

## Stimulus parameters and performance accuracy in naming treatment: Effect of word class, familiarity rating, and embodiment group

Stimulus selection for treatment of word retrieval deficits in aphasia is a component of successful treatment. Several categories of stimulus parameter have been investigated, such as word frequency (Kittredge, Dell Verkuilen & Schwartz, 2008; Morrison, Ellis & Quinlan, 1992; Nozari, Kittredge, Dell & Schwartz, 2011), age of acquisition (Brysbaert & Cortese, 2010; Gilhooly & Gilhooly, 1980), imageability (Luzzatti, Raggi, Zonca, Pistarini, Contardi & Pinna, 2002), word class (Matzig, Druks, Masterson & Vigliocco, 2009; Raymer, Ciampitti, Holliway et al., 2007), instrumentality (Jonkers & Bastiaanse, 2007) and familiarity (Sass, Heim, Sachs, Theede, Muehlhaus, Krach & Kircher, 2010). No category has been without disagreement as to the presence or magnitude of effect

Recently another category – embodied semantics – has been considered (Arevalo, Baldo & Dronkers, 2010; Arevalo, Perani, Cappa et al., 2007; Meteyard, Cuadrado, Bahrami & Vigliocco, 2010). Embodied semantics refers to the recruitment of sensorimotor cortex that typically supports motor execution, during tasks of processing linguistic stimuli that refer to motor-related concepts. Examples of stimuli that might be used in such tasks are writing (hand embodiment), chewing (mouth embodiment) and kicking (foot embodiment). That is, to process the term “writing” for example, in order identify a picture, motor cortex subsuming the act of writing may be activated in addition to cortex thought to support semantic knowledge about writing. Meteyard et al. (2010) concluded that evidence supports embodiment theories that consider a middle ground of neural convergence zones, but not highly constrained theories of either embodiment or disembodiment (that is, that motor cortex is not involved at all).

The present project reports an item analysis of stimulus parameters used in a single subject study of naming. Three parameters were examined for their contribution to successful naming performance: word class (noun vs. verb), word familiarity (familiar vs. unfamiliar) and embodiment (hand, foot or mouth). The dependent variable of response accuracy was compared across parameters, with the prediction that accuracy would be greatest for stimuli within one of the embodied groups (hand, foot or mouth), followed by familiar words. Word class was predicted to influence accuracy the least.

### Method

*Participant.* One female, aged 77 years, who was 12 years post onset of a single left hemisphere CVA participated. She completed high school and was a homemaker. Her *WAB* (Kertesz, 2006) results indicated a diagnosis of anomia, which was supported by subtests of the *PALPA* (Kay, Lesser & Coltheart, 1992). She scored at the 95<sup>th</sup> percentile on the *Raven's Progressive Matrices* (Raven, 2003). Her hearing and vision were adequate for the treatment task which was naming pictures within a cueing hierarchy. Written consent for participation was obtained following local IRB requirements.

*Treatment.* The treatment design was a multiple baseline across stimuli; the dependent variable was correctly naming pictured items. Treatment was a semantic and phonologic cueing hierarchy, with cues created specifically for each item. A stable baseline was established prior to initiating treatment, and probe trials were conducted daily for treatment stimuli and weekly for stimuli intended for generalization. Treatment sessions were one hour and conducted twice weekly for four weeks.

*Materials.* 117 pictured nouns and verbs selected from the Snodgrass and Vanderwoort (1980) pictured set comprised the stimuli – 60 for treatment and 57 for generalization. Familiarity was rated according to norms provided by Snodgrass and Vanderwoort and from ratings by the participant. Membership in an embodiment group (hand, foot mouth) was determined from word definition by two individuals who reached agreement on each item.

*Item analysis.* Each treatment and generalization item was analyzed for accuracy across time. Stimuli were recast into three categories: word class (noun vs. verb), familiarity (familiar vs. unfamiliar) and embodiment (hand, foot, or mouth) for accuracy analysis.

## Results

Accuracy rates for items in all categories but one (hand embodiment group) showed large standard deviations and wide ranges. Percent accuracy across all treated items was 64%, and 46% across all generalization items (Table 1). The difference between treatment accuracy rates and generalization accuracy rates was greater for items in the large categories of word class, familiarity and embodiment, than for items which combined word class and familiarity (i.e. high familiarity nouns). Percent accuracy was greatest for items in the “mouth” embodiment group (91%), followed by high familiarity nouns (71%), then all nouns (66%) and finally the “hand” embodiment group (61%). Items in the remaining categories were near or below 50% accuracy across time.

## Discussion

Results of this study argue for careful selection of stimuli, however cannot support the saliency of one of the three categories investigated over the others. That is, while effects of word class, familiarity and embodiment were apparent, none was substantially better than the others.

The number of items contributing to each analysis varied, sometimes by more than 50 items (i.e. 73 items were in the high familiarity group while 11 were in the “mouth” embodiment group), which may have accounted for differences in accuracy. In addition, items were not rated for typicality within a group (e.g. how close the familiarity ratings were for items in that group, or how representative of the “foot” embodiment group were those items). The one group with the smallest standard deviation, the “mouth” embodiment group, also had the highest accuracy rate, suggesting that selecting stimuli that are consistent may lead to better acquisition; generalization accuracy for this group however was low.

Data from the current project illustrate the success of a cueing hierarchy for treating naming deficits in people with aphasia, however do not conclusively support embodiment theory as a basis for stimulus selection.

Table 1. Percent correct for items overall, and by word class, familiarity and embodiment.

|       |  | Overall |       |
|-------|--|---------|-------|
|       |  | Treat   | Gen   |
| Mean  |  | 64.12   | 45.61 |
| SD    |  | 35.45   | 38.42 |
| Range |  | 0-100   | 0-100 |

  

|       |  | Noun vs Verb |        |                |       |
|-------|--|--------------|--------|----------------|-------|
|       |  | Treatment    |        | Generalization |       |
|       |  | Noun         | Verb   | Noun           | Verb  |
| Mean  |  | 65.73        | 59.73  | 42.44          | 55.36 |
| SD    |  | 35.24        | 35.77  | 38.78          | 36.92 |
| Range |  | 0-100        | 14-100 | 0-100          | 0-100 |

  

|       |  | Familiar vs Unfamiliar |       |                |       |
|-------|--|------------------------|-------|----------------|-------|
|       |  | Treatment              |       | Generalization |       |
|       |  | High                   | High  | Low            | Low   |
| Mean  |  | 71.41                  | 52.70 | 51.39          | 35.71 |
| SD    |  | 34.54                  | 33.73 | 36.32          | 40.75 |
| Range |  | 0-100                  | 0-100 | 0-100          | 0-100 |

  

|       |  | High Familiarity |        |                |       |
|-------|--|------------------|--------|----------------|-------|
|       |  | Treatment        |        | Generalization |       |
|       |  | Noun             | Verb   | Noun           | Verb  |
| Mean  |  | 49.25            | 38.60  | 40.54          | 28.22 |
| SD    |  | 27.96            | 15.05  | 15.90          | 17.43 |
| Range |  | 0-100            | 14-100 | 0-100          | 0-100 |

  

|       |  | Low Familiarity |        |                |       |
|-------|--|-----------------|--------|----------------|-------|
|       |  | Treatment       |        | Generalization |       |
|       |  | Noun            | Verb   | Noun           | Verb  |
| Mean  |  | 32.72           | 23.68  | 25.52          | 18.47 |
| SD    |  | 14.64           | 12.78  | 11.42          | 9.97  |
| Range |  | 0-100           | 14-100 | 0-100          | 0-100 |

  

|       |  | Embodiment |      |        |                |       |       |
|-------|--|------------|------|--------|----------------|-------|-------|
|       |  | Treatment  |      |        | Generalization |       |       |
|       |  | Hand       | Foot | Mouth  | Hand           | Foot  | Mouth |
| Mean  |  | 60.59      | na   | 90.50  | 54.63          | 66.67 | 35.00 |
| SD    |  | 33.06      | na   | 11.76  | 41.04          | 14.43 | 28.50 |
| Range |  | 0-100      | na   | 71-100 | 0-100          | 50-75 | 0-75  |

