Reaction Time Effects of Semantically-Related and Unrelated Visual and Auditory Distraction in Younger and Older Adults

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The Problem

Burning Questions

• Few studies of the effects of semantic distraction on linguistic processing in aphasia or people without aphasia

• Does an ambient background of semantic auditory distraction facilitate or interfere with ongoing linguistic processing (visual picture identification)?

• Does semantic relatedness of foils to targets effect picture identification?

• Do people with aphasia perform differently on a picture identification task than age-matched controls during conditions of competing ambient distraction?
Purposes

Twofold:

• To determine the effects of semantic relatedness on a picture identification task during ambient auditory distraction

• To explore semantic relatedness during distraction in demographically-matched non-neurologically impaired participants as well as in participants with aphasia
Why is this Important?

• Examining the parameters of interference, competition, and distraction effects on linguistic and cognitive processing may help us understand how the brain filters, selects, and allocates resources

• Multi-tasking (dnd “giga-tasking”) is pervasive and increasing, threatening our sanity and safety

• Compromised safety may be related to attentional resource depletion and ambient distraction
  – Risk of falls in the elderly
  – Cell phone driving accidents
  – Medical errors and industrial accidents
Multi-Tasking
Within-Subject Variables

- **Semantic Category**
  - Sports
  - Vegetables

- **Auditory Condition**
  - Quiet
  - Semantically related
  - Semantically unrelated
  - Bursts of white noise
Where Do We Process Vegetables?

Broccoli’s Area?  Maybe. Maybe not.

(thanks to JCR)
Semantically RELATED

Participants heard “Point to Corn” and then saw these pictures
Semantically UNRELATED

Participants heard “Point to corn” and then saw these pictures.
AUDITORY Conditions

41  Vhp dqvlf do\$ uhd\$v\$g h{dp s ch=
Category: Vegetables  Target: Corn
Participant heard: ÊEhdqv\$ Vtxdvk\$ h\$f ÎŠ-

51  Vhp dqvlf do\$ xquh\$d\$v\$g
Category: Sports
Participant heard: ÊKdp p hu\$  Exfnh\$ h\$f ÎŠ-

61 Txlhw\$ no distraction

71 Exuw\$ ri z klv\$ qr lvh/ non-linguistic interruption

- Qr wuj hwlv\$ vz hu\$ xvh\$ dv dxglw\$/ glwdf hvuv
Comparison of Semantic CATEGORIES

- Item analysis compared mean, standard deviation, and coefficient of variation (a ratio of sd to mean)

- RTs for vegetable targets were always shortest, regardless of visual or auditory distraction condition but differences between categories did not reach statistical significance (and were therefore pooled)

- Based on data from a previous study, the category Elugv was omitted because of item ambiguity and poor participant knowledge of avian categories...we believe the entire category migrated
Procedures (Auditory)

• All participants passed a hearing screening at 25dB
• Corrective hearing amplification or corrective lenses were allowed

• Auditory ambient distracters were presented at 60dB SL at ~500 ms intervals while participants processed the instruction to point to the target

• Conditions were counterbalanced
## Design Overview

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<thead>
<tr>
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<th>Target Category</th>
<th>7 Dxglwu/ Glvwdf wr q Ohvhv</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Quiet</td>
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<tr>
<td><strong>Semantically-Related</strong></td>
<td>1. Sports</td>
<td></td>
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<tr>
<td></td>
<td>2. Veggies</td>
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<tr>
<td><strong>Semantically UNRELATED</strong></td>
<td>1. Veggies</td>
<td></td>
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<tr>
<td></td>
<td>2. Sports</td>
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**7 Dxglwu/ Glvwdf wr q Ohvhv**

- 1. Sports
- 2. Veggies
- Semantically RELATED-Auditory
- Semantically UNRELATED - Auditory
- Bursts of white noise

**Design Overview**

**Visual Arrays**

- 4 pictures

**Target Category**

- 4 Auditory Distraction Levels
  - Quiet
  - Semantically RELATED-Auditory
  - Semantically UNRELATED - Auditory
  - Bursts of white noise

**Ylvxdo Duul v**

- 7 slf wuhv,
Methods and Procedures

• 17 healthy, young adults (mean age 20.1 yrs)

• 16 healthy, older adults (mean age 75 yrs)

• 10 participants with aphasia
  – Mean age 60 years
  – Single, left thromboembolic CVA
  – 7 fluent; 3 non-fluent
  – Mean Aphasia Quotient 83.2 on Western Aphasia Battery

• Participants were instructed to “point” to one of four displayed pictures using a 4-button keypad

• Task requirements remained constant; categories and auditory distractions were counterbalanced
Controls vs. Aphasia Reaction Times across Conditions*

*Statistically significant differences between controls and aphasia groups across all conditions.
Reaction Time Performance during Quiet, Related vs. Unrelated, and White Noise Conditions for Controls vs. Aphasia

null = no significant differences across conditions (controls)

** = statistically significant differences between quiet, unrelated, and related conditions; and between unrelated and related conditions (p< .05) (aphasia)
Picture Identification Reaction Time (Ms)
Control vs. Aphasia Groups Across Conditions
(Quiet; Semantically Related; Semantically Unrelated; White Noise)
Conclusions, 1.

- **Across all conditions, participants with aphasia had significantly longer reaction times**
  - This finding extended across semantic relatedness as well as across all conditions of distraction

- In the group of participants with aphasia, picture identification was **slowed by semantically related auditory distraction when compared to conditions of quiet and semantically-unrelated distraction**

- Control participants had no significant slowing of response across quiet, semantically unrelated or semantically related conditions
Conclusions, 2.

- Both control and aphasia participants performed significantly faster in the presence of white noise (annoyance factor?)

- Few errors were made; accuracy was not a factor that needed to be analyzed

- Performance in the presence of distraction is determined by many factors, including the linguistic context or semantic relatedness of the distraction
Older vs. Younger Participants

• A previous study contrasting younger and older participants on this task has found significant slowing on these tasks for older persons

• Our findings support and extend those of Wingfield, Tun, et al that there are important age effects to consider in linguistic processing during distraction or dual tasks

• Our findings support as well that the type of distracter is important
  – Meaningful distracters impaired performance more in previous studies
  – Semantic-relatedness emerges as another parameter of distraction that affects linguistic processing in older but not younger adults

• The degree of degradation of performance between older participants and those with aphasia provides further evidence that interference, competition, and distraction is less well tolerated during cognitive-linguistic processing by those with aphasia
Discussion

• But why did participants get faster during bursts of white noise?
  – The **bursts of white noise** were included to provide an interruption without a linguistic load. Possibly, participants found the static-like white noise sound **annoying** and it actually became an **incentive to hurry** and make a selection so that the noise would stop

• In Carpenterian fashion, **we’ve only just begun**. Much more research is needed to clarify the effects of interference, competition, or distraction on linguistic and cognitive processing
References


LaPointe, L.L., Stierwalt, JAG, Hancock, A.B., Goff, R., Heald, G.R., & Snowden. Reaction time effects of semantically related and unrelated visual and auditory distraction in younger and older normal adults. Presentation at Clinical Aphasiology Conference, May, 2006, Gent, Belgium.


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