Correlation among sentences with social relations and spatial distance: A gaze-tracking study

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November 21, 2014

Abstract

In everyday language, people commonly use spatial concepts to communicate aspect of social relations in expressions such as “he’s a close friend”. The Conceptual Metaphor Hypothesis suggests that such expressions arise because abstract representations such as social intimacy are grounded in physical experience such as spatial distance through metaphorical mapping. It is also know that spatial information can modulate participants’ reports on their social bonds in a way that is coherent with the conceptual metaphor hypothesis. In this experiment I looked at how cues of spatial distance affect reading times of sentences related to social intimacy of two people. Results agree with previous work and the CMH and show faster reading times when the cues align with the intimacy of the relation in the sentence.

1 Introduction

The aim of the experiment is to extend findings of spatial distance effects on abstract sentence interpretation in two ways:

First, I examined an abstract semantic domain, namely intimacy in social relations, which according to the CMT is also associated with spatial distance.

Second, I examined whether spatial distance effects could be observed in the absence of an „and“-coordination of nouns.

1.1 Conceptual Metaphors

In cognitive linguistics, conceptual metaphor, or cognitive metaphor, refers to the understanding of one idea, or conceptual domain, in terms of another. An example of this is the understanding of quantity in terms of directionality (e.g. "the prices are rising").

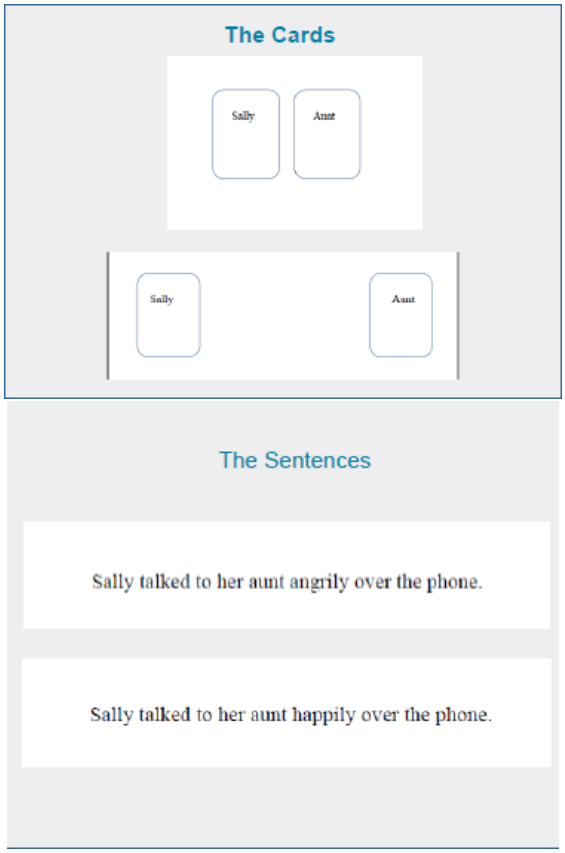
A conceptual domain can be any coherent organization of human experience. The regularity with which different languages employ the same metaphors, which often appear to be perceptually based, has led to the hypothesis that the mapping between conceptual domains corresponds to neural mappings in the brain. [Feldmen, Narayanan]

2 Methodology

A gaze tracking experiment was conducted on a group of 23 subjects.

The Experiment involved a set of English sentences which were preceded by a pair of cards inscribed with a pair of nouns. The cards either moved closer or further apart. After the pair of cards the next slide carried a sentence with the pair of nouns and were either showed positive social intimacy or negative social intimacy.

The structure of the sentences were
NP –VP –NP –ADV –PP –NP



3 Implementation

Some of the implementation details of the experiment are as follow

1.) The Gaze-Tracking software used was SMI BeGaze developed by SensoMotoric Instruments.

2.) Each subject was presented with a set of 12 sentences – 6 of which had positive correlation between Spatial Cue and Social Intimacy and 6 which had a negative correlation between the two parameters.

3.) The subject was instructed to not move post calibration and read each sentence without flickering unnecessarily. The sentences were all in a single line to avoid an output of complicated and crisscrossing path-maps.

4.) Subjects were asked to simply read the sentence and indicate to the experimenter when they want to move on to the next slide.

4 Results

Presented below are some snapshots from 3 videos of conduction and their analysis. The next subsection shows the data obtained by Guerra and Knoeferle in their original work (as our raw data had some limitations and could not be analyzed).

4.1 Path-Maps

A)

Spatial Cues of Distance – Less Social Intimacy

B)

Spatial Cues of Nearness – Less Social Intimacy

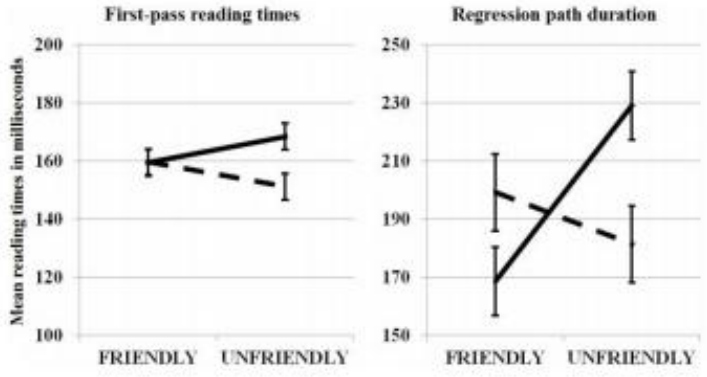
C)

Spatial Cues of Distance – More Social Intimacy

As we can see, on comparison on screenshots of Path-Map videos of A) and B), that it takes more effort by the subject to read sentences with negative correlation between Spatial Cues and Social Intimacy in the sentences.

4.2 First Pass Times and Regression Plots

[Analysis and Plots take from Guerra and Knoeferle, 2014]



Mean first-pass reading time (on the left) and regression path duration (on the right) in milliseconds for the PP region as a function of spatial distance (solid and dashed lines represent close and far distance, resp.) and sentence type (friendly vs. unfriendly) in Experiment. Error bars represent standard errors of the mean (SE).

At the critical ADV region, a main effect of distance in regression path duration was observed (close: 475 ms, far: 385 ms; p=.007). Moreover, while first-pass times for sentences expressing similarity were virtually the same when preceded by cards close together vs. apart (296 ms vs. 298 ms, resp.), for sentences expressing dissimilarity shorter first-pass times were observed when preceding cards were close vs. far (278 ms vs. 298 ms, resp.).

No other significant effects emerged in this region. At the immediately subsequent region (PP), we observed marginally significant main effects of distance in first-pass, and of distance and social relation in regression path duration (all p-values <.1). More importantly, reading times at the PP region were faster when a sentence expressing a friendly interaction was preceded by cards close together compared to far apart, while reading times for sentences expressing an unfriendly interaction were faster when preceding cards moved far apart compared to close together. This interaction between spatial distance and social relations was reliable in first-pass (p=.035) and regression path (p=.009). The figure above shows the pattern of interaction in the experiment.

5 Conclusions

In the Experiment I observed whether spatial cues would affect reading times of sentences about social relations. Furthermore, I examined whether these effect could emerge in the absence of an „and"-coordination of nouns. The results from showed that spatial distance

distinctively affected reading times (at the PP) as a function of whether they expressed a friendly or an unfriendly social relation.

6 Limitations

There were a number of issues that plagued the experiment and made the raw output data unfit to be used for analysis. Some of these are mentioned below with possible solutions.

1) Unsteady Gaze – The experiment and the software apparatus required a steady gaze while reading. Flickering and/or diverting from the sentence led to unusable crisscrossing data of X-Y coordinates versus Time. A possible solution is to give the subject support to rest against.

2) Multiple-line sentences – Another bottleneck was the difficult to use sentences that would run on to multiple lines as the gaze of the subjects wavered between the two lines. The solution would ideally be to clearly instruct the subjects to focus on a word at a time sequentially.

3) Run-time of BeGaze – A serious bottleneck on the acquisition of data was the amount of time taken by the software to collate the data of each subject. Time for software to start up would range up to 40 min per subject. Proper maintenance of the system that runs the software needs to be done to avoid such bottlenecks. Also, the experiments should ideally optimize the number of slides to present each subject.

7 Future Work

There are two stages to possible future work on this project:

The raw data contains a number of insights with regards to X-Y Coordinates vs Time, Regressions, Fixation Times and more. Proper analysis of the data would lead to numerical evidence for correlations between total time, first pass time with the similarity or dissimilarity of cues.

The domain of the work can be extended from social relations to other aspects like the mapping of Temperature-Intimacy and Spatial Cues to Positivity/Negativity.

8 Acknowledgements

I would like to thank Dr. Amitabha Mukerjee for his guidance and mentorship in the project.

References

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Additional Material

The sample videos and the raw data can be found at
http://home.iitk.ac.in/~shashab/se367/project/