be due to positive transfer--transfer of the NL process to the TL, resulting in correct pronunciation. That is, in English production of initial obstruent clusters, a vowel may first be inserted, devoiced, and then deleted, e.g. sky: /skay/ --> [sukay] --> [su̥kay] --> [skay]. Further indirect evidence that this process is readily transferred to English is the widespread observation of ESL teachers that Japanese speakers often delete vowels between voiceless consonants in English, creating consonant clusters which do not normally occur in native speakers. Even stress in English does not block this process: [sti] city.

Word Initial Obstruent plus Liquid. Figure 2 indicates a slight increase in correct production as formality increases, which is consistent with the generalization of several other studies (Gatbonton, 1975; Dickerson and Dickerson, 1977; Sato, 1985). Most of the errors are due to transfer, e.g. [ɾ] for /r/ and /l/, and decrease as formality increases. Developmental errors are infrequent and relatively constant across styles. Some examples of developmental errors observed were [wʳ] (an r-colored [w]) for /r/ and /l/, substitution of [r] for /l/ or [l] for /r/, and occasionally metathesis: [bard] bride.

Word Final Voiceless Stop. Figure 3 is similar to Figure 1 with nearly 100% correct production in all styles. On the basis of underlying Japanese syllable structure this would not be predicted, since there are no final obstruents. The relative ease of production might be due to at least two factors: surface

Japanese phonology and markedness. In Japanese a word final /i/ or /u/ which follows a voiceless obstruent has the tendency to devoice and delete. If the process is transferred to English it would result in a correct final voiceless stop, <u>leak</u>: /lik/ --> [liku] --> [liku̥] --> [lik]. Another possible explanation involves markedness as it applies to L2 acquisition. Final ~~voiced~~ voiceless obstruents are much less marked and are acquired earlier than voiced obstruents (Eckman, 1977, 1985; compare Figure 3 with Figure 4).

Word Final Voiced Stop. In contrast to voiceless stops, final voiced stops are considerably more difficult in all styles. The data (Figure 4) thus lend strong support to Eckman's (1977) claim that in L2 acquisition final voiced obstruents are acquired later than the voiceless counterparts.

In terms of stylistic variation, the most striking feature of the patterns in Figure 4 is that although there is a slight increase in correct production from the Conversation to the Text, there is a decrease in the Word List with an accompanying increase in developmental errors. This finding is contrary to the widespread observation that the greatest accuracy occurs in reading isolated words. The reason for this pattern is because of the developmental process of final devoicing, contributing to the decrease in accuracy in the Word List. The most favorable phonetic environment for this process is before a pause, such as in utterance final position. Since in reading the Word List speakers were instructed to leave a relatively long pause (1-2 seconds) between each word, in effect each word functioned as an utterance; not surprisingly, devoicing was very prevalent. In the Conversation and Text, pauses after final voiced obstruents occurred, but were considerably less frequent and depended on the speakers' fluency and rate. Devoicing is also favored before another voiceless obstruent, but since in the Conversation and Text this environment accounted for only a portion of the total, the process was not favored nearly as much as in the Word List, where the voiced stop was always followed by a pause. Therefore, the environment for a word final voiced stop in a Word List, Text, and Conversation cannot properly be considered identical.

The devoicing process also occurs to some extent in native speakers of English. In order to test whether devoicing occurred in this sample, the speech of the native speaker was transcribed. Although in some words there was very slight devoicing, e.g. [gred̥] *grade*, it was not devoiced to the extent that *grade* sounded like *grate*. To further test whether devoicing occurred, a native speaker of American English unfamiliar with this study was asked to listen to the recording and to write down (not phonetically) the words he heard. Although there were some mistakes, e.g. *weeks* for *leaks*, *capped* for *tapped*, there was only one instance of a final voiced obstruent being perceived as a voiceless: irk for erg. After the task was completed the listener remarked that this word did not really sound like irk but he did not remember that the word erg existed. It is possible that devoicing did occur to some extent and the listener perceived the consonant as voiced due to vowel length because vowels before voiced obstruents are longer than before voiceless obstruents. Therefore, this test does not definitively demonstrate the absence of devoicing in this careful style of speech; however, it suggests the process is infrequent.

Word Final Liquid plus Voiceless Stop. Although there are little differences in frequencies between the Conversation and Text, there is a noticeable increase in correct productions for the Word List and a decrease in developmental errors (Figure 5). This trend is similar to the one observed in Figure 2, where correct production is favored as formality increases.

Word Final Liquid plus Voiced Stop. When the final stop is voiced instead of voiceless, the pattern is different (Figure 6). In non-utterance final position (Conversation and Text), as formality increases there is an increase in correct production (as in Figure 5); however, in the Word List there is a decrease in correct production. This decrease is most likely due to devoicing, which is favored in utterance final position (already discussed in connection with Figure 4). The consistency of this factor can be seen in the similarity of Figures 4, 6, and 8, which show an increase in correct production from the Conversation to Text but a decrease in the Word List.

Another developmental process occasionally occurring for final liquids plus stops (voiced and voiceless) was metathesis: [brub] bulb. The possibility was considered that this was a form of dyslexia, due to the fact that reading was involved. However, this was probably not the case since metathesis occurred in the Conversation: [prumən] Pullman. Another possibility is that the pronunciation was not due to metathesis but rather the result of vowel insertion and deletion of the stressed vowel: bulb: /bʌlb/ --> [bʌrub] --> [brub]. This explanation seems even more plausible when one considers that in many speakers a stressed /i/ is deleted in city: [sti].

Word Final Voiceless Obstruent Clusters. Subjects were quite accurate in all three styles, with the most formal style favored (Figure 7). Because final clusters are intrinsically more difficult than single consonants (based on markedness: universally less frequent and acquired later in L1 acquisition), this would explain why the subjects were not quite as successful with clusters as they were with single final voiceless consonants

(Figure 3). However, the high success even with clusters (approximately 90 percent) deserves comment, since Japanese has no final clusters. A possible explanation is the devoicing and deletion of vowels, discussed in connection with word initial clusters of fricative plus stop and final voiceless stops (Figures 1 and 3). In a similar fashion, a word such as *pats* may be pronounced correctly based on the following derivation: /pæts/ --> [pætusu] --> [pætu̥su̥] --> [pæts]

Word Final Voiced Obstruent Clusters. The generalizations comparing final voiceless obstruent clusters to single final voiceless obstruents and final voiced obstruent clusters to single final voiced obstruents are similar: Since clusters are universally more difficult than single obstruents, this would explain the relatively greater success with single obstruents compared to clusters (Figure 3 vs. 7 and Figure 4 vs. 8). Furthermore, the greater success of final voiceless obstruents (Figures 3 and 7) as compared with voiced obstruents (Figures 4 and 8) may be explained on the basis markedness considerations: Final voiced obstruents are more marked than voiceless obstruents. Figures 4 and 8 are similar in that there is a decrease in correctness in the Word List, presumably due to devoicing, which is favored before a pause. The frequent pronunciation of voiced clusters as voiceless may have been the result of simple devoicing, e.g. *pads* /pædz/ --> [pæts]. However, another possible explanation involves vowel insertion, iterative devoicing, and vowel deletion: /pædz/ --> [pæduzu̥] --> [pæduz̥u̥] --> [pædu̥z̥u̥] --> [pæd̥u̥z̥u̥] --> [pæts] (cf. *pats* discussed above).

Summary of Phenomena

Variability as a Function of Style. For some phenomena there is more variability as style increases in formality, while in others there is less (cf. Figure 4 vs. Figure 5). Therefore, Tarone's (1983) claim that the greatest systematicity occurs in the vernacular is not supported by this study.

Figure 9 graphs the averages for the combined phenomena. Overall, there is very little change as style varies. This is very likely due to the fact that final obstruent devoicing is favored in the Word List for tasks containing final voiced stops, which decreases correct utterances; whereas, in the other tasks there is a general increase in correctness for the Word List. Thus, when averaged these two opposing effects cancel one another.

Devoicing. This study demonstrates that two devoicing processes in Japanese learners of English are important factors in pronunciation--both vowel devoicing and deletion between voiceless obstruents and final obstruent deletion. On the one hand, vowel devoicing and deletion explain the relative success of initial and final voiceless obstruent clusters; on the other hand, final obstruent devoicing explains the lesser success with final voiced obstruents.

Intervening Factors. The results may have been affected by a number of intervening factors which are difficult to control for in a study with this design. It has been strongly argued that phonological environment should be strictly controlled whenever possible. It is possible in the Word and Text but very difficult in a free conversation--one might wait forever to obtain an instance of /lb/#. Therefore, the most reliable comparison between styles in this study may be between the Word List and Text.

Another factor conceivably affecting the results is fluency in reading and conversation. A subject who is not very fluent at reading the Text may introduce a pause at the end of each line and thus create a different environment than if the word appeared in the middle of the line. This apparently happened with Subject 4. In the Text, rigged appeared on the end of a line while tabbed did not; in the five readings she devoiced the final consonants in rigged four times but never in tabbed. In addition, the difference in fluency in conversation vs. reading should be considered. A subject who is not fluent in conversation may pause to think out nearly every word. Since considerable attention is obviously paid to each word, in effect, this "Conversation" might be considered a "Word List" and therefore more formal than the Text. On the other hand, another person might have fewer pauses in Conversation than in the Text. These factors, difficult to control for in any analysis, might introduce some inconsistency in the results.

Order of Acquisition. The order of acquisition of the phenomena for these five subjects is consistent with expectations based on NL transfer and Universal Grammar considerations (Greenberg, 1966, 1978), and as they pertain to L2 acquisition (Eckman, 1977, 1985): (1) Consonant clusters with liquids are more problematic than those with only obstruents (Figures 1, 2, 5, 6, 7, 8). This is expected because the Japanese liquid is very different from English /r/ and /l/, but Japanese has all the obstruents considered in this study. (2) Transfer of the Japanese process of vowel devoicing and deletion between voiceless obstruents accounts for the relative success of voiceless obstruent clusters in English. (3) Word final single obstruents are acquired before clusters (Figures 3 vs.7, 4 vs. 8); in the languages of the world word final single obstruents are more frequent than clusters and in L1 acquisition are acquired first. (4) Word final voiceless obstruents are acquired before voiced obstruents (Figures 3 vs. 4, 5 vs. 6, 7 vs. 8); universally, final voiceless obstruents are more common than voiced obstruents and are acquired first.

Relevance to the Ontogeny Model. The results of this study are more interesting in terms of the previously discussed reasons for the correct and incorrect productions than as direct evidence for or against the Ontogeny Model (Major, 1987). Although there is systematic variation in the relationship between T, D, and C according to style, this study suggests the relationship also depends on the process and stage of the learner. A task that is mastered in all styles provides no evidence for or against the model, nor does a task for which there are 100% T substitutions. In order to provide evidence for the relationships claimed one might consider additional phenomena, subjects with a greater variation in proficiency, and a larger number of styles.

In light of the fact that only 11 of 32 analyses of variance were significant, it would be premature to say anything decisive about the claims of the Ontogeny Model. Of the 24 analyses of variance to test whether changes in the outcomes T, D, and C according to style were significant, only seven were significant at $p < 0.05$ (Table 10). In the eight other analyses of variance to test the interaction of T and D, four out of eight were significant (Table 11). These last analyses of variance indicate, for example, that there is a significant difference in the patterns of T and D in Figure 4, where D increases and T is fairly steady; likewise in Figure 5, where D decreases and T is fairly steady, the differences are also significant.

There are some general trends in the graphs that are relevant to the model, regardless of whether they are statistically significant. The Ontogeny Model claims that as formality increases T will decrease but D will increase and then decrease (Figure 10). The Patterns for D supporting the claims of the

--Figure 10 about here--

model include the complete graph where D increases and decreases or portions of the graph: (1) an increase in D (the first portion of the graph), (2) little change in D (the middle portion), and (3) a decrease in D (the last portion). The strongest evidence against the model would be an increase in T as formality increases. The five graphs that exhibit noticeable variation all support the claims of the model: One shows D steady (Figure 2), one shows D decreasing (Figure 5), and three show a portion where D increases (Figures 4, 6, 8). In four of these five figures T is either relatively steady or decreasing. The only instance of possible counterevidence for the model is Figure 8, where T slightly increases and then decreases. Therefore, the trends, although in general not statistically significant, provide weak support for th ·ↄdel but no strong counterevidence.

CONCLUSION

Although the data provide only mild support for the Ontogeny Model, they suggest a systematic relationship between style and pronunciation, as measured by correct production and transfer and developmental errors. Except for word final voiced obstruents, the greatest accuracy occurs as style becomes more formal, and the order of acquisition for the various phenomena conforms to expectations based on NL transfer and Universal Grammar. The results also indicate the importance of vowel devoicing and deletion between voiceless obstruents and word final obstruent devoicing. The first process, transferred from native Japanese phonology, accounts for the high percentage of correct production of voiceless obstruent clusters. The second, a developmental process, accounts for the relatively poor production of word final voiced obstruents, especially in the Word List.

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APPENDIX A. TEXT

As Max walked out into the early morning, a whistling train raced by, making his heart skip a beat. He tilted his head toward the sky and smelled the flowers in full bloom. He was eager to try his skill at fishing in his boat rigged especially for catching shrimp. As he stepped in his boat, he could feel the slap of the waves on the sides. Birds molt at this time of year and often leave the bulk of their feathers in his boat. One plume reeked with the smell of mold. The boat had several leaks so he tried to drain out the water by tipping it. He had tried this unsuccessfully before, and it would irk him every time. So he sat down on an old crate and started bailing out the water with a can, but it was difficult because the slaps of the waves were so hard. One leak was so bad he even wondered if he should stay on shore and not make the trip. In the bottom of the boat he felt the prick of a fishhook barb and some broken glass. He positioned a large stone over the biggest hole. Then he placed some brown pads on the seat, tapped his fingers on one side, and started rowing out to sea.

In the open water, he started daydreaming about his early childhood--the pride he had felt playing in the local baseball league--the roar of the crowd, the laughs, an excited shriek by a girl--pats on the back by his coach--dreams of playing in the big leagues. His mind continued to drift. He remembered how he would ask his father to play spy games with him--the colored light bulb in his room--how he raised calves that eventually became slabs of meat. He thought of his mother--her soft voice and slight lisp and the picture on the mantel, which showed her as a new bride. He recalled helping her fry a slab of bacon and how he tried to grate cheese with a harp--how he liked to eat the pulp of freshly squeezed orange juice with a spoon. His thoughts then wandered to the immediate past. In physics class last week he was tabbed the most promising student. He chuckled. Although his report card grade was an "A" he could barely keep separate the definitions of erg, ohm, and gravity.

APPENDIX B. WORD LIST

1. train
2. raced
3. heart
4. sky
5. bloom
6. skill
7. rigged
8. shrimp
9. slap
10. molt
11. bulk
12. plume
13. reeked
14. mold
15. leaks
16. drain
17. irk
18. crate
19. slaps
20. hard
21. leak
22. stay
26. pads
27. tapped
28. pride
29. league
30. laughs
31. shriek
32. pats
33. leagues
34. ask
35. spy
36. bulb
37. raised
38. calves
39. slabs
40. lisp
41. bride
42. slab
43. grate
44. harp
45. pulp
46. spoon
47. class

23. barb
24. glass
25. stone
48. tabbed
49. grade
50. erg

NOTES

[1] It should be pointed out that systematicity is not synonymous with lack of variability because much variability is systematic; however, for some types of variability there seem to to be no systematic patterns. On the other hand, it can be argued that a data which show no variability are the most systematic.

[2] For example, liquids are very subject to environmental influence. In Ganda, which phonemically has one liquid, [l] occurs before back vowels and [r] before front vowels (Halle and Clements, 1983:53). Dickerson and Dickerson (1977) found that Japanese learners of English produced /r/ more correctly before a mid vowel than before a high vowel.

[3] In order to keep the total number of trials constant, i.e. T + D + C = constant (in this case n = 25), if both a T and D error occurred, they were each counted as 0.5.

Table 1. Phonological environments and words used for word list and text. F = fricative, S = stop, L = liquid.

1. #F-L

#/sl/	slap slaps			#/sr/	shriek
	slab slabs				shrimp

2. #F-S

#/sp/	spy	#/st/	stay	#/sk/	sky
	spoon		stone		skill

3. #S-L

#/pr/	pride	#/tr/	train	#/kr/	crate
#/br/	bride	#/dr/	drain	#/gr/	grate
#/pl/	plume	*#/tl/		#/kl/	class
#/bl/	bloom	*#/dl/		#/gl/	glass

4. S#

/p/#	slap	/t/#	grate	/k/#	leak
/b/#	slab	/d/#	grade	/g/#	league

5. L-S#

/rp/#	harp	/rt/#	heart	/rk/#	irk
/rb/#	barb	/rd/#	hard	/rg/#	erg
/lp/#	pulp	/lt/#	molt	/lk/#	bulk
/lb/#	bulb	/ld/#	mold	*/lg/#	

6. S-S#

/pt/#	tapped	*/tS/#		/kt/#	reeked

/bd/# tabbed	*/dS/#	/gd/# rigged

7. S-F#

/ps/# slaps	/ts/# pats	/ks/# leaks
/bz/# slabs	/dz/# pads	/gz/# leagues

8. F-S#

/sp/# lisp	/st/# raced	/sk/# ask
*/zb/#	/zd/# raised	*/zg/#

9. F-F#

/fs/# laughs

/vz/# calves

Table 2. #F-S (word initial fricative plus stop)

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	0	0.00	3	10.00	0	0.00
S1	D	0	0.00	0	0.00	0	0.00
	C	4	100.00	27	90.00	30	100.00
	T	0	0.00	2	6.67	0	0.00
S2	D	0	0.00	0	0.00	0	0.00
	C	15	100.00	28	93.33	30	100.00
	T	0	0.00	1	3.33	0	0.00
S3	D	0	0.00	0	0.00	1	3.33
	C	7	100.00	29	96.67	29	96.67
	T	0	0.00	0	0.00	0	0.00
S4	D	0	0.00	0	0.00	0	0.00
	C	18	100.00	30	100.00	30	100.00
	T	0	0.00	2	6.67	0	0.00
S5	D	0	0.00	0	0.00	0	0.00
	C	33	100.00	28	93.33	30	100.00
Mean %	T		0.00		5.34		0.00
All Ss	D		0.00		0.00		0.66
	C		100.00		94.66		99.34

Table 3. #O-L (word initial obstruent plus liquid)

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	3	75.00	63	78.75	60	75.00
S1	D	1	25.00	2	2.50	3	3.75
	C	0	0.00	15	18.75	17	21.25
	T	17	60.71	33	41.25	13	16.25
S2	D	2	7.14	4	5.00	13	16.25
	C	9	32.14	43	53.75	54	67.50
	T	7	46.67	37	46.25	30	37.50
S3	D	2	13.33	26	32.50	19	23.75
	C	6	40.00	17	21.25	31	38.75
	T	4	25.00	29	36.25	6	7.50
S4	D	2	12.50	4	5.00	23	28.75
	C	10	62.50	47	58.75	51	63.75
	T	22	36.67	19	23.75	3	3.75
S5	D	4	6.67	7	8.75	15	18.75
	C	34	56.67	54	67.50	62	77.50
Mean %	T		48.81		45.25		28.00
All Ss	D		12.93		10.75		18.25
	C		38.26		44.00		53.75

Table 4. S# (word final voiceless stop)

[-voi]

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	1	2.44	0	0.00	0	0.00
S1	D	0	0.00	0	0.00	1	6.67
	C	40	97.56	15	100.00	14	93.33
	T	9	12.00	0	0.00	0	0.00
S2	D	0	0.00	0	0.00	0	0.00
	C	66	88.00	15	100.00	15	100.00
	T	0	0.00	1	6.67	0	0.00
S3	D	0	0.00	0	0.00	0	0.00
	C	26	100.00	14	93.33	15	100.00
	T	0	0.00	1	6.67	0	0.00
S4	D	0	0.00	0	0.00	0	0.00
	C	99	100.00	14	93.33	15	100.00
	T	0	0.00	0	0.00	0	0.00
S5	D	0	0.00	0	0.00	0	0.00
	C	106	100.00	15	100.00	15	100.00
Mean %	T		2.89		2.68		0.00
All Ss	D		0.00		0.00		1.34
	C		97.11		97.32		98.66

Table 5. S# (word final voiced stop)

[+voi]

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	0	0.00	1	6.67	0	0.00
S1	D	5	21.74	0	0.00	8	53.33
	C	18	78.26	14	93.33	7	46.67
	T	3	15.79	0	0.00	0	0.00
S2	D	5	26.32	0	0.00	2	13.33
	C	11	57.89	15	100.00	13	86.67
	T	0	0.00	1	6.67	0	0.00
S3	D	3	11.54	5	33.33	7	46.67
	C	23	88.46	9	60.00	8	53.33
	T	0	0.00	1	6.67	0	0.00
S4	D	3	14.29	0	0.00	6	40.00
	C	18	85.71	14	93.33	9	60.00
	T	0	0.00	0	0.00	0	0.00
S5	D	3	6.98	5	33.33	9	60.00
	C	40	93.02	10	66.67	6	40.00
Mean %	T		3.16		4.02		0.00
All Ss	D		16.17		13.32		42.66
	C		80.67		82.66		57.34

Table 6. L-S# (word final liquid plus voiceless stop)

[-voi]

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	0	0.00	6	20.00	4	13.33
S1	D	1	50.00	9	30.00	7	23.33
	C	1	50.00	15	50.00	19	63.33
	T	0	0.00	0	0.00	0	0.00
S2	D	3	21.42	10	33.33	2	6.67
	C	11	78.57	20	66.67	28	93.33
	T	0	0.00	0	0.00	0	0.00
S3	D	4	33.33	7	23.33	2	6.67
	C	8	66.67	23	76.67	28	93.33
	T	0	0.00	0	0.00	2	6.67
S4	D	3	42.86	13	43.33	10	33.33
	C	4	57.14	17	56.67	18	60.00
	T	0	0.00	0	0.00	0	0.00
S5	D	2	33.33	11	36.67	5	16.67
	C	4	66.67	19	63.33	25	83.33
Mean %	T		0.00		4.00		4.00
All Ss	D		36.12		33.32		17.35
	C		63.81		62.68		78.65

Table 7. L-S# (word final liquid plus voiced stop)
[+voi]

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	1	50.00	2.5[3]	10.00	3.5	14.00
S1	D	1	50.00	6.5	26.00	13.5	54.00
	C	0	0.00	16	64.00	8	32.00
	T	3	30.00	0	0.00	0	0.00
S2	D	6	60.00	9	36.00	5	20.00
	C	1	10.00	16	64.00	20	80.00
	T	0	--	0	0.00	1	4.00
S3	D	0	--	7	28.00	11	44.00
	C	0	--	18	72.00	13	52.00
	T	0	0.00	0	0.00	1	4.00
S4	D	1	25.00	5	20.00	10	40.00
	C	3	75.00	20	80.00	14	56.00
	T	0	0.00	0	0.00	0	0.00
S5	D	4	25.00	4	16.00	13	52.00
	C	12	75.00	21	84.00	12	48.00
Mean %	T		20.00		2.00		4.40
All Ss	D		40.00		25.20		42.00
	C		40.00		72.80		53.60

Table 8. 0-0# (final voiceless obstruent clusters)

[-voi] [-voi]

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	0	0.00	3	6.67	0	0.00
S1	D	0	0.00	14	31.11	5	11.11
	C	9	100.00	28	62.22	40	88.89
	T	3	9.67	7	15.56	0	0.00
S2	D	2	6.45	4	8.89	1	2.22
	C	26	83.87	34	75.56	44	97.78
	T	0	0.00	2	4.44	0	0.00
S3	D	2	22.22	2	4.44	0	0.00
	C	7	77.78	41	91.11	45	100.00
	T	0	0.00	3	6.67	0	0.00
S4	D	1	11.11	3	6.67	0	0.00
	C	8	88.89	39	86.67	45	100.00
	T	0	0.00	0	0.00	0	0.00
S5	D	2	6.45	0	0.00	0	0.00
	C	29	93.55	45	100.00	45	100.00
Mean %	T		1.93		6.68		0.00
All Ss	D		9.25		10.22		2.66
	C		88.82		83.22		97.34

Table 9. 0-0# (final voiced obstruent clusters)

[+voi] [+voi]

(T = Transfer, D = Developmental, C = Correct TL production)

		Conversation		Text		Word List	
		n	%	n	%	n	%
	T	0	0.00	6	17.14	0	0.00
S1	D	1	100.00	15	42.86	26	74.29
	C	0	0.00	14	40.00	9	25.71
	T	0	0.00	14	40.00	2.5	7.14
S2	D	0	0.00	2	5.71	7.5	21.43
	C	3	100.00	19	54.29	25	71.43
	T	0	--	13	37.14	2	5.71
S3	D	0	--	13	37.14	24	68.57
	C	0	--	9	25.71	9	25.71
	T	0	--	0.5	1.43	0	0.00
S4	D	0	--	13.5	38.57	24	68.43
	C	0	--	21	60.00	11	31.43
	T	0	--	0	0.00	0	0.00
S5	D	0	--	6	17.14	22	62.86
	C	0	--	29	82.86	13	37.14
Mean %	T				19.14		2.57
All Ss	D	(n= 4 only)			28.28		59.14
	C				52.57		38.28

Table 10. Analysis of Variance for Patterns of T, D, and C.

		F value	PR > F
	T	9.84	0.0070
#F-S	D	1.00	0.4096
	C	7.72	0.0136
	T	6.14	0.0242
#O-L	D	0.72	0.5136
	C	3.64	0.0750
	T	0.77	0.4928
S#	D	1.00	0.4096
[-voi]	C	0.17	0.8436
	T	0.84	0.4658
S#	D	5.42	0.0326
[+voi]	C	2.57	0.1372
	T	1.16	0.3616
L-S#	D	11.01	0.0050
[-voi]	C	9.61	0.0075
	T	3.03	0.1125
L-S#	D	1.96	0.2107
[+voi]	C	2.29	0.1717
	T	6.01	0.0255
O-O#	D	0.94	0.4311
[-voi] [-voi]	C	2.34	0.1582

		F value	PR > F
	T	4.44	0.0779
0-0#	D	3.24	0.1254
[+voi] [+voi]	C	0.63	0.5721

Table 11. Analysis of Variance for Interaction of T and D.

		F value	PR > F
1	#F-S	10.81	0.0053
2	#0-L	3.54	0.0792
3	S# [-voi]	1.58	0.2648
4	S# [+voi]	7.95	0.0125
5	L-S# [-voi]	6.71	0.0195
6	L-S# [+voi]	2.44	0.1573
7	0-0# [-voi] [-voi]	0.34	0.7225
8	0-0# [+voi] [+voi]	21.78	0.0034

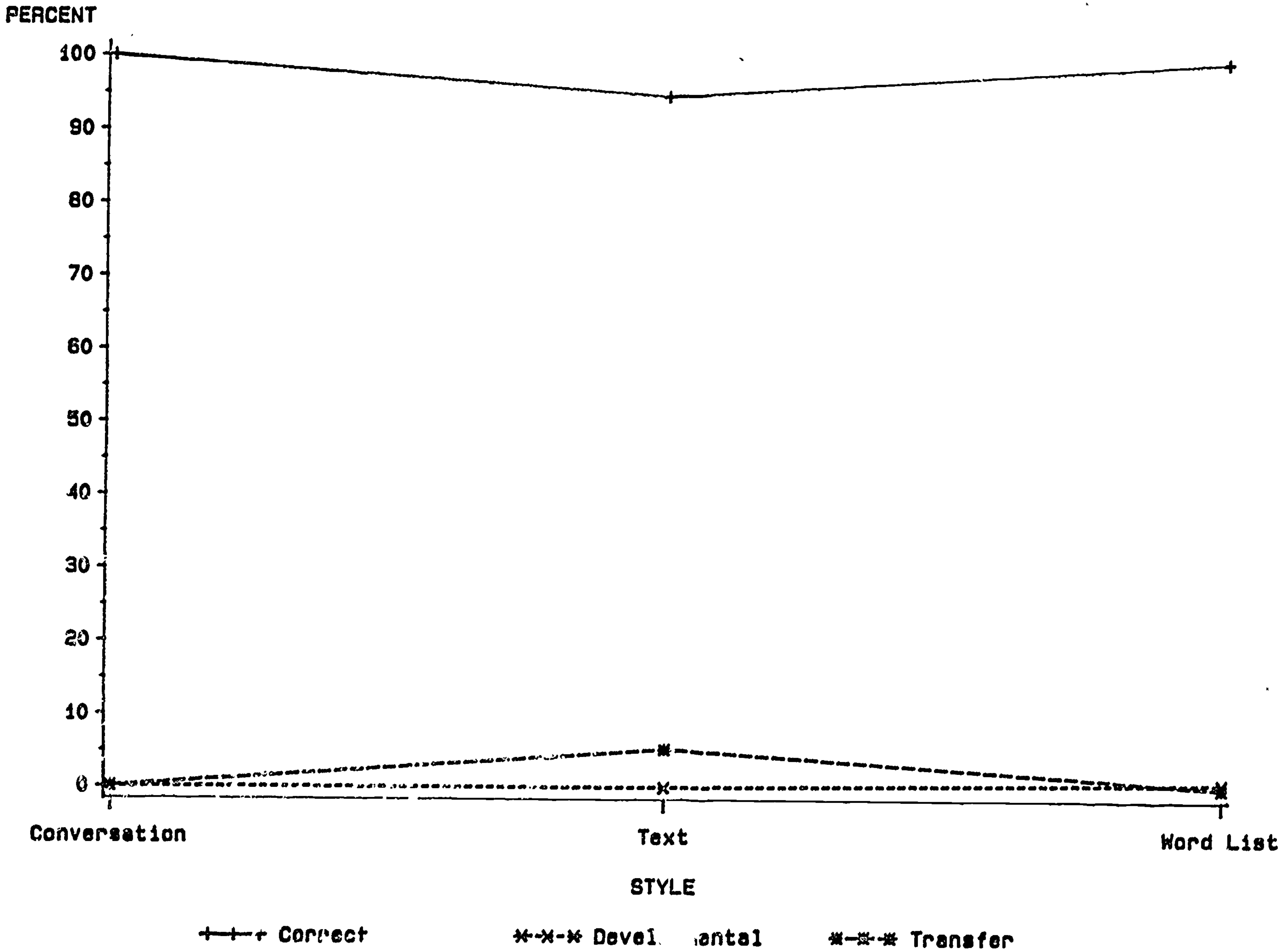

Figure 1. ØF-S (word initial fricative plus stop)

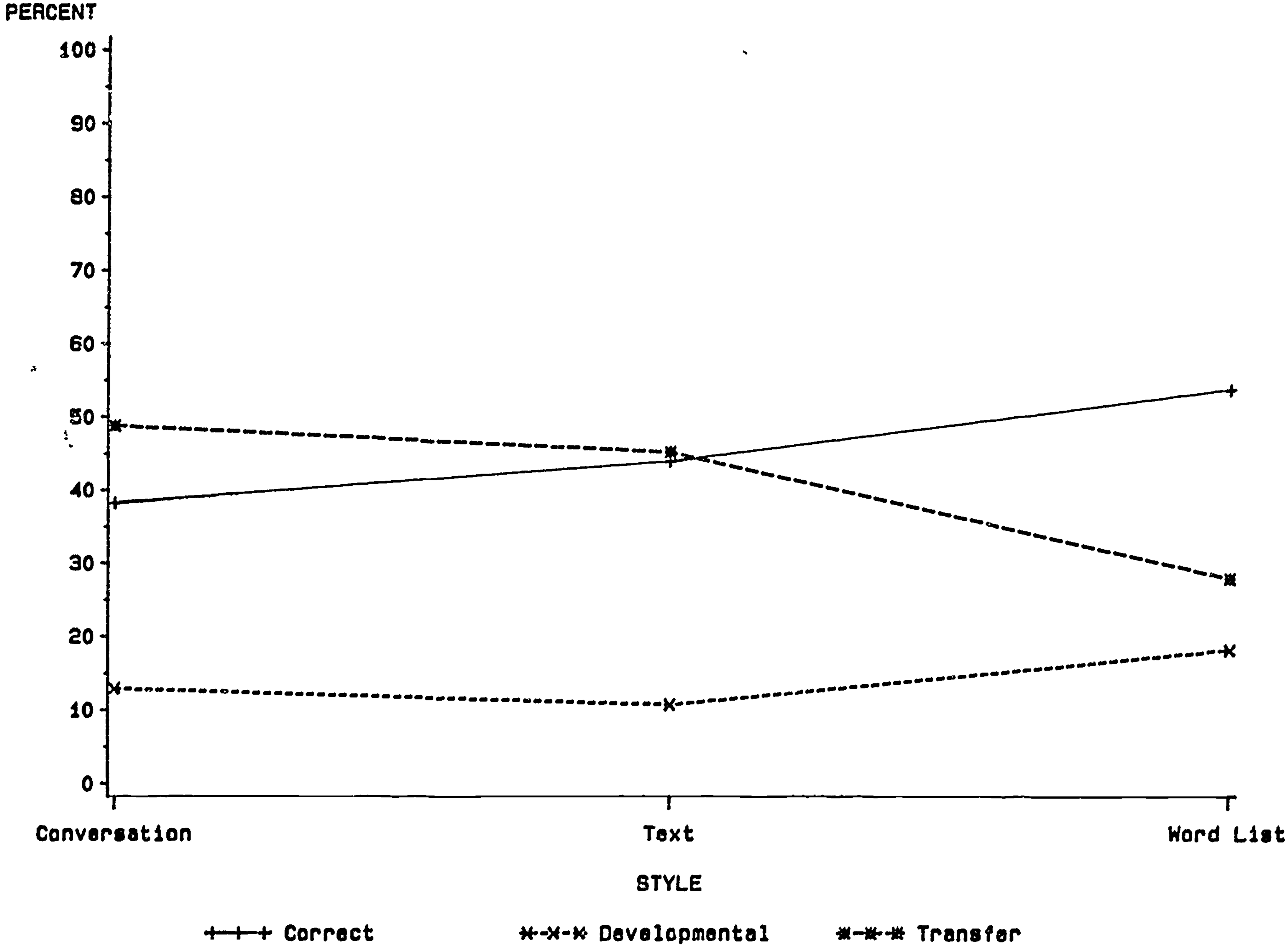

Figure 2 #O-L (word initial obstruent plus liquid)

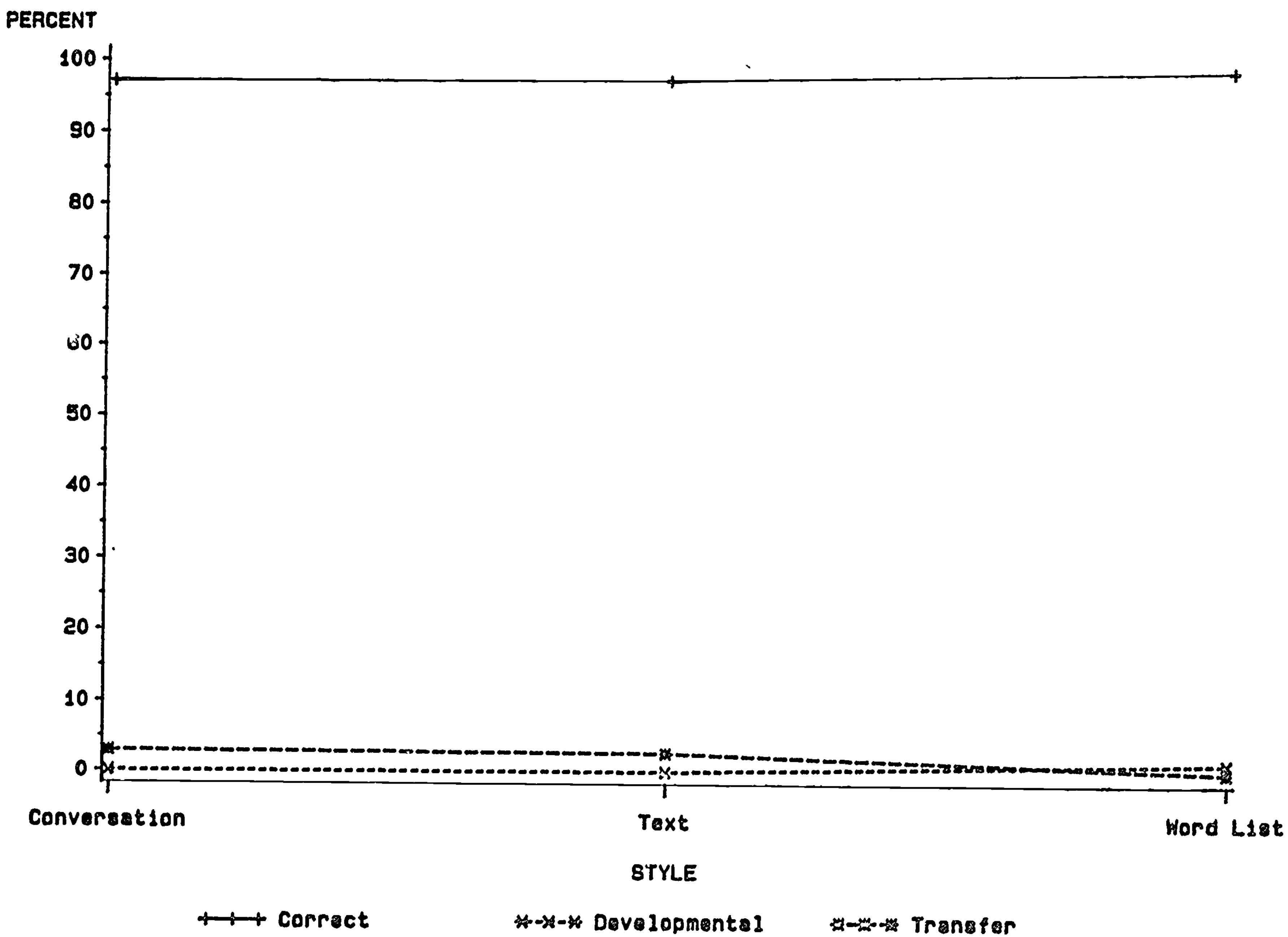

Figure 3 S# [-voi] (word final voiceless stop)

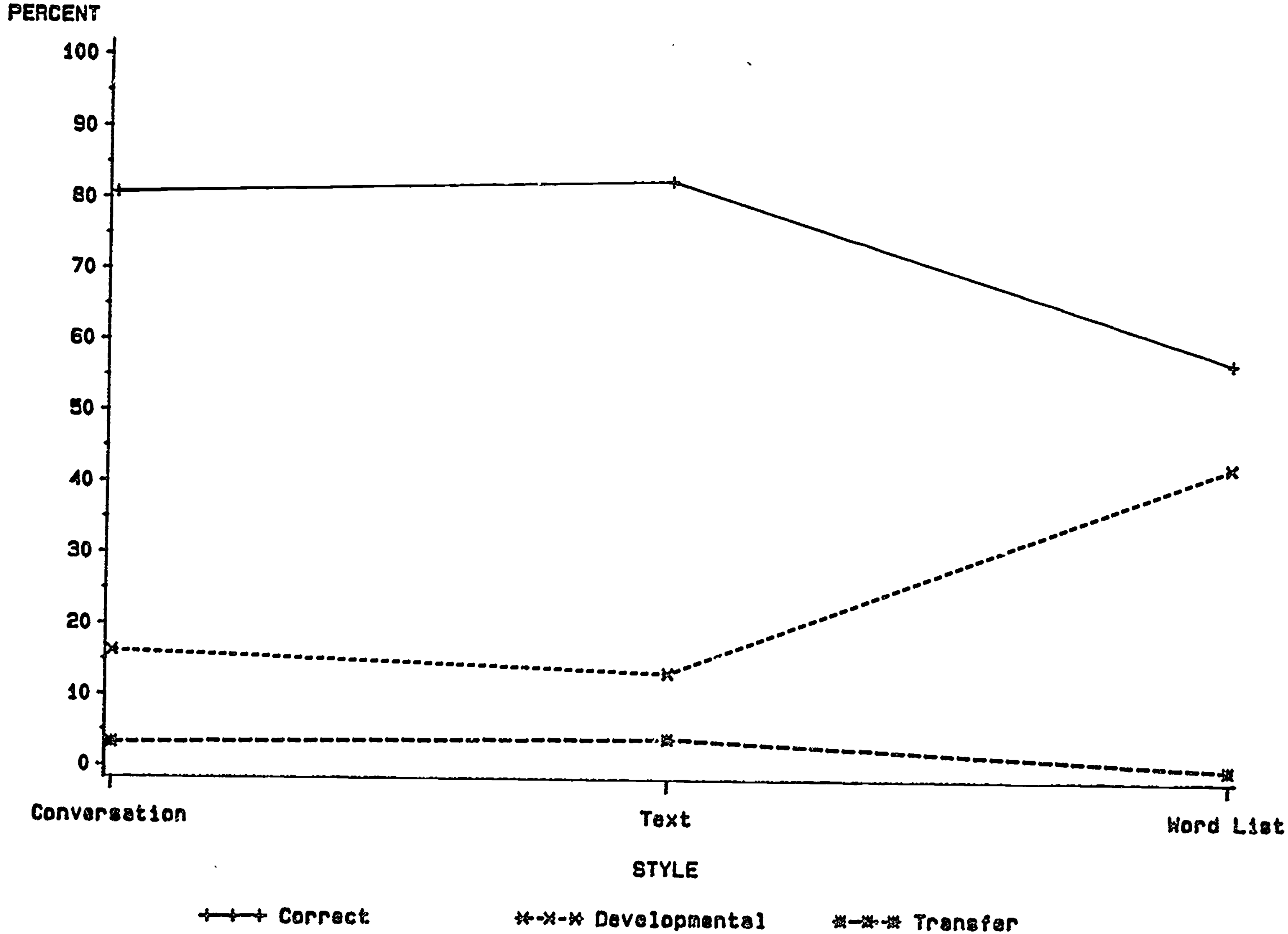

Figure 4 S# [+voi] (word final voiced stop)

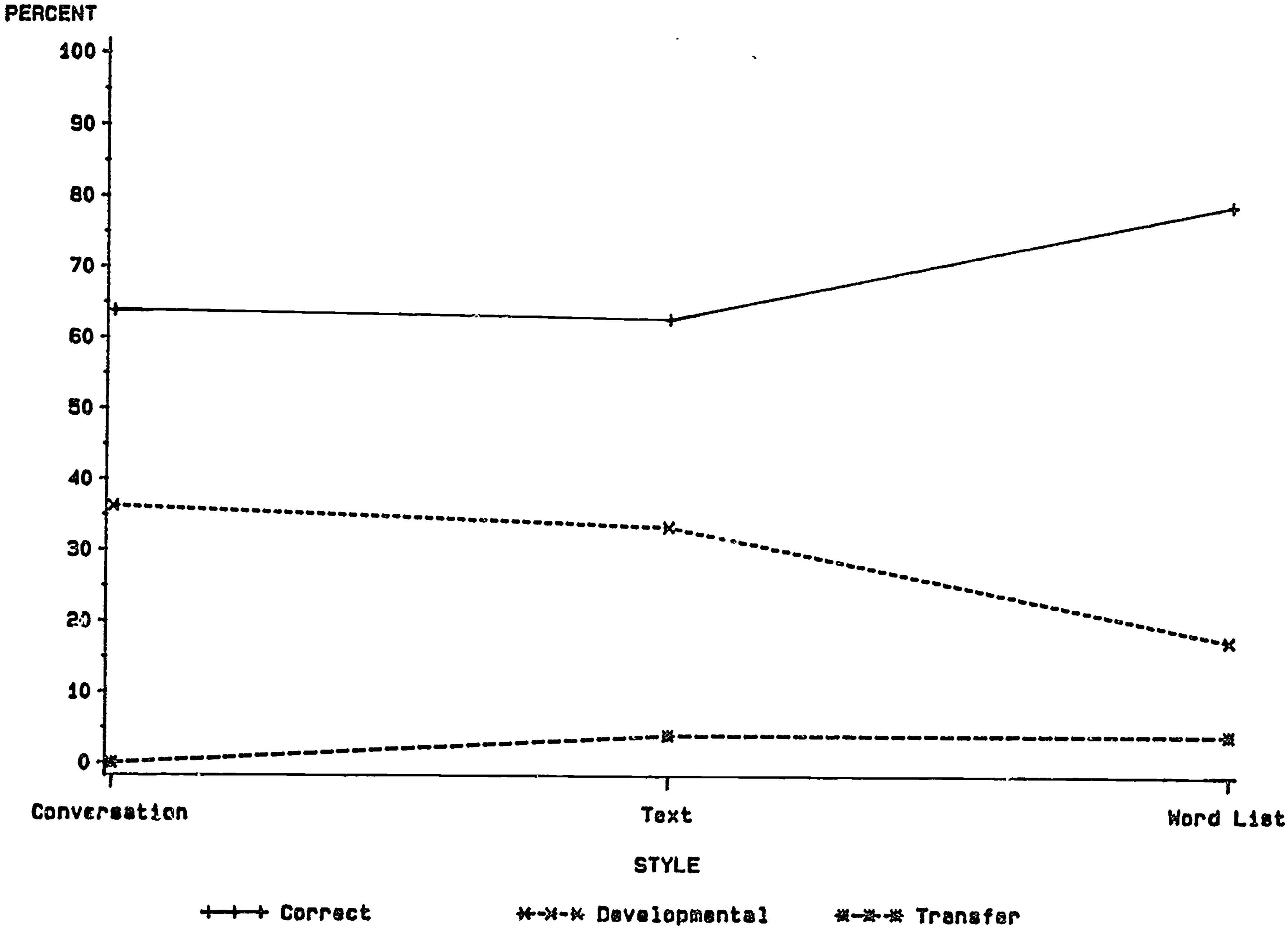

Figure 5 L-S# [-voi] (word final liquid plus voiceless stop)

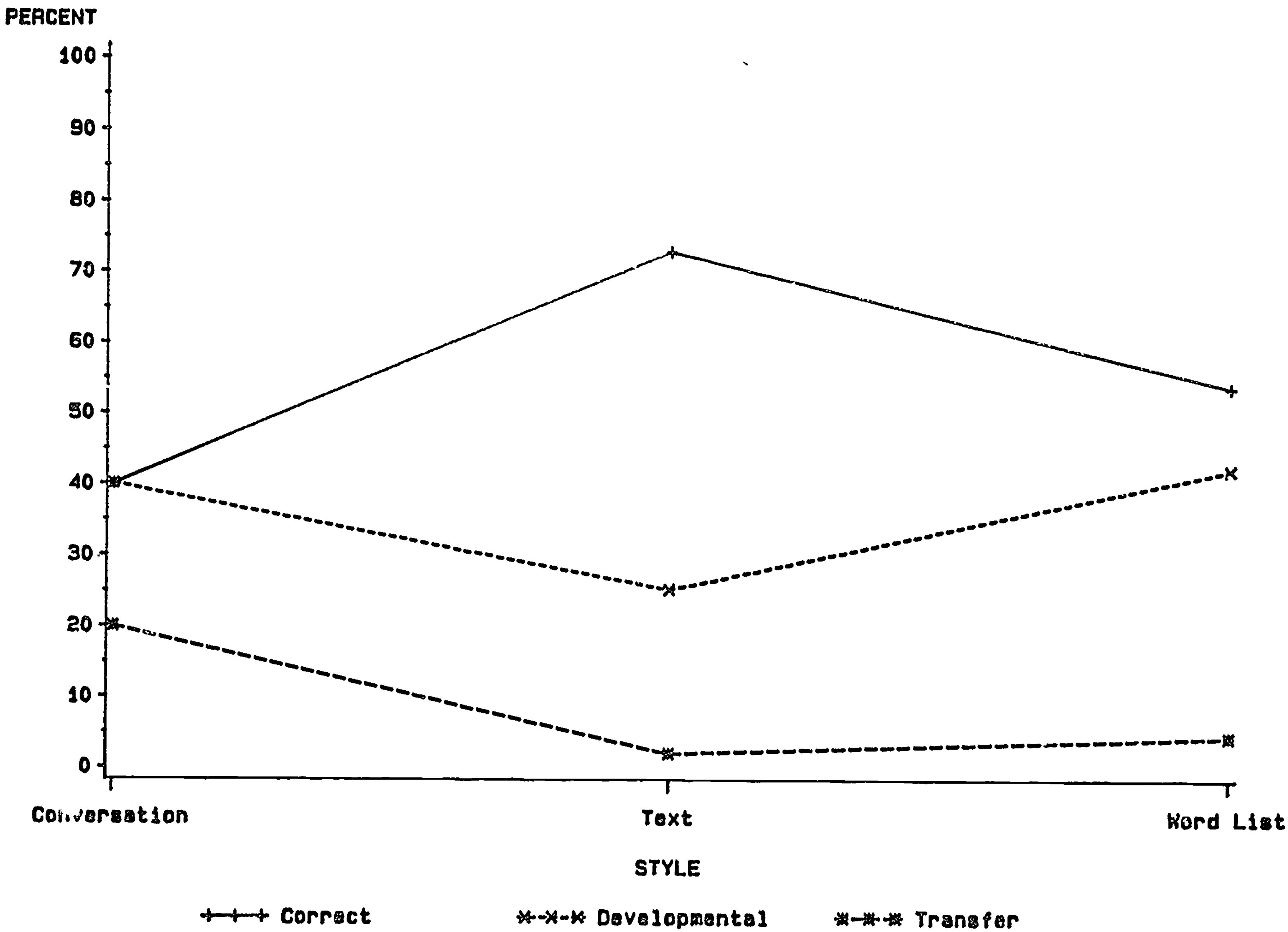

Figure 6 L-S# (word final liquid plus voiced stop)
[+voi]

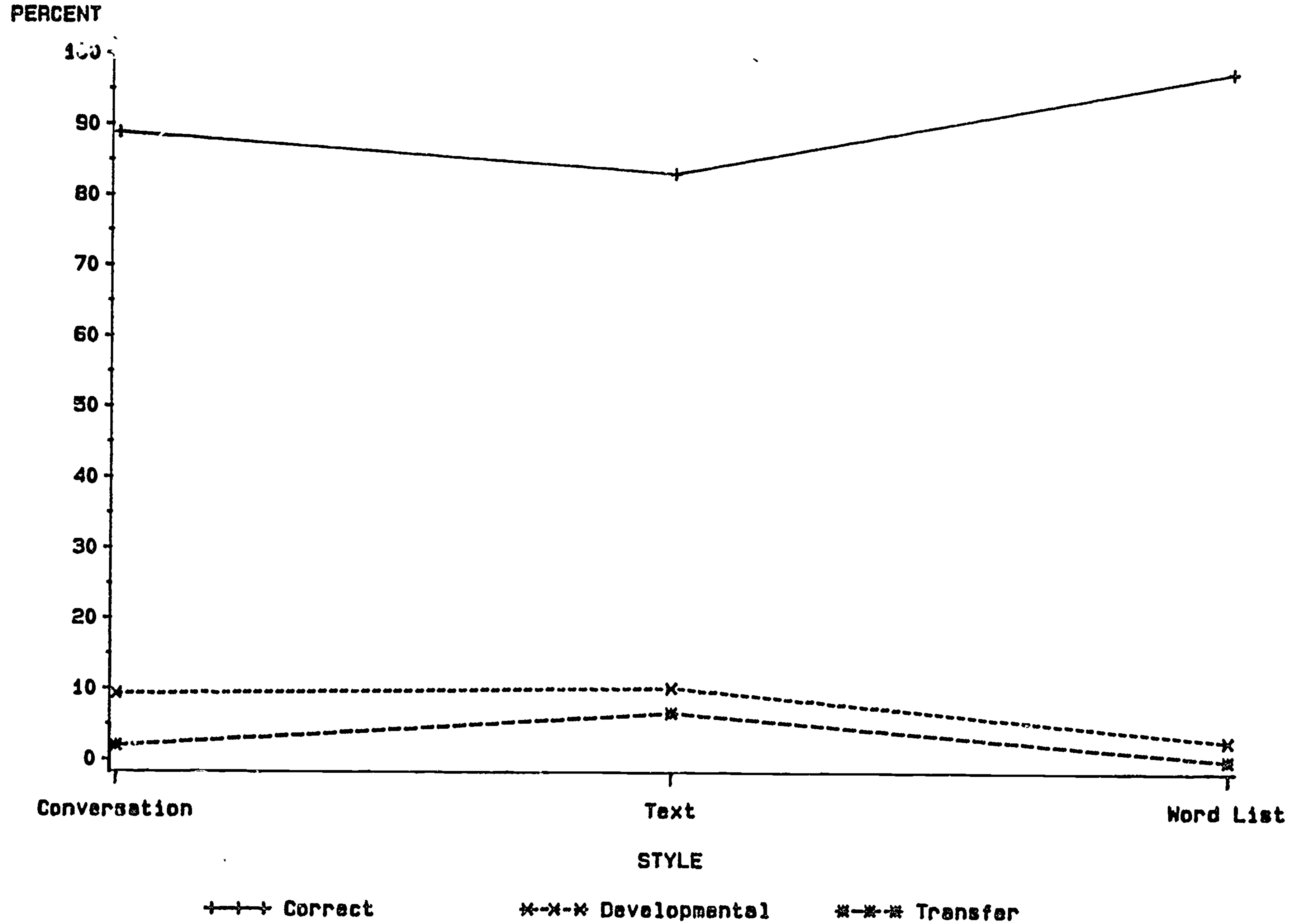

Figure 7 O-O# (final voiceless obstruent clusters)
[-voi] [-voi]

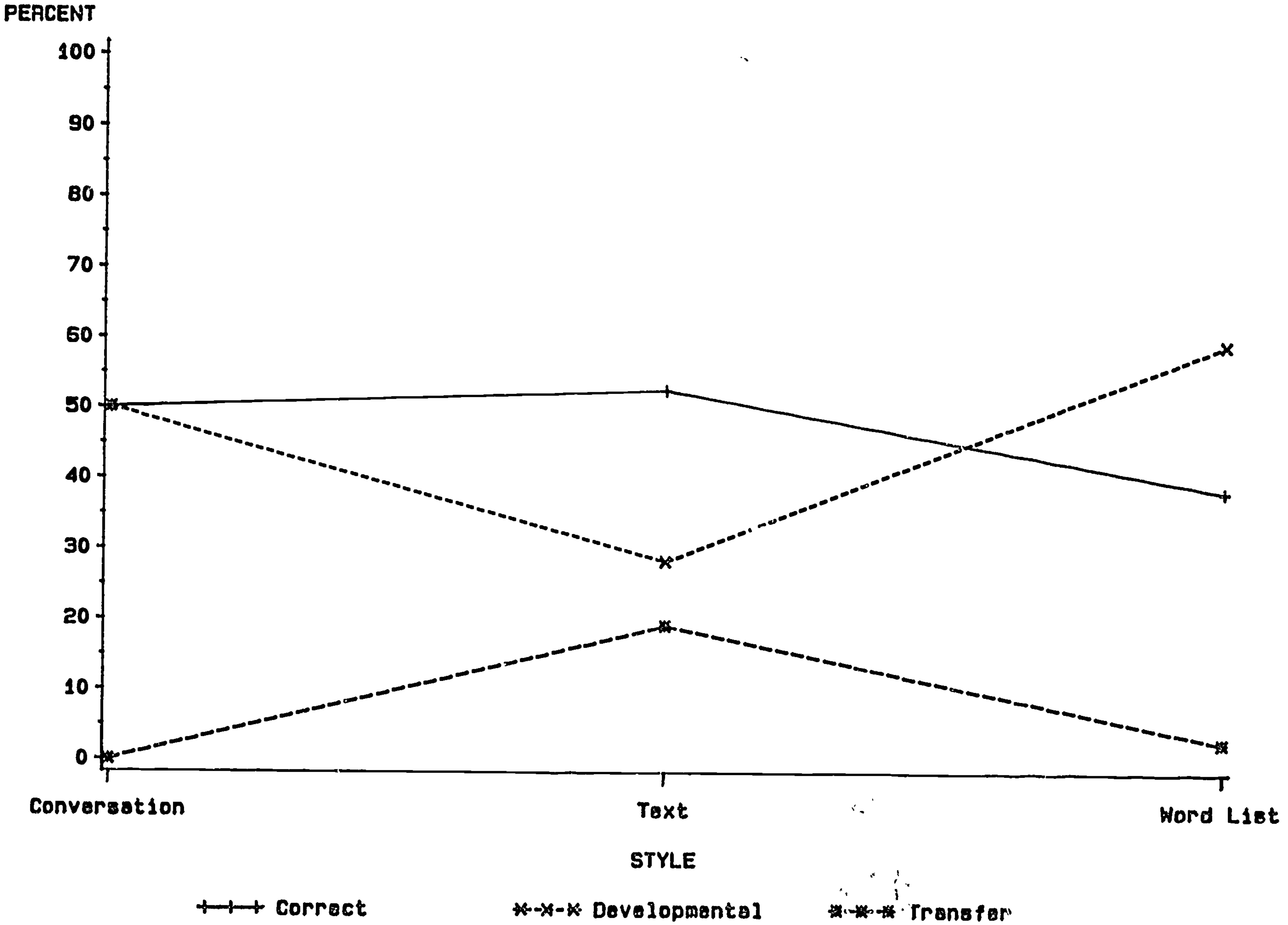

Figure 8 O-O# (final voiced obstruent clusters)
[+voi] [+voi]

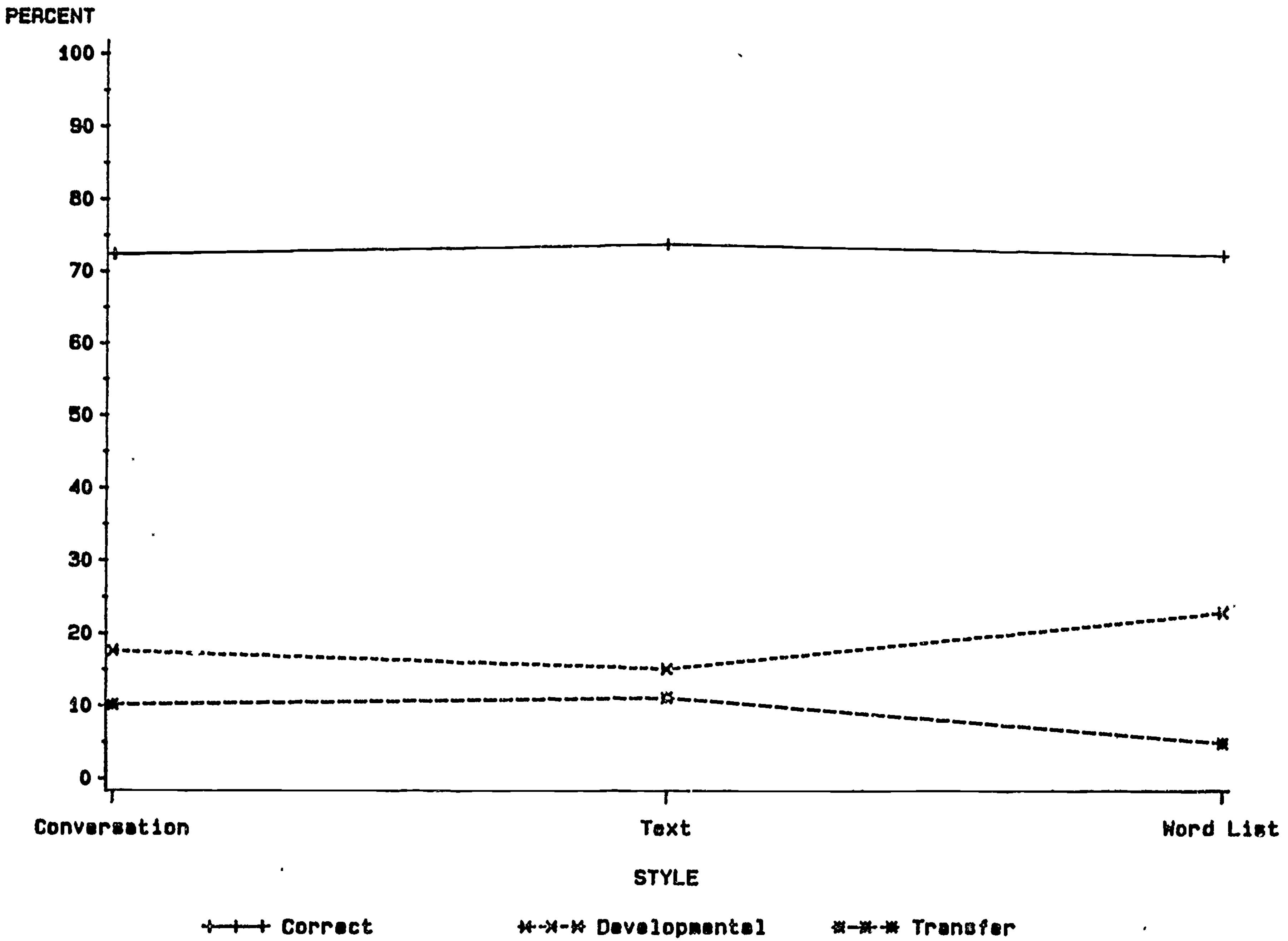

Figure 9. Summary of Phenomena

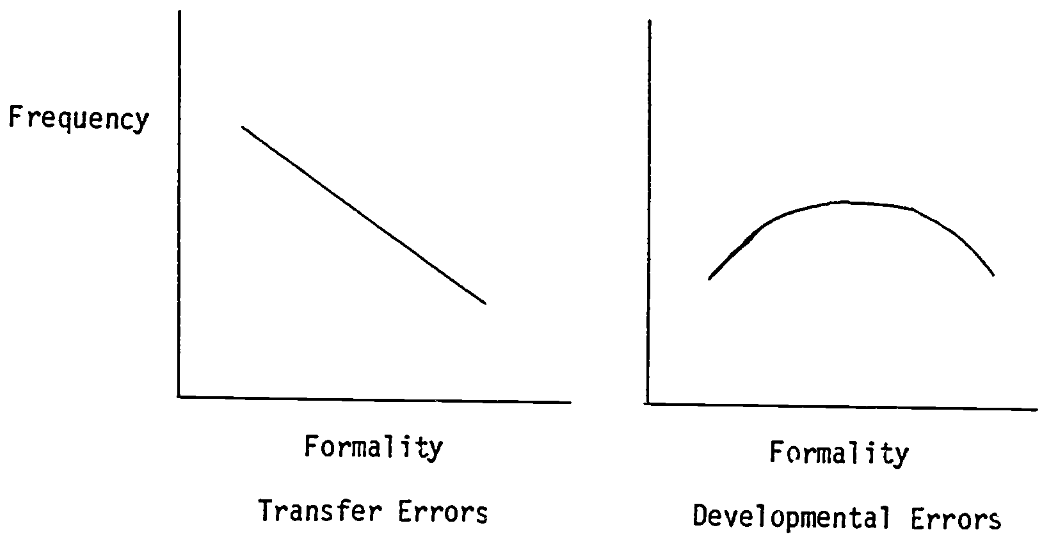

Figure 10. Claims of the Ontogeny Model