

Semantic proto-role property similarity predicts aptness of metaphorical events

Lucas Y. Li (lly27@cornell.edu), Marten van Schijndel (mv443@cornell.edu) – Cornell

While much of the work on Conceptual Metaphor Theory focuses on conventional mappings [1], Lakoff and Turner [2] also argue that all metaphor is constrained by generic-level event structure, including causality and persistence of entities. However, this has not yet been tested empirically. We operationalize event structure using proto-role properties (PRPs) [3], the fine-grained semantic features characteristic of Agents and Patients, and test whether aptness is predicted by similarity in PRP profiles of the entities mapped in the metaphor.

Experiment 1: We construct 24 Animal-domain and 24 Human-domain events, varying agentivity of the base event templates (eg. *encountered/interviewed/interrogated*), and fully cross them to create Animal-Human metaphors (Table 1a). For norming, participants (n=115) rate the PRPs of each event’s entities, following [4, 5]. A second group (n=81) rates the aptness on a 5-point Likert scale. An LMM¹ finds PRP similarity of subjects predicts aptness, particularly *Awareness*, *Instigation*, and *Resisted*. Object distances are not significant, which is unsurprising as our stimuli are only constructed to vary agentivity of subjects (Table 2).

Experiment 2: We test if this extends to metaphors LLM-generated from source-target frame pairs. We estimate PRP averages of FrameNet frames and for each literal sentence and target frame, sample PRP-compatible and incompatible source frames while controlling for FrameNet distance. From each source-target pair, we generate a novel metaphor using [6]’s BART-based model and dataset, which takes a literal sentence and source frame and replaces the target verb with a metaphorical verb evoking that source frame (Table 1b). Participants (n=50) are asked to select the more apt metaphor in a forced-choice design. They prefer metaphors with PRP-compatible source frames ($p<0.001$) and their choices are predicted by PRP distances,² especially subject *Instigation* and *ChangeOfState* (Table 3).

Discussion: This work provides evidence that event structure predicts aptness, but PRPs are not all equally important. Personification shows why: non-human subjects can be construed as Agents despite mismatches in animacy if they preserve causal structure [2]. Accordingly, Experiment 1 finds aptness of controlled metaphors is predicted by features of the subject related to event participation. Experiment 2 supports the importance of causal structure; when only the verb is made metaphorical, the significant subject PRPs are *Instigation* and *ChangeOfState*. Experiment 2 also finds effects for features of objects, suggesting they may influence aptness in ways less directly predicted by the personification-based account developed here. Although significant predictors differed across experiments, this is expected as Experiment 1 varies entire event descriptions, whereas Experiment 2 tests a mapping of only the verb. Our results show that Lakoff and Turner’s proposed event structure constraints on metaphor are empirically supported by human judgments.

¹ aptness ~ role-specific_PRP_distances + (1 | participant) + (1 | base_template_pair)

² choice ~ role-specific_PRP_distances + FrameNet_distance + (1 | participant)

References

[1] Lakoff and Johnson, 1980. Metaphors we live by. [2] Lakoff and Turner, 1989. More than cool reason: A field guide to poetic metaphor. [3] Dowty, 1991. Thematic proto-roles and argument selection. *Language*. [4] Kako, 2005. Thematic role properties of subjects and objects. *Cognition*. [5] Reisinger et al., 2015. Semantic proto-roles. *TACL*. [6] Stowe et al, 2021. Metaphor generation with conceptual mappings. *ACL*.

Figures and Tables

Table 1: Example stimuli

a) Experiment 1: Aptness rating task	b) Experiment 2: Forced-choice
Human target: <i>A policeman interviewed a witness.</i>	Target: <i>Be content to prove your sway.</i>
Animal source: <i>A wolf marked its territory.</i>	Compatible-frame source: <i>Be content to build your sway.</i>
Rated: <i>A policeman interviewing a witness is like a wolf marking its territory.</i>	Incompatible-frame source: <i>Be content to feel your sway.</i>

Table 2: PRP distance effects on metaphor ratings in Experiment 1. Negative coefficient indicates preference for greater similarity. Significant rows bolded.

Position	Property	Coef.	p-value
subj	awareness	-0.421	0.001
	instigation	-0.232	0.048
	volition	-0.215	0.170
	was_for_benefit	-0.192	0.052
	change_of_state	-0.129	0.306
	change_of_location	-0.116	0.222
	resisted	-0.177	0.043
dobj	awareness	0.065	0.231
	instigation	0.033	0.676
	volition	-0.004	0.960
	was_for_benefit	-0.076	0.295
	change_of_state	-0.022	0.774
	change_of_location	-0.098	0.195
	resisted	-0.042	0.513

Table 3: PRP distance effects on metaphor preference in Experiment 2. Negative coefficient indicates preference for greater similarity. Significant rows bolded.

Position	Property	Coef.	p-value
subj	awareness	0.407	0.124
	instigation	-0.360	0.028
	volition	-0.007	0.979
	sentient	0.042	0.730
	change_of_state	-0.312	0.003
	change_of_location	-0.019	0.814
	change_of_possession	-0.083	0.344
	existed_after	-0.104	0.294
	existed_before	-0.066	0.429
	existed_during	0.164	0.025
dobj	awareness	0.054	0.688
	instigation	0.095	0.472
	volition	-0.137	0.331
	sentient	-0.235	0.048
	change_of_state	0.129	0.324
	change_of_location	0.255	0.041
	change_of_possession	-0.178	0.096
	existed_after	0.038	0.889
	existed_before	0.206	0.162
	existed_during	-0.557	0.070
iobj	awareness	0.006	0.963
	instigation	0.263	0.067
	volition	-0.027	0.863
	sentient	-0.262	0.014
	change_of_state	-0.285	0.009
	change_of_location	0.131	0.269
	change_of_possession	0.100	0.266
	existed_after	0.108	0.476
	existed_before	0.208	0.085
	existed_during	-0.358	0.052