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14. ABSTRACT

The goal of this grant was to test the ambiguity-priming hypothesis empirically, as well as to provide a quantitative description of this behavior using approaches borrowed from game theory. Ambiguity-priming was behaviorally tested with N=20 individuals at the visual perceptual level with a motion detection task including points with probabilistic coherence. We did not find evidence for the hypothesis that ambiguity priming facilitates pattern detection or influences set-shifting in the visual perceptual domain with the random-dots motion task. However,

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Report Title

Final Report for "Ambiguity Priming Facilitates Pattern Detection and Resistance to Set-Shifting"

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List of papers submitted or published that acknowledge ARO support during this reporting period. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Number of Papers published in peer-reviewed journals: 0.00

(b) Papers published in non-peer-reviewed journals or in conference proceedings (N/A for none)

Number of Papers published in non peer-reviewed journals: 0.00

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts): 0

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts): 0

(d) Manuscripts

Number of Manuscripts: 0.00

Patents Submitted

Patents Awarded

Graduate Students

NAME PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Post Doctorates

NAME PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Faculty Supported

NAME PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Names of Under Graduate students supported

NAME PERCENT_SUPPORTED

FTE Equivalent:
Total Number:

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: ......

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:......

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:......

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):......

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:......

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense ......

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Names of Personnel receiving masters degrees

NAME

Total Number:

Names of personnel receiving PHDs

NAME

Total Number:

Names of other research staff

NAME	PERCENT_SUPPORTED

FTE Equivalent:

Total Number:

Sub Contractors (DD882)

Inventions (DD882)

Final Report for "Ambiguity Priming Facilitates Pattern Detection and Resistance to Set-Shifting"

Lilianne R. Mujica-Parodi

SUNY Stony Brook, Deptartment of Biomedical Engineering

AMSRD-ARL-RO-OI Proposal Number: 56817-MA-II

Agreement Number: W911NF-09-1-0462

Statement of Problem Studied

The goal of this grant was to test the ambiguity-priming hypothesis empirically, as well as to provide a quantitative description of this behavior using approaches borrowed from game theory. Ambiguity-priming was behaviorally tested at the visual perceptual level with a motion detection task including points with probabilistic coherence.

Summary of Accomplishments

Programming of Stimuli: Our choice of a programming platform was the MATLAB Psychophysics toolbox to allow for precise control of stimuli presentation as well as maximal versatility in modulating the task flow. The stimulus design was adapted from Shadlen and Newsome (Shadlen & Newsome, 2001). Given the novelty of the stimuli we added a five-minute long practice session in which we give subjects feedback on their response accuracy as well as showing the correct direction. This assures elimination of variability across subjects that might be caused by difficulties in adjusting to the use of the equipment, and the necessary number of trials needed to converge to the plateau level of performance.

Response Box: Typical behavioral testing in response time tasks uses a keyboard or a mouse for response collection. However this method introduces measurement error into the measured response times due to the imprecise interaction between the software and the hardware. This measurement error varies between 20-70 ms, which is comparable to human variability in reaction time (Li et al, 2009). To obtain the highest accuracy in the collected response times we have ordered a customized response box. This serial response box fabricated by (USTC, China) and can achieve an accuracy of 0.01 ms. The positioning of four buttons for the corresponding directions was carefully chosen to be in a linear set-up to allow for the most comfortable hand positioning for the subjects.

Pilot Data: We presented a standard set of stimuli of varying coherences (difficulty levels) to 10 subjects in order to establish performance level as a function of stimulus coherence. This is the standard method used for the Random Dot-Motion Task, which normally focuses solely upon mean performance per coherence level for the entire group. However, we observed that there was actually a quite significant degree of individual variability in participants' ability to detect signal in varying degrees of noise. We found this unexpected feature to be provocative in terms of its behavioral implications, relatively unexplored within the literature (from a neurobiological perspective), and worthy of further investigation. However, this method proved to be ineffective for the purposes of this grant as there was great variability between the performance levels of subjects for a given level of stimuli. We found that the same set of stimuli elicited radically different response patterns between subjects. As the proposed task design calls for strict control over the level of difficulty associated with the stimuli to be presented in the course of the experiment, it was necessary to employ methods tailored to the sensitivity of each and every subject.

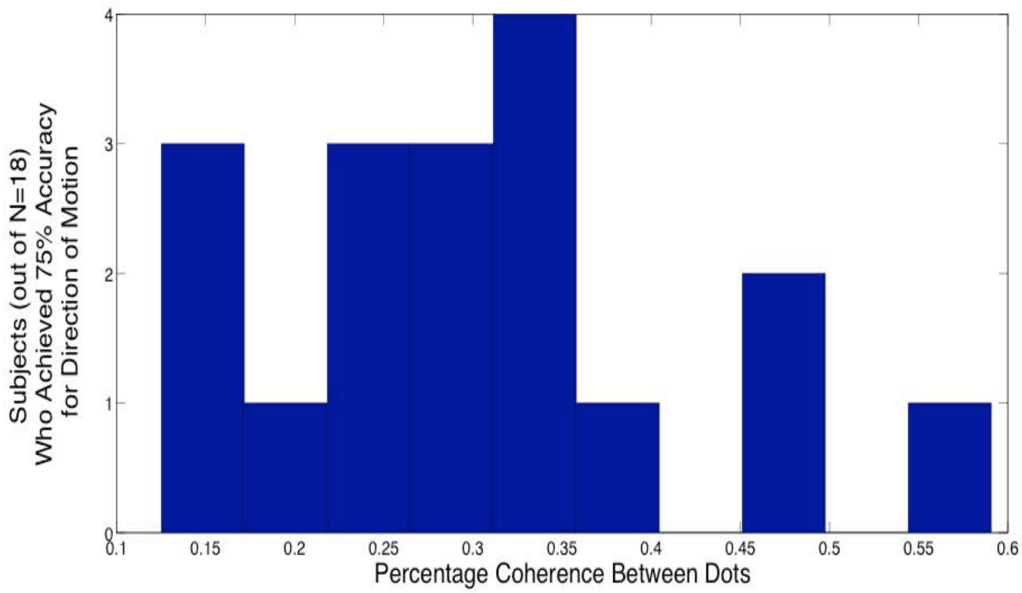

Figure 1: A histogram of N=18 additional participants' performance using the adaptive algorithm showed a wide range of coherence levels necessary to reach 75% accuracy, ranging from 15% coherence to 55% coherence. The distribution was roughly Gaussian (statistics above), with 17% requiring very low (15%) coherence in order to reach 75% accuracy and 17% requiring high coherence (45-55%) coherence in order to reach the same level of accuracy.

Adaptive Algorithm: Given the great disparity between participants' sensitivity to the stimuli we therefore sought to employ an adaptive algorithm, which would allow us to find more precisely the desired difficulty levels for each participant. To find the most effective method we have compared two of the most commonly used approaches in psychophysics: staircase estimation of threshold performance and direct fitting of the psychometric curve. We implemented an adaptive staircase method (ADM; Faes, et al., 2007), and a Bayesian algorithm for fitting (Wichmann & Hill, 2001). We carried out extensive Monte Carlo simulations generating random responses assuming different underlying psychometric functions. We found that the ADM method was more accurate and that a reasonably low number of trials (i.e., ~100 trials for +/- 5% of desired performance level) are sufficient to establish designated values of performance. Testing in an additional set of participants (N=18) using the adaptive algorithm we identified a large range of coherencies needed to reach 75% correct (see Figure 1), thus identifying the optimal, hyper, and hyposensitive groups described in our Specific Aims. Distributions were normal (*D'Agostino-Pearson Test*: p=0.3715; *Kolmogorov-Smirnov Test*: p=0.7), with M=30.22%, SD=±12.26% coherence.

Set Shifting Analyses: With an N = 20, a 2 × 3 repeated measures analysis of variance (ANOVA) was conducted to assess the effects of priming duration (8 sec vs. 12 sec) and ambiguity/coherence (low vs. med vs. high) on participants' reaction times on set shifting test trials. An effect of prime duration approached significance ($F(1, 15) = 3.70$, $p = 0.07$) where participants were faster to respond after longer (M = - 390ms) compared to shorter (M = -200ms) priming periods. However, the expected effect of coherence was not significant ($F(2, 30) = 0.49$, $p = 0.61$) and neither was the prime duration × coherence interaction ,$F(2, 30) = 0.05$, $p = 0.92$.

A 2 × 3 repeated measures ANOVA assessing the effects of priming duration (8 sec vs. 12 sec) and ambiguity/coherence (low vs. med vs. high) was also conducted on participants' set shifting. The main effects of prime duration ($F(1, 15) = 0.89$, $p = 0.36$) and coherence ($F(2, 30) = 1.65$, $p = 0.22$) were not significant and neither was the prime duration × coherence interaction, $F(2, 30) = 1.66$, $p = 0.22$.

Summary: We did not find evidence for the hypothesis that ambiguity priming facilitates pattern detection or influences set-shifting in the visual perceptual domain with the random-dots motion task. However, through the construction and optimization of this task we observed that there was a significant amount of individual variability in participants' ability to detect signal in varying degrees of noise. We found this individual variability in pattern detection to have potentially important behavioral implications, to be understudied, and worthy of further investigation, which we hope to carry out in a pending Army Research Laboratory proposal.

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