

SELECTION vs. ASSOCIATION STRENGTH IN THE VERB GENERATION TASK

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ABSTRACT

Neuroimaging and neuropsychological data from Thompson-Schill et al. (1997,1998) showed that in the verb generation task, the left IFG was more involved in a high selection condition (where nouns elicited two verbs with approximately equal frequency) than a low selection condition (in which the nouns had only one dominant verb response). They proposed that this area was involved in selecting semantic information from competing information. However, in the low selection condition, the dominant verb response most likely had a high association strength with the noun whereas in the high selection condition, it is possible that neither of the most frequently given verbs had a high association with the noun. Thus, low association strength for any verb rather than selection may be the source of difficulty in their high selection condition. We compared two high selection conditions: 1) High selection, high association condition (HH) - both verbs were highly associated with the nouns and 2) High selection, low association condition (HL) - both verbs had low associations with the nouns. Young and old neurally intact subjects showed no difference in latencies between a low selection condition and the HH condition, but longer latencies in the HL condition. A patient with damage to the left IFG was equally accurate in the low and HH conditions, but less accurate in the HL condition. The results suggest that low association strength between nouns and verbs, rather than competition for selection, increases the involvement of the left IFG in verb generation.

VERB GENERATION TASK

Subjects were given concrete nouns and asked to generate a semantically appropriate action verb for each noun.

"scissors" --> "cut"
"kite" --> "fly"

Activation in the left inferior frontal gyrus (left IFG) has been found in neuroimaging studies of verb generation (Raichle et al., 1994; Wise et al., 1991; Peterson et al., 1989, 1990). One interpretation is that this area is critical for the retrieval of semantic knowledge. Alternatively, Thompson-Schill and colleagues (1997, 1998) proposed that left IFG is involved in selecting among competing responses. They compared verb generation in a low-selection condition, in which each noun was strongly associated with a single verb (e.g., "scissors" - "cut") and a high -selection condition, in which each noun had two or more associations of similar strength (e.g., "rope" - "tie", "lasso", "twirl"). They found greater activation of left IFG in the high selection condition and suggested this region is involved in a selection operation (selection from alternative verb responses) rather than semantic retrieval.

ALTERNATIVE EXPLANATIONS OF THOMPSON-SCHILL ET AL.

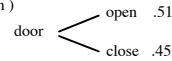


Inhibitory difficulty under high selection demands?
OR, Low association strength of alternative responses?

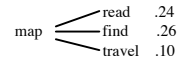
PRESENT STUDY

Three conditions

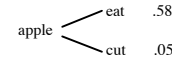
1. High Selection -High Assoc. (HH, both verbs were highly associated with the target noun)



2. High Selection -Low Assoc. (HL, both verbs had low associations with the target noun.)



3. Low Selection- High Assoc. (LH, there is only one dominant verb response, others have very weak associations with target noun.)



So, If selection demands is the critical factor, then LH > HH = HL
If association strength is critical, then LH ~ HH > HL

MATERIALS

45 concrete nouns (15 for every condition) were chosen on the basis of verb generation data collected from 71 Rice undergraduate students. Participants were given 250 concrete nouns and ask to generate a verb from each noun.

1. We used the relative response frequency of a verb as an index of its association strength with the target noun.

e.g. TREE --> climb (most common response, association strength = 47/71)
--> grow (second-most common response, association strength = 18/71)
--> ...

2. We used the ratio of the association strength of the most common response to the second most-most common response as an index of the selection demand of target noun.
e.g. Selection demand of noun "TREE" = 47/18

Materials were chosen for the three conditions (spoken and written frequencies were matched across 3 conditions).

1. **HL** (15 nouns)

Mean Association strength of both the first and second responses to the target noun < 14/71, Mean ratio/Mean selection demand = 1.53 (1~2.5)

2. **HH** (15 nouns)

Mean Association strength of both the first and second responses > 25/71, Mean selection demand = 1.44 (1~2.5)

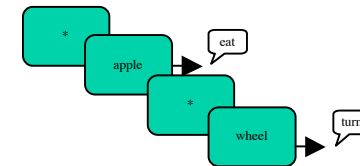
3. **LH** (15 nouns)

Mean selection demand = 17.25 (>4.5).

SUBJECTS

- Semantic STM deficit patient, ML (damage in left IFG)
- 10 young controls, undergraduates of Rice University
- 10 elderly controls (Age and education matched with ML)

Procedure

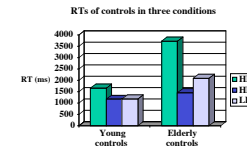


What does a ## do?
What do you do with a ##?

From onset of noun,
measured RT for
producing verb

RESULTS

Control groups



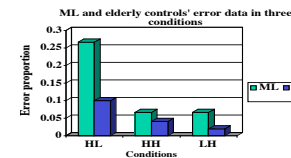
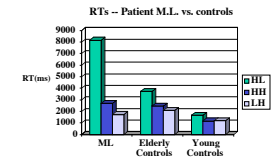
Controls showed no difference in RTs between the low selection condition and the HH condition, but longer latencies in the HL condition.

Old controls took a longer time than young controls to produce appropriate verb responses

Patients ML

ML (a patient with damage to the left IFG) showed the same RT pattern as controls: no difference between HH and Low condition, much longer RTs in HL condition.

Note that, ML's RTs are comparable with elderly controls in HH and LH conditions, but a great deal longer than both control groups in HL condition.



Error analysis

ML was equally accurate in the both LH and HH conditions (comparable to elderly controls), but less accurate in the HL condition.

CONCLUSIONS

The results suggest that degree of association strength, rather than selection demands, determines reaction time and error rates in the verb generation task.

Damage to the left IFG greatly increases the difficulty in retrieving verb responses with low association strengths to the target noun. This damage did not cause difficulty in retrieving a verb when the noun had two highly associated verb responses. Thus, the results argue against a selection interpretation of the role of the left IFG. Instead, it appears to be involved when retrieval difficulty is great.

References

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