RECENCY EFFECTS FOR NATIVE AND NON-NATIVE LANGUAGE PRESENTATIONS[1]

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Lists of nine digits were presented auditorily to native speakers of Spanish and to native speakers of English. Speakers of each language group served in two conditions: digits presented in English and digits presented in Spanish. The normalized data showed significantly better recall for native language presentation only at the terminal list position. This difference between native and non-native presentations, commonly termed a "recency advantage", is not predicted by most contemporary explanations for recency effects. An alternative explanation for the effect in terms of "primary linguistic input" is proposed.

When lists of linguistic items (e.g., digits) are presented for subsequent short-term recall, recall is better when presentation is auditory than when it is visual. This advantage to auditory presentation, commonly termed a modality effect, arises due to superior recall of items at the end of the lists with auditory presentation, recall of items located earlier in the lists being essentially equal regardless of modality of presentation. That is, the modality effect arises due to better recall of the last few items in lists which are "heard" compared to those which are "seen".

The modality effect occurs in a wide variety of experimental paradigms and with a wide variety of linguistic stimuli (see Penney, 1975, for discussion), though perhaps the largest number of experiments demonstrating the effect have employed auditory and visual presentation of digits for strict serial recall.

Serial position curves for the ordered recall of sequentially-presented items typically show a striking increase in recall accuracy for the last one or two positions when presentation is auditory, the accuracy of the last position typically exceeded only by that of positions one and two. With visual presentation, however, improvement on the last couple of items is meager by comparison.

Perhaps the most widely accepted explanation for modality and recency effects is that proposed by Crowder and Morton (1969). According to Crowder and Morton, the difference in recall for auditory and visual presentation arises due to differences in the sensory stores for vision and for audition. Sensory stores are hypothesized as being the initial memory systems in which sensory information is held in a relatively raw, unanalyzed state "until some higher-order perceptual mechanism can integrate it sufficiently with other samples of information to trigger a learned category state", (Crowder, 1978, p. 343). They are also hypothesized as having a very limited capacity. (Crowder estimates their capacity at approximately one item.) Sensory stores (e.g., iconic and echoic memory) thus differ from short-term memory stores, which handle information which has already been categorized. Information in sensory stores remains relatively faithful to the physical properties of the sensory stimulus; it is precategorical (Crowder, 1972, 1978). The need for the existence of such stores is reasonably well established on grounds other than those relating to modality and recency (Crowder, 1972, 1978), and is not being questioned here.

Fairly extensive study of the visual sensory store suggests that it has a very short duration, on the order of a fraction of a second (Averbach & Coriell, 1961; Sperling, 1960). In contrast, the auditory sensory store, called "precategorical acoustic store" (PAS) by Crowder & Morton (1969), is hypothesized as having a duration on the order of a second or more (Crowder, 1972).

According to the PAS explanation of the modality and recency effects, sequentially presented items are immediately identified and are stored in short-term store, from which they are output at time of recall. When stimuli are presented auditorily, there is presumably an additional source of information about the identity of the final items which is provided by relatively unanalyzed acoustic information which is still resident in PAS. This presumably allows subjects to go back and check the categorized information in short-term store against precategorical sensory information still present in PAS. According to Crowder, similar benefit would presumably be provided for visually presented stimuli by information from iconic memory, but the very brief persistence characteristics of the visual sensory store result in information being either lost, or at least no longer existing in usable form by the time such operations are hypothesized as occurring.

Although the PAS explanation for modality and recency effects enjoys a wide following, a number of alternative explanations have been proposed. Some researchers argue that an accurate explanation of modality and recency effects must include influences from higher levels of analysis than that of sensory register differences. The fact, for instance, that word length does not have an effect on the recency portion argues against PAS as the sole explanation for recency (Watkins, 1972; Watkins & Watkins, 1973), suggesting the involvement of post-word-identification levels. Likewise, the findings of Salter and his colleagues (Salter & Colley, 1977; Salter, Springer, & Bolton, 1976), showing differential effects of an auditory suffix[2] as a function of semantic factors, suggests that the cause(s) of recency effects reside, at least in part, at higher levels than that of PAS.

Perhaps the strongest demonstrations that modality/recency effects cannot entirely be accounted for by sensory stores explanations are provided by Campbell & Dodd (1980), who showed evidence for a recency advantage to (visual) lipread input relative to orthographic input, and by Shand (1980), who showed a recency advantage for visually presented American Sign Language signs relative to printed English words with congenitally deaf signers. Such differences are unaccounted for by an explanation which relies on PAS, since in both of the above studies, the differences in recency effects which are demonstrated do not involve auditory inputs.

The experiment reported here provides additional evidence that processing mechanisms at a more abstract level of analysis than sensory stores are necessary to account for modality and recency effects and provides further support for a hypothesis first proposed by Shand (1980) which suggests that phenomena such as modality and recency effects arise, at least in part, due to purely linguistic considerations.

1. Method

The present experiment is a short-term memory paradigm in which lists of nine digits were presented sequentially for subsequent recall to native speakers of English who were learning Spanish, and to native speakers of Spanish who were learning English. Stimuli consisted of two corpuses of the digits 1-12, one in English, one in Spanish. The digits, spoken by the same adult male bilingual speaker of Spanish and English, were recorded on audiotape. The stimulus tapes, one English and one Spanish, were constructed from this tape with the aid of a computer and programs developed at Bell Laboratories. For both stimulus tapes, no digit appeared more than once within a list, and (across lists) each digit appeared an equal number of times in each position.

Subjects. Thirty-two paid subjects, sixteen native Spanish speakers and sixteen native English speakers served as subjects. For the Spanish speakers, 9 were male; 7 were female. For the English speakers, 3 were male; 13 were female. The native English speakers were students enrolled in Spanish courses in the Language Program at the University of California, San Diego; the native Spanish subjects were students enrolled in the Program in American Language and Culture, also at UCSD. Subjects ranged in age from 17 to 34.

Procedure. Each subject received both the English tape and the Spanish tape. Written instructions were presented in the subject's native language. Order of presentation of conditions was counterbalanced across subjects: half of the subjects received the native language tape first, half received the tape in their non-native language first.

Subjects received two practice lists prior to the start of each condition. Each condition consisted of 24 lists of 9 digits. Recall consisted of writing down the appropriate digits on an answer sheet. Subjects were instructed to not begin writing their answers until the list was finished, to begin with the first digit, and continue to the end of the list without regression. They were told to write a dash in the slot for any digit they could not remember. Subjects were continuously monitored to assure that strict serial recall procedures were followed. A $5 bonus was promised to the subject who correctly recalled the largest number of digits in the correct position.

Throughout the experiment, the time that the subjects needed to write down their responses determined the inter-list intervals, with the next list beginning as soon as the subjects were ready. Subjects were run singly or in small groups. The entire experiment lasted approximately 45 minutes.

2. Results

Normalized serial position data (following McCrary & Hunter, 1953) are shown for the native English speakers in Figure 1.

As can be seen in Figure 1, and as was confirmed by t-tests, the only position where the differences in the curves reach significance is at position 9 ($t\ (15) = 2.78$, $p < .01$). For the native English speakers, we find a significant recency advantage for English presentation relative to Spanish presentation at the terminal list position. That is, native English speakers recalled the last in a series of English digits significantly better than the last in a series of Spanish digits.

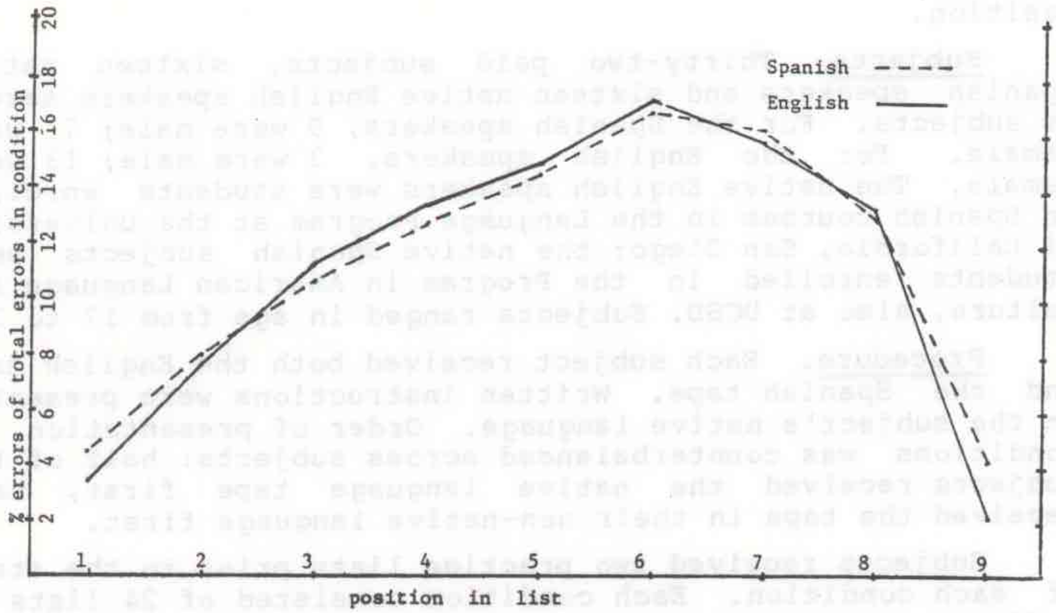

Figure 1. Serial position curves for native English speakers

Normalized serial position data for native Spanish subjects are shown in Figure 2. As with the native English

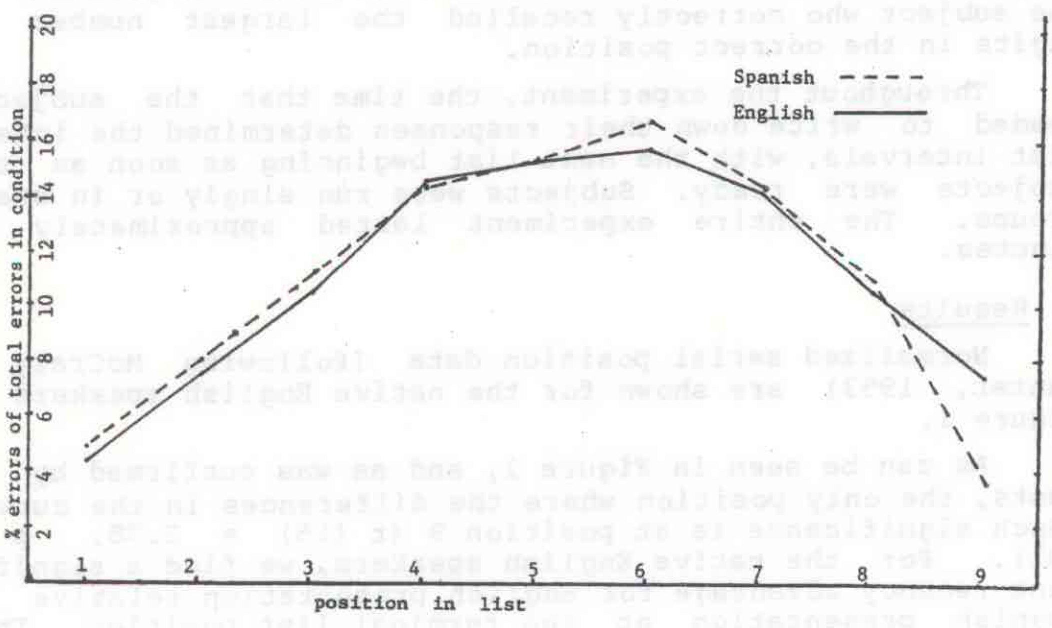

Figure 2. Serial position curves for Native Spanish subjects

speakers, the only position at which the differences in the serial position curves reach significance is at position 9 ($t(15) = 4.70$, $p < .001$). With native Spanish speakers, however, the recency advantage is for Spanish presentation rather than for English presentation. From a consideration of the data from both native Spanish speakers and native English speakers, we see that there is a recency advantage for native language presentation relative to non-native language presentation.

3. Discussion.

The finding of superior recall with auditory presentation of digits as a function of native vs. non-native language presentation, with superiority of the native language presentation being confined to the recency portion of the serial position curve, is entirely unpredicted by an account of recency effects in terms of PAS, since the same sensory store is involved for both native and non-native presentations. It argues quite strongly for the involvement of higher level mechanisms. This is not to discount the possible validity of a sensory store explanation as a partial explanation for modality and recency effects. The differences found in the present experiment are not nearly as robust as the striking differences between auditory and visual presentation observed in numerous previous experiments by Crowder and others. PAS may well account--at least in part--for modality and recency effects. The present experiment argues strongly, however, that it is not the whole story.

How, then, are we to account for the present results? We suggest that one plausible explanation is provided by the "primary linguistic input hypothesis" first proposed by Shand (1980). Our results are in accord with the notion that an advantage arises for stimuli which are presented in a system which constitutes primary linguistic input for the subjects. For normally hearing native speakers of English, this would consist of phonological English. For native Spanish speakers, spoken Spanish would constitute such input. The advantage presumably arises due to the added difficulties imposed on "nonprimary" inputs, which are normally recoded into some internal code based on the primary linguistic system rather than on an internal representational system based in some more direct way on the physical stimulus.

This proposal suggests that differential recency effects, which give rise to the so-called modality effect, cannot be entirely attributed to differences between audition and vision, but rather may arise, at least in part, due to differences in the way primary linguistic inputs and non-primary linguistic inputs are handled by the brain in the course of perceptual analysis, storage, and/or retrieval.

Additional evidence which seems to favor the primary linguistic input hypothesis as a partial account of these effects has been provided by Shand (1980), who found a recency advantage for American Sign Language (ASL) signs relative to printed words for congenitally profoundly deaf signers of ASL, and by Shand & Klima (1981), who found that an ASL sign appended to the end of a list of ASL signs produced a suffix effect, as did a static tracing of an ASL sign appended to a list of tracing of other ASL signs. Further evidence favoring the primary linguistic input hypothesis is also provided by Tarrter & Shand (1980), who found a recency advantage for normally spoken digits relative to digits presented auditorily in Pig Latin.

Regardless of the validity of the primary linguistic input hypothesis, the present experiment, demonstrating a recency advantage to native language presentation over non-native presentation, argues very strongly that levels of analysis at a higher level than sensory stores are involved in phenomena such as recency and modality. PAS may well be a contributing factor. However, it is insufficient, in and of itself, to account for the phenomena entirely. Further experimentation will be required before it can be determined which levels of anaysis are involved, and the degree to which each level contributes to these phenomena.

4. Footnotes

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2. When a redundant, not-to-be-recalled, auditorily-presented linguistic item is appended to the end of a list of auditory linguistic items presented for immediate recall, recall of the last item(s) is selectively impaired. This is typically termed a "suffix effect" (Crowder, 1967).

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