A Cognitive Model of Scales

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Scales are ubiquitous in language and thought and scalar reasoning is a fundamental cognitive operation [1]. Scales are used for comparing situations and individuals and the results are often drivers for decisions and actions. They are crucial to the semantics and pragmatics of language, including event structure, comparatives, interrogatives, negation, and polarity. We present a cognitive model of scales and its computational realization. The model is able to solve previously open questions in scalar inference.

In our model, scalar reasoning is conceptualized as *simulated action* [4] often as motion along a path. The model is based on a common projection that maps scales to linear paths [3]. The logic of paths and motion along paths is structures scalar inferences and entailments. Projections from regions in the path form ranges of the scale. Projections can incrementally create subscales through zoom in operations. Realizing propositions is like moving on a path from the low to high levels of the scale. Places visited are available as inferences. Inferences on locations visited from the *simulated motion* carry over to inferences on scalar values. Negation corresponds to motion along segments of the path not visited. This corresponds to the reverse scale with simulated motion from the high to low location. Entailments (downward and upward) fall out of the simulation on forward and reverse simulations.

Simulated motion evokes aspects of the structure and performance of actions that are crucial to scalar coordination and reasoning. In general terms, the dynamics of action selection and performance helps coordinate two different kinds of scalar entities

1. Expenditures, resource consumption, and impediments to action
2. Enablers, stimuli, and reward scales.

More specifically, different elements of the fine grained structure of actions (resources, sub-actions, preconditions, effects, outcomes, progress amounts, etc.) are often conceptualized as scales and linguistic constructions explicitly compare alternative values on these scales, while allowing the speaker to emphasize or attenuate the rhetorical aspects of the comparison.

The paper will describe results of applying the model to the following linguistic phenomena

1. ***Scalar entailments***. This includes scalar entailments in canonical and scale reversal contexts (such as with negation, conditionals, and questions) (see [5] for a detailed discussion).
2. ***Polarity Sensitive Items (PSI)*** (emphatic and attenuative) are linguistic phenomena that are sensitive to the polarity (negative or positive) of the linguistic context. This includes Negative Polarity Items (NPI) and Positive Polarity Items (PPI). The model deals with both *canonical* and *inverted* PSI [2].
3. ***Coordinated scales***: Scalar models often involve multiple scales combined in complicated ways based on linguistic constructions. We believe our model is the first model that explains how sentences such as the celebrated one below (from [1]) are interpreted.

    a. You can't get a poor man in bad times to wash a car for $2, let alone a rich man in good times to wash a truck for $1.

References

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