

A Computational Model of the Perception of Partially Occluded and Fragmented Figures

Faculty Research Grant - Closing Report - Account #22-563-09
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June 1, 2003

I. Introduction

This Faculty Research Grant was awarded in support of continued development of my computational model, which aims to explain human perception of partially occluded and fragmented figures, and the testing of this model's predictions. In my grant proposal, I outlined the following **2 year plan** for my research:

Phase 1: Model build out.

- a. Add relative contour depth property.
- b. Add relative contour curvature property.
- c. Add a 'grouping' mechanism to implement the Gestalt law of good continuation.

Phase 2: Test outstanding model predictions.

- a. Prediction 1: In addition to **contour** information, humans use **region** information from the retinal image.
- b. Prediction 2: In classifying **contour** information in the retinal image, humans use **global** information from the image. That is, information processing is not strictly local.

Phase 3: Implement model on Beowulf parallel system.

Since the grant duration (1 year) was shorter than the overall research plan (at least 2 years), I originally intended to focus on Phase 1 activities (see proposal). However, a student wanted to do research with me, so I did some Phase 1 work and then switched to Phase 2 activities for the remainder of the grant period. I think this worked well for us both. Phase 2 activities involved human psychophysical experiments. Because such experiments have a certain form, the student was able to make immediate contributions, while absorbing a new research area and learning about the scientific method. The arrangement also helped me, because it is useful to have a collaborator when doing human psychophysics (Phase 2 activities), and therefore I did not have to search for someone. Also, it was my first experience as a professor to work with a student, and this experience was very positive.

II. Description of grant-supported activity

Phase 1 involves additional programming of the computational model, so I ported my code from my old HP/UX workstation at Purdue to my HP Itanium workstation at IUSB. I tested this code on the new system thoroughly, including replication of some simulations performed on the old system. Next, I created a visualization tool so that I could inspect individual images input to the model and output by the model. Then, I wrote the code for Phase 1, part (a), to add the relative contour depth property to the model. (The code will be tested this summer, with the goal of presenting the results in a paper at the Cognitive Science Society conference in Chicago in summer '04). After writing this code, I switched to Phase 2 of the project.

Phase 2 required running human psychophysical experiments. We tested prediction 1 in Phase 2, part (a), that humans use **region** information (in addition to **contour** information) from the retinal image. Two experiments were performed to test this hypothesis, and we found that humans indeed use region information in perceiving partially occluded and fragmented figures. Further, these two experiments suggested a possible explanation for the region effect that was observed – namely, that region information engages human **visual attention**, which in turn facilitates processing of partially occluded and fragmented figures. We designed, setup, and executed a brand new third experiment to test this possibility. We found that the region effect obtained in Experiments 1-2 may be partially, but is not fully, explained in terms of human visual attention. We presented the results of Experiments 1-3 at the annual meeting of the Vision Sciences Society in Sarasota, Florida last month (May 9th, 2003) and our abstract will be published in the Journal of Vision later this year. These three experiments also led to a brand new conjecture. Perhaps humans only use region information when it is ambiguous as to what is represented by the retinal image. When the retinal image is unambiguous, perhaps it suffices to use only contour information. I plan to test this new conjecture later this summer by having my computer model simulate some of the human experiments performed this past year. If the conjecture holds up, the psychophysical and simulation results should form the basis of a nice paper.

Running Experiment 3, which was not in the original proposal, took precedence over testing prediction 2 in Phase 2, part (b), of the original proposal. As described above, the unplanned Experiment 3 resulted from testing prediction 1 in Phase 2 and therefore needed to be run before moving on to something else. However, I will begin the experiment for Phase 2, part (b), this month (June 2003).

Finally, I have sought out potential sources of external funding using Community of Science and other resources. I have determined that the following agencies support my line of research:

- National Eye Institute (NEI/NIH)
- Office of Naval Research (ONR)
- National Science Foundation (NSF)
- Army

Of these, I have spoken with Michael Oberdorfer at the National Eye Institute/NIH who suggested that an R15 ‘Area’ grant might be a good choice, since it is a “special program for ‘teaching-emphasis’ universities”. In the end, I decided to try instead to push two publications through in the coming year. I think this would give any grant proposal I may write a better shot at being funded.

III. Were you able to complete the project? Describe any difficulties you had.

My original project estimate was 2 years, longer than the 1 year duration of the grant itself. Thus, my grant proposal sought funding for only part of this project. The grant allowed me to accomplish a significant piece of this project.

IV. Did, or will, the project result in a specific product – a manuscript, composition, syllabus, etc.? If so, please describe and indicate state of development.

Effect of Region Information on Perception of Partially Occluded Figures by Michael R. Scheessele and Thomas M. Perez was presented as a poster at the annual meeting of the Vision Sciences Society in Sarasota, Florida on May 9th, 2003. The abstract will appear in *Journal of Vision* later this year. The support of this IUSB Faculty Research Grant was acknowledged

As mentioned above, upon successful testing of the **relative contour depth feature** code this summer, I plan to submit a paper to the Cognitive Science Society '04 conference. Also as mentioned, Phase 2 work led to a new conjecture, which I plan to test this summer. If the conjecture holds up, I believe it would make a nice paper. If/when either of these 2 papers are published, support of this IUSB Faculty Research Grant will be properly acknowledged.

In closing, I am grateful for the support of this Faculty Research Grant, without which I would have made little progress with this project.

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