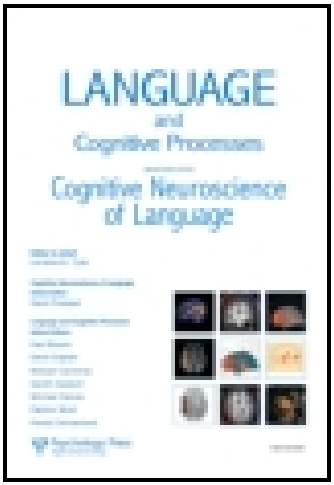

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Gating

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This summary sheet presents the gating paradigm as it is used in spoken word recognition research. In this task, a spoken language stimulus is presented in segments of increasing duration and subjects are asked to propose the word being presented and to give a confidence rating after each segment. The dependent variables are the isolation point of the word, the confidence ratings at various points in time and the word candidates proposed after each segment. Different variants of the task are presented, as are the main effects that have been found or confirmed with it. The advantages and the problems associated with the task are discussed, and the studies that have used it with special populations are mentioned.

Issues Addressed

1. The amount of acoustic–phonetic information needed to identify a stimulus, such as a syllable, a word, a group of words, etc.
2. The role played by phonetic, lexical and contextual variables during identification.
3. The underlying processes leading to identification.
4. The nature of lexical representations.

First Uses

Grosjean (1980) for the current version (words presented in segments of increasing duration, three dependent variables). For earlier and simpler versions, see Pickett and Pollack (1963), Ohman (1966) and Ellis, Derbyshire and Joseph (1971).

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Description

A spoken language stimulus is presented in segments of increasing duration usually starting at the beginning of the stimulus. The first segment is normally very short (e.g. 20–30 msec) and the last one corresponds to the entire stimulus. Variants of the task differ on increment size of gates, presentation format, direction of presentation, missing part replacement, number of stimuli tested simultaneously, context, type of response, etc. (see Design Issues).

Stimuli

Any linguistic stimulus of interest (sound, syllable, word, phrase, sentence, etc.). Most studies have gated words but some have gated groups of words (e.g. Bard, Shillcock, & Altmann, 1988; Grosjean & Hirt, 1996) and sentences (e.g. Li, 1996). Gates can correspond to time intervals or to linguistic units (e.g. Walley, 1988).

Dependent Variables

1. Isolation point—that is, the size of the segment (measured in msec or % of stimulus) needed to identify the stimulus (without any change in response thereafter).
2. Confidence ratings at various points in time (at isolation point, end of stimulus, etc.). One can also examine the duration of the segment needed to attain (and maintain) a particular rating after isolation. Ratings are used to define points in the stimulus such as the total acceptance point or the "recognition" point (see Analysis Issues).
3. Candidates proposed at each segment before the stimulus has been isolated.

Independent Variables

Various stimulus characteristics such as frequency, length, morphology, types of context for word stimuli, phonetic and phonological cues for word fragments, prosodic and syntactic variables for sentences, etc.

Analysis Issues

1. *Missing values.* Missing isolation points can be replaced by the duration of the word (e.g. Grosjean, 1980), the duration of the word plus 50 msec (e.g. Walley, Michela, & Wood, 1995), the mean isolation point across subjects (e.g. Grosjean et al., 1994), etc. Missing confidence ratings are either not

replaced (e.g. Grosjean, 1980) or replaced by the lowest confidence rating on the scale (e.g. Walley et al., 1995).

2. *Total acceptance point.* Some define it as the gate duration at which the subject has given the stimulus word a perfect confidence rating (e.g. Grosjean, 1985); others require slightly less than perfect confidence (e.g. Walley et al., 1995).
3. "*Recognition point*". Obtained by taking the segment size needed, after the isolation point, to reach a particular confidence level (e.g. 80% confidence for Tyler & Wessels, 1983). There is no consensus that this reflects a word's actual recognition point.
4. *Written responses.* This is an issue if the handwriting is illegible, the spelling is incorrect, homophones are present, the responses are not full words, etc.
5. *Oral responses.* Can be transcribed "on the fly" or recorded and transcribed later. Need for inter-judge reliability.

Effects Found with Paradigm

1. Context (syntactic and semantic)
   Shown by: Craig, Kim, Rhyner and Chirillo (1993); Grosjean (1980); Grosjean and Itzler (1984); McAllister (1988); Salasoo and Pisoni (1985); Tyler (1984).
2. Word frequency
   Shown by: Grosjean (1980); Lively, Pisoni and Goldinger (1991); Metsala (in press); Tyler (1984); Walley et al. (1995).
3. Word length
   Shown by: Craig and Kim (1990); Grosjean (1980).
4. Word stress
   Shown by: McAllister (1991).
5. Word morphology
   Shown by: Schriefers, Zwitserlood and Roelofs (1991); Tyler and Marslen-Wilson (1986); Tyler, Marslen-Wilson, Rentoul and Hanney (1988).
6. Competitor frequency and/or number
   Shown by: Metsala (in press); Marslen-Wilson (1990); Walley et al. (1995); Wayland, Wingfield and Goodglass (1989).
7. Gender marking
   Shown by: Grosjean et al. (1994).
8. Earliness of word recognition
   Shown by: Grosjean (1980); Salasso and Pisoni (1985); Tyler and Wessels (1983).

9. Delayed recognition (after acoustic offset)
   Shown by: Bard et al. (1988); Grosjean (1985).
10. Recognition based on end of word
    Shown by: Nooteboom (1981); Salasoo and Pisoni (1985); Walley (1988).
11. Co-articulation and contingency of choice
    Shown by: Marslen-Wilson and Warren (1994); Warren and Marslen-Wilson (1987, 1988).
12. Underlying lexical representation and type of access
    Shown by: Lahiri and Marslen-Wilson (1991); Marslen-Wilson and Warren (1994).
13. Response format (written *vs* oral)
    Shown by: Walley et al. (1995).

Design Issues

1. Increment size of gates: for time segments, increment size can vary anywhere from 20 to 100 msec; for linguistic segments, increment units can be sounds, syllables, word fragments, words, etc. (e.g. Walley, 1988; Grosjean & Hirt, 1996).
2. Presentation format. *Successive*: subjects hear all the segments of the stimuli, starting with the shortest and finishing with the longest. *Individual*: different groups of subjects hear different segment sizes of the stimuli (e.g. Cotton & Grosjean, 1984). *Duration-blocked*: subjects hear all the stimuli at a particular segment size, then all the stimuli again at the next segment size, and so on (e.g. Walley et al., 1995; see Potential Artifacts).
3. Direction of presentation: stimuli are usually presented forwards, from beginning to end ("left-to-right"), but also backwards, from end to beginning ("right-to-left") (e.g. Salasoo & Pisoni, 1985).
4. Missing part: replaced by silence (usual) or by some kind of signal (e.g. Salasoo & Pisoni, 1985; Walley, 1988).
5. Number of stimuli tested simultaneously: one (usual) or several (e.g. Salasoo & Pisoni, 1985).
6. Context: can precede the stimulus (e.g. Grosjean, 1980), follow it (e.g. Grosjean, 1985), or both (e.g. Salasoo & Pisoni, 1985). Context can remain the same for all presentations (e.g. Grosjean, 1980) or increase after each presentation (e.g. Bard et al., 1988; Wingfield, Alexander, & Cavigelli, 1994).
7. Type of response: written or oral (e.g. Nooteboom, 1981; Walley, 1988), without any time constraint (usual) or with time constraint (e.g. Tyler & Wessels, 1985).

Validity

1. Replication of a number of effects found with other paradigms (e.g. word frequency, word length, context, etc.).
2. Same results when subjects are under time pressure (Tyler & Wessels, 1985).
3. Same responses when gates are presented individually as opposed to successively (Bard et al., 1988; Cotton & Grosjean, 1984; Salasoo & Pisoni, 1985).

Advantages

1. Easy to use. Although stimuli preparation may take some time (if not automatised), running subjects can be done with very little equipment.
2. Allows precise control over the acoustic–phonetic information presented to subjects.
3. Indicates how much acoustic–phonetic information is needed to identify a stimulus.
4. Several dependent variables.
5. Useful for studying different kinds of populations (e.g. children, the elderly, etc.) as the response required is not difficult to make and there is usually no time constraint.
6. Potentially powerful paradigm if one can show that the candidates and the confidence ratings proposed reflect what goes on in the mind.

Potential Artifacts

The successive presentation format may induce response perseveration and negative feedback. This in turn may yield a slightly conservative picture of recognition (Craig & Kim, 1990; Walley et al., 1995).

Problems

1. Some do not consider gating as a real on-line paradigm as it may reflect post-access operations. Counter: (a) Opinions diverge on what constitutes an on-line task. (b) Are there indeed two distinct operations during word recognition, access and post-access? There is no general consensus that recognition is strictly a perceptual, bottom-up process that is impervious to higher-level sources of knowledge. (c) If there are indeed two distinct operations, doesn't gating nevertheless reflect some of the processes that take place on-line? All the evidence is not in yet.

2. Some propose that when words are heard in context, the task involves various processing strategies such as guessing (see Zwitserlood, 1989, for example). Counter: Aren't some of these normally involved in language processing?

3. There is no validity yet for the candidates proposed. Do they reflect those in the mind? Are the candidates that are proposed by different subjects entertained in parallel by a given subject? Do the confidence ratings reflect the level of activation of the mental candidates? More work is needed on these questions.

Uses with Other Populations

1. *Children*: amount of input required for recognition, importance of word-initial *vs* word-final information and number and structure of word candidates prior to isolation (Walley, 1988); word frequency and neighbourhood density (Metsala, in press); context (Craig et al., 1993).
2. *Children with disorders*: language delays and reading problems (Elliott, Scholl, Grant, & Hammer, 1990); Down syndrome (Marcell & Cohen, 1992).
3. *Elderly*: amount of bottom-up information needed (Craig, 1992); effect of preceding and following linguistic context (Wingfield et al., 1994); comparison with other age groups (Elliott, Hammer, & Evan, 1987; Craig et al., 1993).
4. *Elderly with disorders*: Alzheimer's disease (Marshall, Duke, & Walley, 1996).
5. *Aphasics*: position of uniqueness point and morphological complexity (Tyler, 1988, 1992); pictorial context (Wingfield, Goodglass, & Smith, 1990).
6. *Bilinguals*: language phonetics and phonotactics (Grosjean, 1988; Li, in press); near homophones (Grosjean, 1988); context (Li, in press).
7. *Deaf using sign language*: sign parameters (Emmorey & Corina, 1990; Clark & Grosjean, 1982; Grosjean, 1981); context (Clark & Grosjean, 1982); morphological complexity (Emmorey & Corina, 1990).

Other Comments

Recognised as a good paradigm when used together with other tasks. It can certainly tell us something about the final outcome of word recognition. Whether it can also do so about intermediate levels (if these exist) remains an empirical issue.

References

Bard, E., Shillcock, R., & Altmann, G. (1988). The recognition of words after their acoustic offsets in spontaneous speech: Effects of subsequent context. *Perception and Psychophysics*, *44*, 395–408.

Clark, L., & Grosjean, F. (1982). Sign recognition processes in American Sign Language: The effect of context. *Language and Speech*, *25*, 325–339.

Cotton, S., & Grosjean, F. (1984). The gating paradigm: A comparison of successive and individual presentation formats. *Perception and Psychophysics*, *35*, 41–48.

Craig, C. (1992). Effects of aging on time-gated isolated word-recognition performance. *Journal of Speech and Hearing Research*, *35*, 234–238.

Craig, C., & Kim, B. (1990). Effects of time gating and word length on isolated word-recognition performance. *Journal of Speech and Hearing Research*, *33*, 808–815.

Craig, C., Kim, B., Rhyner, P., & Chirillo, T. (1993). Effects of word predictability, child development and aging on time-gated speech recognition performance. *Journal of Speech and Hearing Research*, *36*, 832–841.

Elliott, L., Hammer, M., & Evan, K. (1987). Perception of gated, highly familiar spoken monosyllabic nouns by children, teenagers and older adults. *Perception and Psychophysics*, *42*, 150–157.

Elliott, L., Scholl, M., Grant, J., & Hammer, M. (1990). Perception of gated, highly familiar spoken monosyllabic nouns by children with and without learning disabilities. *Journal of Learning Disabilities*, *23*, 248–259.

Ellis, L., Derbyshire, A., & Joseph, M. (1971). Perception of electronically gated speech. *Language and Speech*, *14*, 229–240.

Emmorey, K., & Corina, D. (1990). Lexical recognition in sign language: Effects of phonetic structure and morphology. *Perceptual and Motor Skills*, *71*, 1227–1252.

Grosjean, F. (1980). Spoken word recognition processes and the gating paradigm. *Perception and Psychophysics*, *28*, 267–283.

Grosjean, F. (1981). Sign and word recognition: A first comparison. *Sign Language Studies*, *32*, 195–220.

Grosjean, F. (1985). The recognition of words after their acoustic offset: Evidence and implications. *Perception and Psychophysics*, *38*, 299–310.

Grosjean, F. (1988). Exploring the recognition of guest words in bilingual speech. *Language and Cognitive Processes*, *3*, 233–274.

Grosjean, F., & Hirt, C. (1996). Using prosody to predict the end of sentences in English and French: Normal and brain-damaged subjects. *Language and Cognitive Processes*, *11*, 107–134.

Grosjean, F., & Itzler, J. (1984). Can semantic constraint reduce the role of word frequency during spoken word recognition? *Bulletin of the Psychonomic Society*, *22*, 180–182.

Grosjean, F., Dommergues, J.-Y., Cornu, E., Guillelmon, D., & Besson, C. (1994). The gender-marking effect in spoken word recognition. *Perception and Psychophysics*, *56*, 590–598.

Lahiri, A., & Marslen-Wilson, W. (1991). The mental representation of lexical form: A phonological approach to the recognition lexicon. *Cognition*, *38*, 254–294.

Li, P. (1996). The temporal structure of spoken sentence comprehension in Chinese. *Perception and Psychophysics*, *58*, 571–586.

Li, P. (in press). Spoken word recognition of code-switched words by Chinese-English bilinguals. *Journal of Memory and Language.*

Lively, S., Pisoni, D., & Goldinger, S. (1991). Spoken word recognition: Research and theory. *Research on speech perception progress report no. 17.* Bloomington, IN: Speech Research Laboratory, Indiana University.

Marcell, M., & Cohen, S. (1992). Hearing abilities of Down syndrome and other mentally handicapped adolescents. *Research in Developmental Disabilities*, *13*, 533–551.

Marshall, N., Duke, L., & Walley, A. (1996). The effects of age and Alzheimer's disease on recognition of gated spoken words. *Journal of Speech and Hearing Research*, *39*, 724–733.

Marslen-Wilson, W. (1990). Activation, competition, and frequency in lexical access. In G. Altmann (Ed.), *Cognitive models of speech processing*, pp. 148–172. Cambridge, MA: MIT Press.

Marslen-Wilson, W., & Warren, P. (1994). Levels of perceptual representation and process in lexical access: Words, phonemes and features. *Psychological Review*, *101*, 653–675.

McAllister, J. (1988). The use of context in auditory word recognition. *Perception and Psychophysics*, *44*, 94–97.

McAllister, J. (1991). The processing of lexically stressed syllables in read and spontaneous speech. *Language and Speech*, *34*, 1–26.

Metsala, J. (in press). An examination of word frequency and neighborhood density in the development of spoken recognition. *Memory and Cognition.*

Nooteboom, S. (1981). Lexical retrieval from fragments of spoken words: Beginnings *vs* endings. *Journal of Phonetics*, *9*, 407–424.

Ohman, S. (1966). Perception of segments of VCCV utterances. *Journal of the Acoustical Society of America*, *40*, 979–988.

Pickett, J., & Pollack, I. (1963). The intelligibility of excerpts from fluent speech: Effects of rate of utterance and duration of excerpt. *Language and Speech*, *6*, 151–164.

Salasoo, A., & Pisoni, D. (1985). Interaction of knowledge source in spoken word identification. *Journal of Memory and Language*, *24*, 210–231.

Schriefers, H., Zwitserlood, P., & Roelofs, A. (1991). The identification of morphologically complex spoken words: Continuous processing or decomposition? *Journal of Memory and Language*, *30*, 26–47.

Tyler, L. (1984). The structure of the initial cohort: Evidence from gating. *Perception and Psychophysics*, *36*, 417–427.

Tyler, L. (1988). Spoken language comprehension in a fluent aphasic patient. *Cognitive Neuropsychology*, *5*, 375–400.

Tyler, L. (1992). *Spoken language comprehension: An experimental approach to disordered and normal processing.* Cambridge, MA: MIT Press.

Tyler, L., & Marslen-Wilson, W. (1986). The effects of context on the recognition of polymorphemic words. *Journal of Memory and Language*, *25*, 741–752.

Tyler, L., & Wessels, J. (1983). Quantifying contextual contributions to word-recognition processes. *Perception and Psychophysics*, *34*, 409–420.

Tyler, L., & Wessels, J. (1985). Is gating an on-line task? Evidence from naming latency data. *Perception and Psychophysics*, *38*, 217–222.

Tyler, L., Marslen-Wilson, W., Rentoul, J., & Hanney, P. (1988). Continuous and discontinuous access in spoken word-recognition: The role of derivational prefixes. *Journal of Memory and Language*, *27*, 368–381.

Walley, A. (1988). Spoken word recognition by young children and adults. *Cognitive Development*, *3*, 137–165.

Walley, A., Michela, V., & Wood, D. (1995). The gating paradigm: Effects of presentation format on spoken word recognition by children and adults. *Perception and Psychophysics*, *57*, 343–351.

Warren, P., & Marslen-Wilson, W. (1987). Continuous uptake of acoustic cues in spoken word recognition. *Perception and Psychophysics*, *41*, 262–275.

Warren, P., & Marslen-Wilson, W. (1988). Cues to lexical choice: Discriminating place and voice. *Perception and Psychophysics*, *43*, 21–30.

Wayland, S., Wingfield, A., & Goodglass, H. (1989). Recognition of isolated words: The dynamics of cohort reduction. *Applied Psycholinguistics*, *10*, 475–487.

Wingfield, A., Goodglass, H., & Smith, K. (1990). Effects of word-onset cuing on picture naming in aphasia: A reconsideration. *Brain and Language*, *39*, 373–390.

Wingfield, A., Alexander, A., & Cavigelli, S. (1994). Does memory constrain utilization of top-down information in spoken word recognition? Evidence from normal aging. *Language and Speech*, *37*, 221–235.

Zwitserlood, P. (1989). *Words and sentences: The effects of sentential-semantic context on spoken-word processing.* Doctoral dissertation, University of Nijmegen, Nijmegen.