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ABSTRACT

This study investigated the effect of multilingual linguistic experience on the perception of Japanese durational contrast by learners of Japanese as a foreign language at the basic level. Five monolingual and five multilingual learners listened to recorded sentences containing the utterances /iken/ or /ikken/ and were asked to identify which of the two utterances was employed in each sentence. Amongst the multilingual subjects, some spoke languages that utilize segmental durations phonemically, whilst some spoke languages that did not. Although the results indicated superior perceptual performance by multilingual learners over monolingual learners, there was no significant difference between the two types of multilingual subjects. The results support the hypothesis that not only specific but also non-specific, broadened linguistic experience can result in increased perceptual performance. Other results and their implications are discussed. (Contains 29 references.) (MDM)

L2 Perceptual Acquisition: The Effect of Multilingual Linguistic Experience on the Perception of a "Less Novel" Contrast

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L2 PERCEPTUAL ACQUISITION: THE EFFECT OF MULTILINGUAL LINGUISTIC EXPERIENCE ON THE PERCEPTION OF A "LESS NOVEL" CONTRAST

Kayoko Enomoto (DAL)

Abstract

This paper reports upon a small-scale L2 perception study on the acquisition of stop durational contrasts in Japanese. The study was designed to investigate the effect of specific vs. non-specific, broadened multilingual linguistic/perceptual experience on the learner's perceptual ability to discriminate between single and geminate stops in Japanese. To explore this, an identification test and an AXB discrimination test were conducted with two different types of multilingual adult learners of Japanese and their English-speaking monolingual counterparts. Amongst the multilingual subjects, some spoke languages which utilise segmental durations phonemically, whilst some spoke languages which do not. Whilst overall data from both tests indicated superior perceptual performance by the group of multilingual learners, there was no significant difference in perceptual performance between the two types of multilingual subjects. Thus, the results support the hypothesis that not only specific but also non-specific, broadened linguistic experience can result in increased perceptual performance. In addition, the overall pattern of performance by monolingual subjects was superior to the patterns reported in other studies, as well as indicating their existing perceptual sensitivities towards phonetic differences in the acoustic cue within the same category. These results and their theoretical implications are discussed.

1. Infant speech perception

Studies of speech perception by infants developed from research focussing on the relation of the speech signal to phonemes of language, most commonly concerned with stop consonants varying in voice onset time (VOT)[1]. Most work on infant speech perception has been designed to test L1 perception rather than cross-language perception. The classic experiment by Eimas et al. (1971) described the ability of infants to perceive speech signals as deriving from genetic predisposition. This nativistic view was subsequently challenged by the view that phonemic categories are determined by early linguistic experience in a particular language environment. In support of this proposition, Aslin et al. (1981) demonstrated that infants from an English-speaking environment can reliably discriminate an irrelevant VOT contrast, occurring within the same English-adult phonemic categories.

Following this pattern of findings, Eimas (1985), in his subsequent study, claims that human beings are endowed with innate perceptual mechanisms which facilitate the acquisition of a language.

> In the studies of speech perception by infants we have found these young subjects are richly endowed with innate perceptual mechanisms, well adapted to the characteristics of human language, that prepare them for the linguistic world they will encounter.
>
> (Eimas 1985:34)

This proposition derives from the view, advanced by Chomsky (1981), that innate knowledge and capacities underlie the use of language, whereby infants are born with innate perceptual capacities/sensitivities which enable them to discriminate between the universal set of phonetic distinctions, according to universal phonetic boundaries; if these perceptual mechanisms do represent an innate biological endowment, they should be universal. The same perceptual patterns should occur in infants of every linguistic background. For instance, it may be hypothesised that Japanese infants have an innate sensitivity towards the English /l/-/r/ distinction, whilst many studies (e.g. Goto 1971; Miyawaki et al. 1975; Mochizuki 1981) report that adult native Japanese speakers fail to perceive the contrast.

Thus, it may be argued that there is a decline or loss in initial perceptual capabilities after being exposed to a particular L1 which presents distinctions only in certain contrasts. To support this proposition, cross-language speech perception studies, focussing on the relation between infant and adult perceptual categories, have addressed the question of adult-infant differences by directly comparing their ability to discriminate non-native contrasts. For instance, Trehub (1976) showed that, whilst English-speaking adults achieved perfect accuracy with English contrasts, they were constantly confused with French and Czech contrasts. On the other hand, infants could differentiate both contrasts which they are not likely ever to have heard before. Furthermore, Werker et al. (1981) found such a developmental decline between infancy and adulthood.

2. The effect of linguistic experience

The findings from cross-language speech perception studies suggest the need for further inquiry with regard to the decline or loss of initial perceptual capabilities in adult speech perception.

2.1 The effect of training

Laboratory training studies have reported that, after intensive training, Japanese learners of English showed some success in improving the perception of /l/-/r/ (for discussion of the methods and tasks used in such training, see Gillette 1980; Strange and Dittmann 1984; Logan et al 1991). These studies on /l/-/r/ suggest that the training process requires intensive instruction and considerable time and effort, at least for some types of phonetic contrasts.

> It was concluded that modification of perception of some phonetic contrasts in adulthood is slow and effortful, but that improved laboratory training tasks may be useful in establishing categorical perception of these contrasts.
> (Strange and Dittmann 1984: 131)

Likewise, MacKain et al. (1981), in a cross-sectional study, also found that intensive conversational instruction with native speakers correlated with improved perception of /l/-/r/ by Japanese learners of English, although the perception of the experienced-Japanese group was not yet native-like. On the other hand, other training studies employing synthetic VOT continua in general showed rapid improvement with relatively little training (e.g. Pisoni et al. 1982; McClaskey et al. 1983).

These results, taken as a whole, may be interpreted as indicating that innate perceptual mechanisms which formerly enabled infants to make universal distinctions are still available to adults and operate in adulthood after a long period of not being used. This confounds the hypothesis that early L1 experience 'immutably' changes some of the speech perception mechanisms. Whilst early experience/exposure to a particular language environment has an important role to play in restricting initial perceptual capabilities in early childhood, such linguistic restrictions in L1 do not completely inactivate unused innate perceptual mechanisms. In other words, already-established adult perceptions of speech can be modified by later linguistic experience in adulthood.

With regard to apparent discrepancies between results from VOT and /l/-/r/ training studies, i.e. why the modification of perception of the /l/-/r/ contrasts by Japanese adults appears to be more difficult than modification of VOT perception by English-speaking adults, Strange and Dittmann (1984) suggest three possible reasons: 1) L1 allophone-related experience, 2) intrinsic difficulty of the phonetic variation based on language universals, and 3) complexity of acoustic parameters.

2.2 Decline and age

A study by Werker and Tees (1983) investigated non-native speech perception (two Hindi speech contrasts) across childhood (4, 8 and 12 years), in order to determine if the decline between infancy and adulthood in non-native perceptual abilities occurs around puberty, as suggested by Lenneberg (1967). Their results show that the decline is evident by 4 years of age, suggesting that important reorganisations in linguistic perceptual abilities occur in early childhood. Furthermore, they report the relative recovery of discrimination by age 8 for the VOT contrast. This confounds simple maturational explanations, suggesting that non native speech discrimination does not decline in a gradual linear fashion across development. To explain this, they note that 8 and 12-year olds are more capable of adopting task-specific perceptual strategy, whereas 4-year olds are 'simply rigid rule followers (as has been shown in other cognitive tasks, cf. Kogan 1974)... (Werker and Tees 1983: 285)'

2.3 The nature of decline

Werker and Tees (1984) provide evidence that age-related decline and modification in non native speech perception represents a shift in attentional focus/cognitive reorganisation of perceptual processes, not sensory-neural loss. Werker and Tees (1984) and Werker and Logan (1985) found that adult English speakers' performance in discriminating the non-native phonetic distinctions was greater than predicted by chance

when using very sensitive procedures. It was also shown that the adults could not use their sensory capacity in speech perception tasks which required the categorising of full syllables or memory demand, i.e. the ability to discriminate non-native distinctions remained at an acoustic level, and had not been completely lost. Werker (1986) summarised these findings, stating that

> It thus appears that initial phonetically relevant sensitivities are maintained and reorganised into functional phonologic categories if the language to which a child is exposed uses those phones to contrast meaning. The initial phonetically relevant sensitivities that are not exercised do not disappear; rather they become inaccessible for use in a language processing context.
>
> (Werker 1986:142)

2.4 The effect of multilingualism

Research on the effect of multilingual linguistic experience has investigated whether experience with specific stimuli is necessary to maintain/acquire the ability to perceive such specific stimuli or if broadened/non-relevant experience facilitates perception of stimuli in general.

Tees and Werker (1984) conducted a study with three groups of English-speaking adults: L2 learners who had been studying Hindi for 1 year, L2 learners who had been studying Hindi for over 5 years, and those who had early experience of hearing Hindi but no further exposure: these three groups were compared on their ability to distinguish the Hindi voicing (voiceless aspirated/breathy-voiced) and the Hindi place-of-articulation (retroflex/dental) contrast. The group of monolingual English speakers who were exposed to Hindi during the first 1.5-2 years of life (but who could neither speak nor understand more than a few words) could discriminate both Hindi contrasts as adults, suggesting that 'specific' linguistic experience early in life may contribute to maintaining the ability to discriminate phonetic distinctions, even when they have lost the ability to speak or understand Hindi.

The results from Tees and Werker's study provided the hypothesis that, if the developmental reorganisation in speech perception is mediated by specific rather than general linguistic experience, non-relevant multilingualism should not facilitate non-native perception. To test this hypothesis, Werker (1986) compared multilingual adult subjects with monolingual English-speaking adults on their ability to discriminate phonetic distinctions not used in (any of) their native language(s): the Hindi retroflex/dental (syllable) distinction and the Thompson glottalised velar/glottalised uvular (syllable) distinction. Her results have verified that broadened non-specific linguistic experience does not contribute to increased 'perceptual flexibility'.

Apart from the above findings, Tees and Werker's study also demonstrated that the monolingual English students with no exposure to Hindi performed better for the voicing contrast than for the place-of-articulation contrast. Furthermore, they report that, whilst a short term intensive training resulted in an improved performance of adults in discriminating the voicing contrast, this was not the case for the place-of-articulation. With regard to this point, Tees and Werker proposed the allophone-related 'stimulation history' of individuals in L1.

> Consequently, we believe that the critical difference between our two contrasts involves the stimulation history of our subjects. The evidence in the case of our key contrast involving a place-of-articulation (retroflex) which is seldom used even allophonically in English supports the idea that lack of stimulation did have a significant impact on our subjects' ability to categorise multiple natural exemplars of this Hindi contrast.
>
> (Tees and Werker 1984:588)

This suggests that some contrasts are easier to acquire than others, depending on one's allophone-related experience in L1. With regard to this, the effect of broadened/non-relevant linguistic experience tested in Werker's (1986) study was only limited to the perception of 'novel' contrasts (the two place-of-articulation Hindi contrasts), and thus the allophone-related stimulation history of the subjects would have been minimal. This leads to the more specific conclusion that broadened linguistic experience will not facilitate cross-language phonetic sensitivity towards 'novel' speech contrasts.

This begs the question, which was not addressed in their study, of the effect of multilingual experience on the perception of less 'novel' (or less alien) non-native contrasts, i.e. the investigation of whether broadened/non-relevant linguistic experience facilitates discrimination of non-native sounds that are not distinctive, but which do occur as allophones in certain contexts. This would provide a situation in which the required auditory experience has already been provided (unconsciously) as allophonic variants, with the subjects in a non-contrastive context

3. Phonetic background for Japanese durational contrasts

Japanese mora sounds /Q/, /N/, H represent one of the best known examples of learning difficulties for L2 learners of Japanese. Thus, the duration of geminate consonants/vowels in Japanese has often been discussed, not only by linguists but also by teachers/learners of Japanese for theoretical and pedagogical reasons. Native Japanese speakers may still detect some kind of 'foreignness' in the speech production of experienced speakers of Japanese, due to their imperfect timing of the geminate vs single contrasts.

The Japanese geminate consonants consist of sound sequences of two identical sounds (e.g. [pp], [tt], [kk]. The mora obstruent 'Q' is realised as the first part of such geminate consonants and its phonetic realisation is conditioned by the subsequent voiceless consonant. The presence/absence of the mora 'Q' has a phonemic distinction, e.g. /i'ken/ 'opinion' and /i'kken/ 'one house'. In other words, phonemic contrast is realised by a difference in duration of the stop gap, preceding the plosion, although the duration of the Japanese mora sounds itself has been controversial in studies in phonetics/phonology (e.g. Han 1962; Homma 1981; Fukui 1978, Beckman 1982; Han 1992)

Japanese is a language which utilises duration to distinguish meaning. Examples of such variations exist in other languages: long vowels contrasts with short ones in Arabic and long consonants contrast with short ones in Italian. In Japanese and Italian, long consonants occur within a morpheme boundary, whilst in English long consonants exist only across word- or morpheme-boundary as in "white tie" and "unknown" respectively

This area of contrast between Japanese and English provides the experimental conditions whereby English native speakers have already had experience with long consonants in a non-contrastive context in L1. Thus, perception research with a multilingual group consisting of multilingual speakers of Italian-English (Italian uses short/long consonants phonemically), English-Arabic (Arabic uses long and short vowels phonemically), German-English and French-English, would enable us to see the effect of both specific and non-relevant multilingual experience on the perception of the Japanese durational (short/long) contrast. This less 'novel' contrast in Japanese may be easier for English-speaking learners to recover than, for example, the Hindi 'novel' contrasts tested in the previous studies.

4. Method

The present study was designed in order to investigate the effect of multilingual linguistic experience on the perception of the Japanese durational contrast, which is not strictly 'novel' to English-speaking learners of Japanese, as geminate consonants do occur across word and morpheme-boundaries in English. To examine the effect of both specific and broad-ned/non-specific multilingual language experience on the perception of the less 'novel' non-native contrast, perceptual identification and AXB discrimination data from the different types of multilingual adult learners of Japanese was compared to those from English-speaking monolingual counterparts. Likewise, the data within the multilingual group was also compared.

The experiment focused on L2 learners' judgment on durational differences between a minimal pair of words /iken/ and /ikken/, which only differed in their stop gap duration. Such data represented perceptual categories for the presence/absence of the Japanese mora sound/Q/.

4.1 Subjects

10 learners of Japanese at the elementary level, with normal hearing, were tested in the present experiment: 5 multilingual and 5 monolingual subjects. The multilingual group consisted of bilingual (except one who is trilingual) subjects, who were learning Japanese. These multilingual subjects have learned/acquired their L2/L3 as adults and have achieved almost native-like fluency and command of those languages. On the other hand, the monolingual group consisted of all English-speaking subjects, who claimed to 'speak' no other languages (Table 1).

When the testing was conducted, all the subjects had received a nearly identical quantity of Japanese language classroom instruction from a native Japanese teacher for one academic year at British tertiary institutions (7 out of 10 subjects were my own students). Prior to the testing, a language experience questionnaire was conducted from which it emerged that they had the same level of Japanese language experience: they had never been to Japan and their interaction with native Japanese speakers and use of Japanese was limited to the classroom only.

Table 1: Subject descriptions

Multi-lingual subjects	L1	L2/L3	Mono-lingual subjects	L1
S1	Italian	English	S6	English
S2	French	English	S7	English
S3	German	English	S8	English
S4	English	Italian	S9	English
S5	English	Spanish Arabic	S10	English

4.2 Materials and stimuli

Three male native speakers of Tokyo Japanese were asked to read 34 minimal pairs of works with regard to /Q/, /N/ and /R/, in a carrier sentence "Sorewa desu." ("It is _ _.") twice, and individual recordings were conducted with high quality recording facilities in a sound-proofed recording studio. Amongst all the recordings, the utterances carrying the minimal pair of /iken/ and /ikken/ which were read by a thirty nine year old male speaker, were chosen as his utterances sounded the most natural and fluent in all respects.

These utterances were subsequently digitised on a SunSPARCstation1, with the sampling rate of 16kHz. Quantification was carried out by means of an analog-to-digital (A/D) and digital-to-analog (D/A) converter [2]. Sampling was done at a 16-bit resolution using an Ariel S32C Model 656 linked to an Ariel S32C digital signal processing board. At the same time, the Proport was equipped with digital anti-aliasing filters

Following this, the decision was made to lengthen the utterance /Sorewa iken desu/ by inserting the duration of silence (i.e. the stop gap) preceding the plosion, using the software, the waves+/ESPS (Entropic Signal Processing Software). In this way, from the original utterance 10 synthetic sentence-stimuli were generated by inserting the duration of 10 msec. silence increments along the durational continuum (Figure 1).

For the identification test, each sentence-stimulus was recorded singly on a cassette tape recorder (MARANTS stereo cassette recorder cp430), with 10 seconds, which were inserted after each of 1. separate randomisations of 10 stimuli. Thus, the identification test consisted of 10 blocks and each block presented a different order of the same 10 stimuli. In total, 100 (10 X 10) stimuli were presented to the subjects.

The AXB test consisted of 5 blocks and one block consisted of 14 trials which were randomised within each block. 14 trials represented 2 AXB orders X 7 possible pairings of stimuli differing by 3 steps along the durational continuum (i.e. 1-4, 2-5, 3-6, ..., 7-10) The AXB test was recorded by inserting an inter stimulus interval of 1 second, an inter-trial interval of 3 seconds, and inter-block interval of 10 seconds.

4.3 Procedures

The recorded stimuli were presented to the subjects through headphones, at a comfortable listening level using a language laboratory system (Tandberg, TCR 5600)

Prior to the testing, the subjects were instructed orally and a block of stimuli was presented before each test, for the purpose of familiarisation, so that the subjects were informed about what to do in each test. The subjects were asked to indicate their duration judgments by marking 'iken' or 'ikken' on an answer sheet in the first identification test and in the following AXB test, they were asked to indicate whether the second stimuli (X) matched the first (A) or the third (B) for every trial of such a triad. They were asked to answer immediately after listening to each trial, and to guess the answers in the case of uncertainty. It took approximately 10 minutes to complete the identification test and 15 minutes the AXB test, including oral instructions and a practice block before each test.

5. Results and discussion

The perceptual data obtained from the identification test and the AXB discrimination test are shown in the following graphs. On the basis of the scores obtained from the identification test, the calculation of predicted AXB discrimination function was computed using the formula: $Pcorr[A, B] = 1/2[1 + (Pa-Pb)^2]$.

Figures 2 and 3 show that the overall performance by the multilingual group is superior to the overall perceptual performance by the monolingual learners in both identification and AXB discrimination tests. Having plotted the means for each group (Figures 4,5 and 6), the comparison of the three groups was conducted on three-way Anova by using a model with one grouping factor (Type = 3 levels) and two within-factors (repeated measures) (Function = 2 levels x Stimulus-Pair = 7 levels). The results revealed that all the main effects were significant (Table 2):

Table 2 Three way Analysis of Variance

Type	$F(2, 7) = 13.19$	$p = .004$*
Function	$F(1, 7) = 6.23$	$p = .041$*
Pair	$F(6, 42) = 4.61$	$p = .001$*
Type by Function	$F(2, 7) = 3.88$	$p = .074$
Type by Pair	$F(12, 42) = 1.58$	$p = .134$
Function by Pair	$F(6, 42) = 2.03$	$p = .083$
Type by Function by Pair	$F(12, 42) = 1.66$	$p = .112$

*$p < .05$ Function (Obtained vs. Predicted)

The comparisons of data between specific- and non-specific multilingual groups was conducted on three way Anova by using a model with one grouping factor (Type = 2 levels) and two repeated measures factors (Function = 2 levels x Stimulus-Pair = 7 levels). The Anova results revealed no significant difference in their perceptual performance, as the main effect of Type failed to reach the .05 level of significance, $F(1,3) = 1.63$, $p = .292$. Likewise, three-way Anova was conducted between specific-multilingual and monolingual groups, and between non-specific and monolingual groups. The results indicated the significant effect of Type in both cases, $F(1,6) = 19.70$, $p = .004$ and $F(1,5) = 9.42$, $p = .028$, respectively. Thus, these results support the hypothesis that not only the effect of specific but also the effect of non-relevant experience increases perceptual performance on the Japanese contrast, which is a 'less novel' contrast. The results have revealed more about the effect of non-relevant,

which reported no significant effect on the perception of 'novel' contrasts by non-relevant, broadened multilingual experience.

Secondly, with regard to the perceptual performance by the monolingual group, the overall pattern of data also revealed a categorical shape rather than a continuous trend which straddled the chance level in both tests. This seems to support the hypothesis that durational contrasts are easier to acquire (or recover) for English speakers than the Hindi place-of-articulation for English speakers or the English /l/- r/ contrast for Japanese speakers: Werker (1986) and MacKain et al. (1981) demonstrated poor performance by their "monolingual" and "not-experienced" groups (respectively) with much less categorical data straddling the chance level. Perhaps, because long consonants occur across word- and morpheme-boundaries in English, the explanations such as allophone-related "stimulation history" in English by the monolingual subjects, the intrinsic difficulty of these contrasts, or the complexity of parameters (in the case of the stop duration contrast, the parameter is the stop duration only) may be plausible for such an apparent difference between these studies in the (not-experienced) monolinguals' perceptual performance.

Finally, the AXB discrimination-obtained data from the monolingual learners also indicated their existing perceptual sensitivities towards phonetic differences in the acoustic cue, performing as well as the specific-multilingual group for the stimulus pair 7-10 (Figure 5). This seems to provide important theoretical implications, with regard to the mechanisms of speech perception. As the findings from infant and cross-language speech perception research suggest, these results may imply that innate perceptual mechanisms which provide us with perceptual sensitivities toward phonetic differences, are not inactivated completely after L1 acquisition, and that adults may still be able to access (or reactivate) their innate perceptual mechanisms to distinguish between phonetic distinctions that are not used in their L1, in adult L2 phonological acquisition

6. Conclusion

This paper has reported findings from the perceptual identification and discrimination performance of monolingual and two types of multilingual subjects with the same level of Japanese language learning experience. These perceptual experiments were designed to examine the effect of multilingual language learning experience on the perception of a Japanese durational contrast in the context of SLA.

The results substantiate claims in support of both the effect of specific experience and the effect of non-specific experience on increased perceptual performance with less alien or less novel contrasts. This, in its broad sense, conforms with Ben-Zeev's study (1977) on bilingualism in the area of cognition: In testing the hypothesis that 'highly bilingual children process syntactic rules with special flexibility' (Ben-Zeev 1977: 1009), she found that bilingual subjects are more advanced in the processing of verbal material, in the discrimination of perceptual distinctions. In addition, whilst showing a greater tendency to look for structure in perceptual situations, they were more able to reorganise their perceptions in response to feedback. Thus, she concluded that bilingualism may lead to increased cognitive flexibility.

In the area of speech perception, Werker (1986) demonstrated the effect of specific experience, but not of non-relevant experience on the perception of alien or novel

contrasts. However, it should be noted here that, in her study, the bilingual subjects were different from those tested in the present study, all her subjects having acquired their L2/L3 between the age of 5-8. In addition, all her subjects were not learning the language whose novel contrasts were tested, i.e. the language was not being learned in the context of SLA, unlike the present study. In this respect, these results may not necessarily be compatible with each other.

The results presented in this study lack empirical and theoretical generalisability because of the numbers of subjects tested: the effect of individual differences cannot be neglected in the interpretations of such a small corpus of data from 10 subjects in total. Thus, the findings presented must be regarded as preliminary and need to be verified/falsified by larger empirical investigations. Such research should shed light on the role of linguistic experience in the development/modification of perceptual categories in L2 phonological acquisition.

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Notes

1. Voice onset time is referred to as the interval occurring between the beginning of the release of air pressure and the onset of regular vocal cord vibration in the articulation of stop consonants, such as /p/-/b/ and /t/-/d/.
2. Analog-to-digital and digital-to-analog are standard terms used to describe the process of converting from cassette sound recordings to the numbers held in the computer, and converting the numbers back to sound so that we can listen to it and/or record it back to a cassette.

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Figure 1: Stop Duration of Stimuli 1 to 10

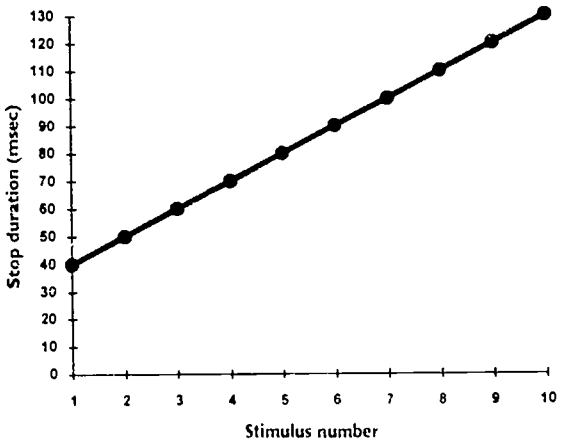

Figure 2: Identification Scores:
Monolingual vs. Multilingual Groups

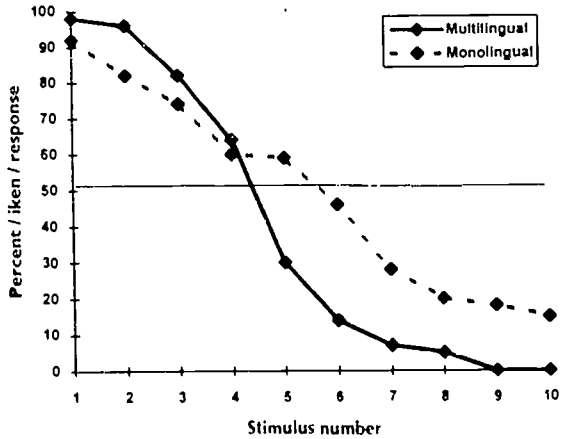

Figure 3: AXB Obtained Scores:
Monolingual vs. Multilingual Groups

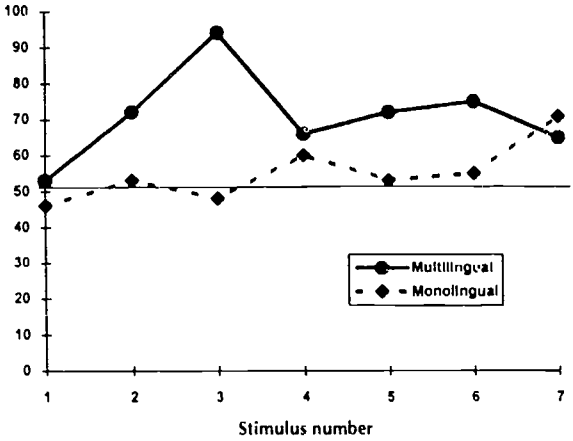

Figure 4: Identification Scores:
Monolingual vs. Two Types of Multilingual Groups

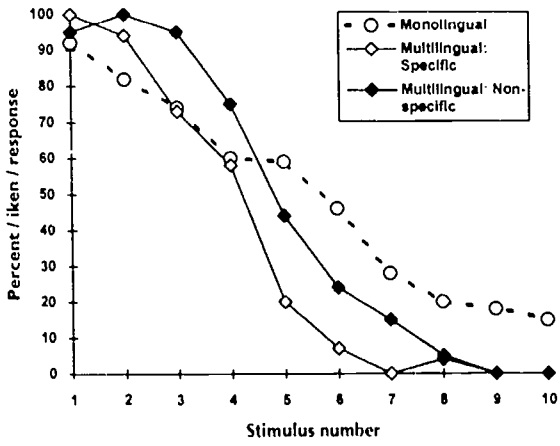

Figure 5: AXB Obtained Scores:
Monolingual vs. Two Types of Multilingual Groups

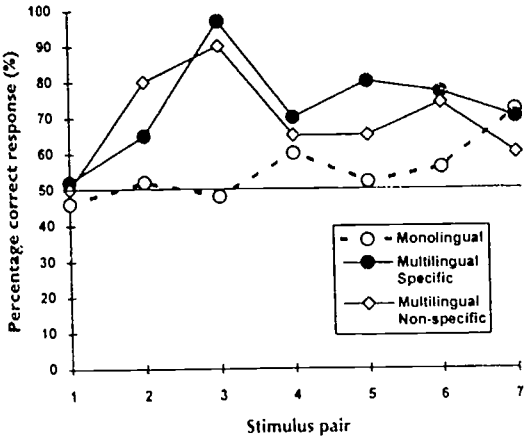

Figure 6: AXB Predicted Scores:
Monolingual vs. Two Types of Multilingual Groups