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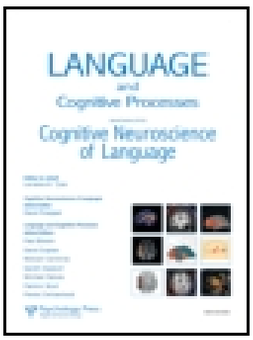

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Sequence Monitoring

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The primary use of sequence monitoring (also known as syllable or fragment monitoring) has been to determine which linguistic units are involved in word recognition, and how these units might differ across languages. The task involves presenting subjects with targets that are either congruent or incongruent with a linguistic unit in the target-bearing item. Faster detection latencies to congruent targets are taken to indicate their perceptual relevance. For example, the finding that subjects are faster to detect a target when it corresponds to the first syllable of the carrier than when it corresponds to more or less than the first syllable is called a syllable effect. This effect is interpreted as evidence for the perceptual relevance of the syllable. Since most research with this task has focused on the generalisability of the syllable effect across languages, this paper will focus primarily on this effect.

Issues Addressed

1. The processing and representation of various types of linguistic information (e.g. syllabic, orthographic, morphological information).
2. The nature of pre-lexical units (phoneme, syllable, mora, etc.).
3. The nature of segmentation and classification procedures.
4. The language-specific/language-universal nature of 1 and 2 above.

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First Uses

Savin and Bever (1970) for the syllable superiority effect (see Connine and Titone, this issue). Mehler, Dommergues, Frauenfelder and Segui (1981) for the first use in its canonical form.

Description

Subjects are first presented with a target (visual, auditory or both) that they are instructed to detect. A spoken stimulus (or carrier) containing this target at its onset is then presented to subjects. This stimulus may be embedded in a sentence or list of words/nonwords, or it may be presented as a single item. Sequence monitoring can be distinguished from phoneme monitoring on the one hand, and word monitoring on the other, by the fact that the targets which are monitored for are syllable-sized—that is, larger than a phoneme but generally smaller than a word. The primary manipulation in the task is the corrrespondence between the target and some structural property of the carrier item. Faster monitoring times to targets which match the structure of the carrier than to those that mismatch suggest the perceptual relevance of the linguistic unit under scrutiny.

Stimuli

In using the task to investigate the role of linguistic units in word recognition, the carrier stimuli consist of words/nonwords forming pairs which have the same initial sequence of phonemes, but where one member of the pair differs in structure from the other. For example, when investigating the syllable, one member of the pair has a first syllable which is open (CV) and the other member of the pair has a first syllable which is closed (CVC). The target either corresponds exactly to the first syllable of the carrier item (e.g. BA in ba.lance, BAL in bal.con), or it may be more/less than the first syllable of the word (e.g. BAL in ba.lance, BA in bal.con) (examples taken from Mehler et al., 1981). Other units of investigation could be the mora, morpheme, etc.

Dependent Variables

1. Detection latencies.
2. Errors (false-positives and misses).

Independent Variables

1. Language of input.
2. Native language of subject.
3. Lexical status of carrier item.

4. Structure of the target (CV, CVC, CVCC).
5. Structure of the carrier word (first syllable/morpheme/BOSS, etc.) matches or mismatches target.

Analysis Issues

Most analysis issues have concerned the syllable effect. For example:

1. What constitutes a syllable effect? A syllable effect is generally characterised as a significant interaction of target type and word type. Subjects are faster (or more accurate) to detect targets which correspond exactly to the first syllable of the word than targets which correspond to more or less than the first syllable of the word. According to a more stringent criterion, to be able to infer a syllable effect there must be a significant crossover interaction between target type and word type. More generally, the precise criteria for this inference depend upon the relationship between the target and the carrier structures actually manipulated in the experiment.

2. What is the locus of the syllable effect? The syllable effect is generally considered to have a pre-lexical locus. Two main proposals for data analysis have been made to determine whether this is the case. Dupoux (1994) has suggested a correlation analysis of mean RT with the syllabic effect. Similarly, other researchers have divided subjects into fast and slow groups. In both types of analysis, bigger syllable effects in the longer reaction times would be indicative of a late, most likely lexical locus.

Effects Found with Paradigm

A. *Syllable effect*

1. Population = native speakers
   Language: French
   Shown by: Mehler et al. (1981); Kearns (1994: see chapter 4, carrier words in sentences).
   Not found by: Kearns (1994: see chapter 3, word list stimuli).

   Language: Spanish
   Shown by: Bradley, Sánchez-Casas and García-Albea (1993); Sebastián-Gallés, Dupoux, Segui and Mehler (1992, Exp. 3, slow responses).
   Not found by: Sebastián-Gallés et al. (1992, Exp. 2, fast responses).

   Language: Catalan
   Shown by: Sebastián-Gallés et al. (1992, Exp. 1, words with initial unstressed syllable); Sebastián (1996).
   Not found by: Sebastián-Gallés et al. (1992, Exp. 1, words with initial stressed syllable).

Language: Portuguese
Shown by: Morais et al. (1989).

Language: Dutch
Shown by: Zwitserlood, Schriefers, Lahiri and van Donselaar (1993).
Not found by: Vroomen and de Gelder (1994).

Language: Japanese
Not found by: Otake, Hatano, Cutler and Mehler (1993); however, a mora effect was found.

Language: English
Not found by: Cutler, Mehler, Norris and Segui (1986, words and nonwords): Bradley et al. (1993); Kearns (1994).

2. Population = non-native speakers
Language: French
Not found by: Cutler et al. (1986, English speakers); Otake, Hatano and Yoneyama (1996, Japanese speakers).

Language: Spanish
Not found by: Bradley et al. (1993, English speakers); Otake et al. (1996, Japanese speakers).

Language: Japanese
Shown by: Otake et al. (1993, French speakers).
Not found by: Otake et al. (1993, English speakers).

Language: English
Shown by: Cutler et al. (1986, French speakers).
Not found by: Otake et al. (1996, Japanese speakers).

3. Population = bilinguals
Language: French
Shown by: Cutler, Mehler, Norris and Segui (1992, "French-dominant" French–English bilinguals).
Not found by: Cutler et al. (1992, "English-dominant" French–English bilinguals); Kearns (1994, French–English bilinguals).

Language: Spanish
Not found by: Bradley et al. (1993, Spanish–English bilinguals).

Language: English
Not found by: Cutler et al. (1992, French–English bilinguals); Kearns (1994, French–English bilinguals).

B. *Word effect* (CV words responded to faster than CVC words)

1. Native speakers (unless otherwise stated)
   Language: English
   Shown by: Cutler et al. (1986: also with English listening to French materials); Cutler et al. (1992, French–English bilinguals).
   Not found by: Bradley et al. (1993).

   Language: Portuguese
   Shown by: Morais et al. (1989, dependent variable = accuracy).

   Language: Spanish
   Shown by: Sebastián-Gallés et al. (1992).

   Language: Catalan
   Shown by: Sebastián-Gallés et al. (1992, words with initial stressed syllable).
   Not found by: Sebastián-Gallés et al. (1992, words with initial unstressed syllable).

C. *Target effect* (CVC targets detected faster than CV targets)

1. Native speakers (unless otherwise stated)
   Language: English (this is the only language in which this effect has been found).
   Shown by: Bradley et al. (1993); Kearns (1994); Cutler et al. (1992, all French–English bilinguals analysed together).
   Not found by: Cutler et al. (1986).

D. *Target effect* (CV targets detected faster than CVC targets)

1. Native speakers (unless otherwise stated)
   Language: French
   Shown by: Kearns (1994).
   Not found by: Mehler et al. (1981).

   Language: Catalan
   Shown by: Sebastián-Gallés et al. (1992, words with initial stressed syllable).
   Not found by: Sebastián-Gallés et al. (1992, words with initial unstressed syllable).

E. *Orthographic effects*

Taft and Hambley (1985) found that subjects were faster to detect a target when it corresponded to the basic orthographic syllable (BOSS) of the carrier word than when it didn't. However, Cutler, Norris and Williams (1987) showed that such effects were confounded with the fact that subjects

are faster to respond to carriers beginning with CVCV than carriers with CVCC, and claimed that this was due to subjects' expectations about the structure of the carrier word.

F. *Morphological effects*

Zwitserlood et al. (1993). Subjects were faster to detect targets which matched the first morpheme of the word than those which did not.

Design Issues

A. *Properties of the target*

1. Modality of the target specification. The target can be presented to the subject auditorily, visually or both. In some cases, a visually presented target may be phonologically ambiguous.

B. *Properties of the target-bearing carrier*

1. Lexical status of carrier.
2. Position of lexical stress.
3. Nature of phonemes corresponding to target. Vowels must be selected so that they are phonetically identical in open and closed syllables. In selecting post-vocalic consonants, their adhesion to the following or the preceding syllable must be taken into consideration.

C. *Properties of the carrier-bearing sequence*

1. Sentences or lists.
2. List structure (target + single carrier, target + series of potential carriers).
3. Probability of positive *vs* negative trials.
4. Degree of match on negative trials (e.g. DI balcon, BI balcon, BAR balcon). A negative trial with partial match is called a foil.
5. Probability of foil.

D. *Properties of the subject population*

1. Native or non-native listeners. If an effect occurs only with a native population, it cannot be due to language-universal processing procedures or processing units. If, on the other hand, listeners show an effect characteristic of their native language in a non-native language, but which is not characteristic of native listeners of the language, then they are assumed to be applying a native language-specific procedure to the non-native input.

Validity

1. The sequence-monitoring task has been useful in identifying different patterns of processing across languages.
2. Although syllable effects have been obtained in several languages, these results have not always been replicated. It is difficult for the moment to determine to what extent the results depend upon the language or upon the factors mentioned in the Design Issues section.

Advantages

1. Easy to use.
2. Can be used with non-native listeners as well as native listeners.
3. Although to date the sequence monitoring task has mainly been applied to syllables, it could potentially be applied to many other types of units and structures.

Potential Artifacts

1. The use of auditory targets could lead to direct auditory matching.
2. The use of visual targets could lead to the employment of orthographic strategies.
3. The metalinguistic nature of the task opens up the possibility that it may not tap into real-time processing.

Problems

A. *General*

1. Metalinguistic nature of the task.
2. Difficulty in obtaining accurate RT measurements, because the physical onset of the carrier word can be hard to determine.

B. *Specific to the syllable effect*

1. Results (i.e. presence of syllable effect) vary with task demands (RT, foils, etc.) and stimulus characteristics (post-vocalic consonant, vowels used, etc.).
2. Difficulty in determining the lexical or pre-lexical locus of the syllabic effect.
3. Difficulty in interpreting any of the effects other than the crossover interaction.

4. Difficulty of determining the exact role played in word recognition by the unit under investigation even when it has been shown to be relevant.

Uses with Other Populations

1. *Illiterates*: Morais et al. (1989): both illiterate and ex-illiterate Portuguese listeners showed a syllable effect.
2. *Non-native listeners*: see section A2 of Effects Found.
3. *Bilingual listeners*: see section A3 of Effects Found. In addition, the native Catalan and Spanish listeners of Sebastián-Gallés et al. (1992) also spoke the other language to some degree. The native Catalan listeners were described as being fluent in Spanish.
4. *Aphasics*: Metz-Lutz, Wioland and Brock (1992) used a syllable-monitoring task with different types of aphasic patients. CV targets were detected in three different conditions: nonsense syllable lists, trisyllabic words and sentences.

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