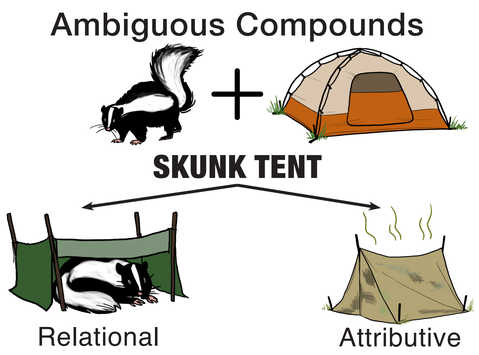
An examination of the neural bases of conceptual combination in stroke aphasia

Abby R. Clements[1], Bethany Blass[2], Casey Ferrara[2], Krysta Duquette[2], Sharon L. Thompson-Schill[1], and Erica L. Middleton[2]

[1]University of Pennsylvania, [2]Moss Rehabilitation Research Institute

Introduction

- Natural language comprehension requires the ability to combine single words and phrases into more complex meanings, a process called *conceptual combination*
- There are two putatively distinct types of conceptual combination: *attributive* (concepts are broken down into features and an attribute of the modifier is mapped to the head noun) and *relational* (a relation between the concepts is identified)
- Two areas of the brain—anterior temporal lobe (ATL) and angular gyrus (AG)—have been theorized to support conceptual combination[1], but it is unclear whether they are distinct hubs, such that ATL supports attributive combinations and AG supports relational[2]



- One alternate theory holds that AG is differentially responsible for events, such that AG damage should be correlated with difficulty with relational compounds specifically, while ATL damage might cause difficulty with both types of combinations[2]

***CURRENT QUESTION:* Will damage to either ATL or AG lead to difficulties with either attributive or relational combinations, respectively?**

Acknowledgments

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References

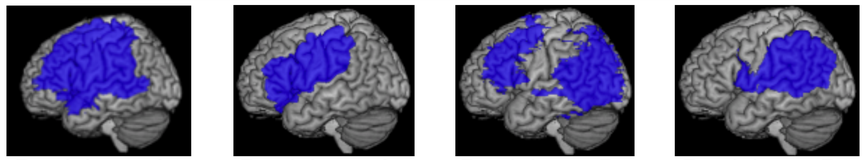
[1] Boylan, C., Trueswell, J. C., & Thompson-Schill, S. L. (2017). Relational vs. attributive interpretation of nominal compounds differentially engages angular gyrus and anterior temporal lobe. *Brain and Language, 169*, 8-21.

[2] Schwartz, M.F., Kimberg, D.Y., Walker, G.M., Brecher, A., Faseyitan, O.K., Dell, G.S., Mirman, D., & Coslett, H.B. (2011). Neuroanatomical dissociation for taxonomic and thematic knowledge in the human brain. *PNAS*, 108(20), 8520-8524.

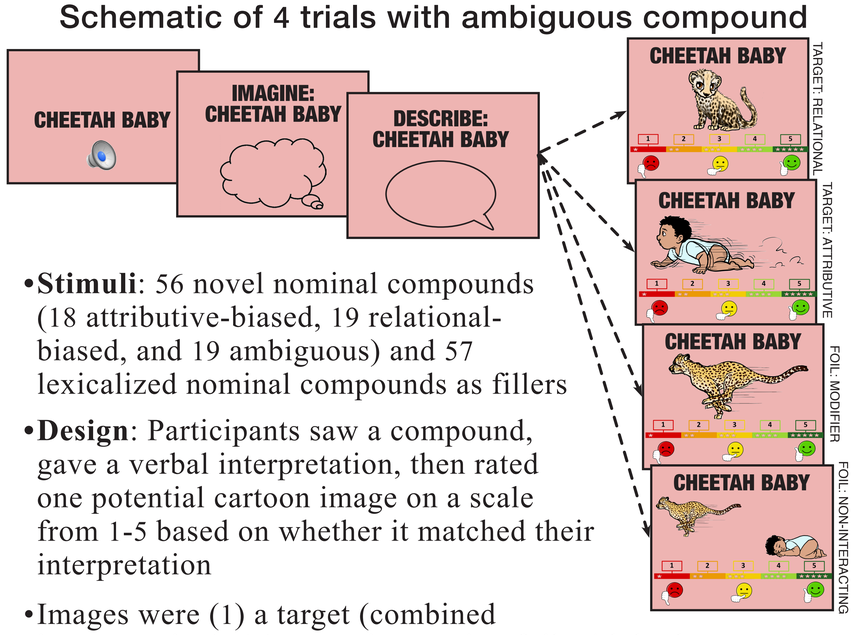
Participants

- 4 participants with chronic aphasia secondary to left-hemisphere stroke (2 anterior lesions including ATL, 2 posterior lesions including AG)
- 15 neurotypical age-matched controls

	% damage BA 38 (ant)	% damage BA 39 (post)	WAB AQ	WAB dx	PNT%	Camels& Cactus%	PPVT%
A1	95%	22%	51.6	Broca's	41	78	77
A2	32%	0%	61.6	Broca's	71	72	72
P1	0%	88%	82.4	Anomic	81	88	85
P2	1%	96%	88.5	Anomic	78	89	85



Methods and Materials



- **Stimuli**: 56 novel nominal compounds (18 attributive-biased, 19 relational-biased, and 19 ambiguous) and 57 lexicalized nominal compounds as fillers
- **Design**: Participants saw a compound, gave a verbal interpretation, then rated one potential cartoon image on a scale from 1-5 based on whether it matched their interpretation
- Images were (1) a target (combined interpretation), (2) a non-interacting foil with both nouns in separate pictures, or (3) a foil with the modifier alone
- **Coding**: Verbal interpretations were coded by two trained coders as relational, attributive, both or neither (percent agreement = 0.84)

Preliminary Results

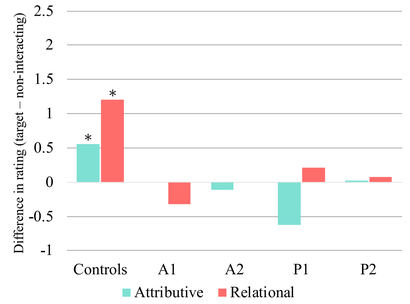


Figure 1: Both sets of participants show disruptions in rating ambiguous compounds.
*$p < 0.05$

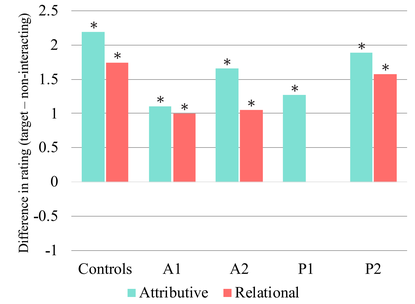


Figure 2: Both sets of participants show ability to interpret both types of biased compounds.
*$p < 0.05$

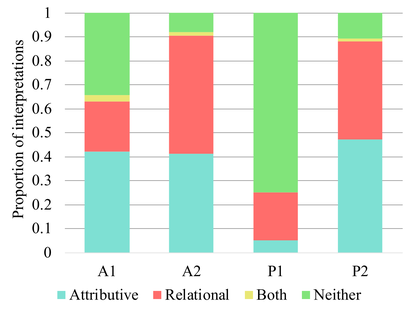


Figure 3: Participants differ in interpreting ambiguous compounds.

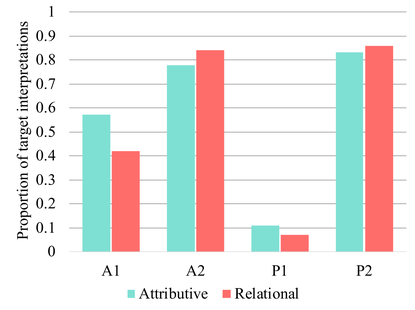


Figure 4: Participants have similar levels of target intepretations on both types of biased compounds.

Discussion

- Both ATL- and AG-damaged participants were able to interpret both types of compounds, with no clear difference based on type of damage
- Lack of damage to right AG may be contributing to their success, since past research has shown it plays an important role in novel conceptual combination[1]
- **Future research:** Examining people with both left- and right-sided damage, or right-sided damage alone
- Voxel-based lesion-interpretation mapping using the different combination types and interpretations
- Implementing a forced-rank task rather than a rating task to more directly compare targets for ambiguous compounds