



Minimal Effects of Order of Noun Activation on Sentence Production

Lori J. P. Altmann, D. Ashley Mullin, & Tami Mann
University of Florida



ABSTRACT

Sentence production theory states that the noun that is activated first takes the sentence subject position regardless of its animacy, thus determining sentence structure (Bock & Levelt, 1994; Levelt, 1989). However, a previous study (Altmann & Kemper, in press) finds that young adults prefer animate nouns as sentence subjects regardless of their positional prominence in the stimulus.

The current study uses a constrained sentence production task to examine the impact of the temporal order of noun activation on sentence structure choice. We compare sentence production when a verb and 2 nouns appear simultaneously to when a stimulus noun appears either 100 ms or 150 ms before the remaining stimulus words. This timing difference is imperceptible in the 100 ms condition but obvious in the 150 ms condition.

According to theory, participants should produce more inanimate subject sentences when an inanimate noun is activated prior to the rest of the sentence words. However, results show little effect of prior presentation of animate or inanimate nouns on the sentence type produced, although it affected accuracy and response times.

METHODS

Subjects

72 University of Florida students between 18 and 28 volunteered for this study and were compensated for their time. All were native speakers of standard English, and none had reading or language disorders. 29 subjects participated in the simultaneous condition, 25 in the offset-100 condition, and 19 (to date) in the offset-150 condition.

Procedure

Participants produced sentences that included 3 stimulus words. Stimuli were centered vertically and horizontally on a computer screen and were identical to those used in Altmann & Kemper (in press). The stimuli consisted of 64 sets of 3 words, each including a transitive verb in its past participle form and 2 nouns differing in animacy. Animate nouns referred to professions (*doctor, butler, farmer*); inanimate nouns were chosen to be plausible objects of particular verbs. Stimuli either had the animate (Top-AN) or inanimate (Top-IN) noun on top of the array, the verb in the center, and the remaining noun below.

Stimuli included 4 types of verb past participles:

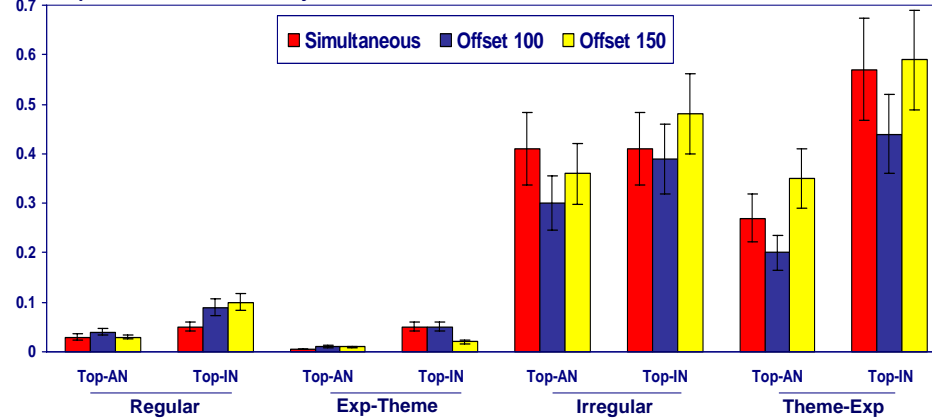
- Regular agent-patient (e.g., *stirred, kicked*)
- Experiencer-theme (Exp-Theme) (e.g., *loved, despised*)
- Irregular agent-patient (e.g., *shaken, thrown*),
- Regular Theme-Experiencer (Theme-Exp) (e.g., *confused, bored*).

Each trial consisted of: a Ready screen ("Ready? Push the space bar"), a fixation star (500 ms), a stimulus set, then the Ready screen. Stimuli disappeared as soon as a response was detected.

Results were analyzed using a series of 3 (Timing) x 4 (Verb Type) x 2 (Noun Position) ANOVAS.

RESULTS

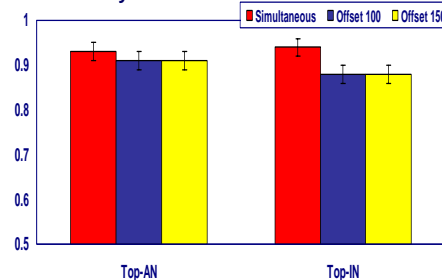
Proportion of Inanimate-Subject Sentences Produced



The timing of stimulus presentation had no effect on sentence type produced.

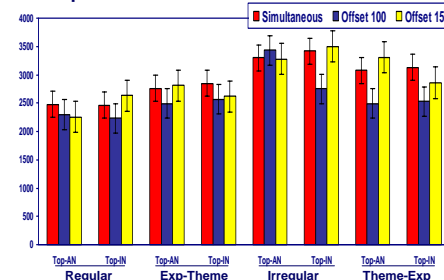
- Main effect of Verb type: $F(3, 67) = 65.265, p < .000, \eta^2 = .74$. Exp-Theme < Regular < (Irregular = Theme-Exp)
- Main Effect of Noun Position: $F(1, 70) = 47.521, p < .000, \eta^2 = .40$. More inanimate subject sentences in Top-IN conditions.
- Verb type x Noun position interaction, $F(3, 68) = 14.706, p < .000, \eta^2 = .39$.
 - Regular & Experiencer-Theme verbs: $\leq 10\%$ inanimate subject (passive) sentences regardless of the animacy of the top noun
 - Irregular Verbs: 40% inanimate-subject passives regardless of animacy of top noun
 - TE verbs: about 25% more inanimate-subject actives when inanimate nouns were at the top of the display

Accuracy of Sentence Production



- Main effect of verb type: $F(3, 6) = 17.356, p < .000, \eta^2 = .44$.
 - Regular verb sentences are produced more accurately than sentences with other verb types.
- Noun position x Timing: $F(2, 68) = 2.726, p = .07, \eta^2 = .07$.
 - Marginally significant
 - Using stimuli with inanimate nouns activated prior to the rest of the stimulus words interfered with accurate sentence production.

Response Times



- Main effect of verb type: $F(3, 67) = 38.458, p < .000, \eta^2 = .63$.
 - Regular verb sentences < Exp-Theme < Theme-Exp < Irregular
- Verb type x Noun position x Timing: $F(6, 136) = 3.857, p < .001, \eta^2 = .14$.
 - Simultaneous timing: for all verb types, Top-IN RT = Top-AN RT.
 - Offset-100: with Irregular verbs Top-IN < Top-AN, no other differences.
 - Offset-150: with Regular verbs, Top-IN > Top-AN; with Theme-Exp, Top-IN < Top-AN.

DISCUSSION

Altering the temporal order of noun activation had no effect on the choice of subjects for sentences in this task. In contrast, differences in verb type affected all aspects of sentence production: sentence structure choice, accuracy of production, and response times.

We suggest that speakers do not begin building a sentence structure until a verb is available, and then the structure choice reflects the frequency with which the verb occurs in a particular structure. This conclusion is supported by the homogeneity of response times and sentence structure choices for each verb type across timing conditions and by consistently high effect sizes for verb type across analyses.

If this is true, speakers may sometimes postpone assigning an inanimate noun to the sentence subject position when it is activated first if they suspect a 'better' (i.e., animate) subject may be available. This strategy is particularly evident in the Offset-150 condition in which speakers seem to wait for all 3 words to appear before constructing a sentence. Consequently, responses in this condition are very similar to those in the simultaneous presentation condition in sentence structure choice and response times.

Furthermore, postponing assignment of first-presented inanimate nouns to the subject position requires that these words be held active in working memory until the sentence is constructed. This likely contributes to lower production accuracy when inanimate nouns appear prior to other stimulus words. Moreover, it also has both facilitatory and inhibitory effects on response times, depending on verb type.

References

- Altmann, L. J. P. & Kemper, S. (in press). Age differences in the effects of order of activation and animacy on sentence production in young and older adults. *Language and Cognitive Processes*.
- Bock, J. K. & Levelt, W. (1994). Sentence Production. In M. Gernsbacher (Ed.), *Handbook of Psycholinguistics*. San Diego: Academic Press.
- Levelt, W. (1989). *Speaking*. Cambridge, UK: Cambridge University Press.

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