

Replication of Study 2 by Mirman & Magnuson (2008, *Journal of Experimental Psychology: Learning, Memory, and Cognition*)

Frank A. Bosco, Ph.D.
Assistant Professor of Management
School of Business
Virginia Commonwealth University
Email: OSFRP@frankbosco.com

James G. Field
Doctoral Student
School of Business
Virginia Commonwealth University
Email: fieldjg@mymail.vcu.edu

Introduction

There exist several theories of semantic processing and representation, each of which defines semantic *similarity* differently. The semantic priming effect (i.e., whereby a word is processed more quickly when preceded by a related word) is relatively robust. Mirman and Magnuson (2008) argue that additional light may be shed on semantic representation theories by considering the effect of semantic neighborhood size and density on visual word processing. In this stream, several reports indicate that words with relatively dense or large semantic neighborhoods are processed more quickly (i.e., a *facilitative* effect). Mirman and Magnuson (2008) delve deeper into semantic neighborhood effects by testing for effects of various neighborhood characteristics, each associated with a distinct theory of semantic representation (Experiment 1). Next, the authors consider whether *near* and *distant* semantic neighborhood characteristics have independent effects on word processing (Experiment 2).

The target finding for replication is the *nearness* effect from Mirman and Magnuson's (2008) Experiment 2. Specifically, words with many near neighbors (e.g., chicken) were associated with an increased level of processing (i.e., categorized more slowly) compared to words with few near neighbors (e.g., hyena). The experiment involves a 2 (many or few near neighbors) x 2 (many or few distant neighbors) within-subjects design. The dependent variable is the reaction time, in milliseconds, of a concreteness judgment (i.e., *Is this item tangible?*). Although both main effects were hypothesized, we suspected that the nearness effect was the primary result, and this was confirmed by the original authors.

Methods

Power Analysis

Mirman and Magnuson (2008) observed a large effect for their primary finding, $F(1, 21) = 17.30$, $p < .001$, partial $\eta^2 = .45$. At this effect size, we require 9, 15, or 22 participants to obtain 80, 90, or 95% power, respectively.

Planned Sample

We plan to recruit undergraduate students who will receive extra credit in undergraduate business administration courses at Marshall University. We will continue to recruit until 30 native English speakers with normal or corrected-to-normal vision complete the study.

Materials

We obtained experiment run files in the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) from the original authors. As such, our materials will be identical with the exception that the original experiment was run in the E-Prime 1.0 software, and converted into the E-Prime 2.0 environment.

“Twenty-five critical items were selected for each of four conditions: 2 (Many or Few Near Neighbors) x 2 (Many or Few Distant Neighbors). Near neighbors were defined as having cosine greater than 0.5, distant neighbors were defined as having cosine less than .25 and greater than 0.0. For near neighbors, “many” was defined as at least 2, and “few” was defined as 0 or 1; for distant neighbors, “many” was defined as more than 200, and “few” was defined as less than 150. ...To balance the critical “yes” trials, we chose 100 filler words (“no” trials) from the MRC Psycholinguistic Database (Wilson, 1988) based on low (less than 400, values range from 100 to 700) concreteness and imageability scores ($M_{\text{concreteness}} = 295$; $M_{\text{imageability}} = 346$) and matched to the critical words on length and frequency” (Mirman & Magnuson, 2008, p. 72-73).

Procedure

We obtained original experiment run files in the E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) from the original authors. As such, our procedure will be identical.

“we used a concreteness judgment task... (participants were instructed to indicate whether or not it was possible to touch the thing named on the screen)...The experiment began with 30 practice trials (with feedback; 15 concrete, 15 abstract trials) to familiarize participants with this task. Stimulus presentation details were the same as Experiment 1” (Mirman & Magnuson, 2008, p. 72).

Analysis Plan

Data preparation and analysis will be identical to Mirman and Magnuson (2008). First, error and filler trials will be removed. Next, we will remove reaction time outliers, defined as more than 2SD from the overall mean, followed by the removal of one item, “LEVEL,” which has concrete and abstract meanings. Finally, we will compute by-subject condition means for each cell in the 2x2 matrix, and conduct repeated-measures ANOVA.

Differences from Original Study

The differences between the original study and the replication are as follows. First, we will recruit participants from undergraduate business courses rather than a general undergraduate participant pool comprised of students enrolled in psychology courses. This is not expected to influence the results because (a) the study concerns simple language processing, and (b) the original authors indicated that there exists a large variety of majors in their undergraduate participant pool. Second, we will conduct the study using LCD computer monitors rather than the original authors' CRT computer monitors. However, the original authors do not feel that this should decrease the likelihood of replicating the effect. Third, we will conduct the study in a large computer lab (i.e., more than 40 computers) rather than a small room with a single computer. The original authors noted that this difference could potentially influence the results. Thus, as a compromise, we will conduct the study in a large lab, but run no more than 4 participants at a time with one participant in each corner of the room. Participants will be separated by a distance of approximately 20 feet in each direction.

(Post Data Collection) Methods Addendum

Actual Sample

Thirty-two undergraduate students were recruited from Marshall University's College of Business, 30 of which provided data for the present study. While we had originally planned to collect data from 30 participants, two participants were deemed unacceptable during data collection: One participant failed to follow instructions by responding with only one finger instead of two, and one participant had an (apparent) severe disability that inhibited the ability to respond to stimuli in a timely fashion. Thus, all analyses are based on 30 native English speakers.

Differences from pre-data collection methods plan

None.

Results

Data preparation

Following the procedures provided by the original authors, we first removed all error trials (i.e., incorrect responses) and filler trials. We excluded RT outliers within participants, with outliers defined as values 2 SDs beyond each participant's overall mean RT for all non-error and non-filler responses.

Confirmatory analysis

As planned, we computed by-subject condition means for each cell in the 2x2 matrix, and conducted two-way repeated-measures ANOVA. Figure 1 displays condition means for the original study and the present replication. Regarding the primary finding, we detected a statistically significant effect of nearness, $F(1, 29) = 8.064$, $p = .008$, partial $\eta^2 = .218$, whereby words with many near neighbors were categorized more slowly than words with few near neighbors. We failed to detect a statistically significant effect for distant neighbors, $F(1, 29) = 1.562$, $p = .221$, partial $\eta^2 = .051$. In addition, we failed to detect a statistically significant interaction effect, $F(1, 29) = 3.192$, $p = .084$, partial $\eta^2 = .099$.

Discussion

Summary of Replication Attempt

The present findings indicate a successful replication attempt in terms of statistical significance. Specifically, a statistically “significant” (i.e., $p < .01$) effect of nearness in the predicted direction was found in our replication study, replicating what was observed in the original study. However, the observed effect size in our replication (partial $\eta^2 = .22$) was smaller than the effect size observed in the original study (partial $\eta^2 = .45$).

References

- Mirman, D., & Magnuson, J. S. (2008). Attractor dynamics and semantic neighborhood density: Processing is slowed by near neighbors and speeded by distant neighbors. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34, 65-79.
- Morey, R. D. (2008). Confidence intervals from normalized data: A correction to Cousineau (2005). *Tutorial in Quantitative Methods for Psychology*, 4, 61-64.

Table 1

Univariate Repeated Measures Analysis of Variance for Individuals' Mean Reaction Time by Nearness and Distance.

Source	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	η_p^2
Nearness	1	5,628.508	8.064	.008	.218
Distance	1	1,857.115	1.562	.221	.051
Nearness × Distance	1	4,214.948	3.192	.084	.099
Error (nearness)	29	697.975			
Error (distance)	29	1,189.196			
Error (nearness × distance)	29	1,320.488			

Note. $N = 30$.

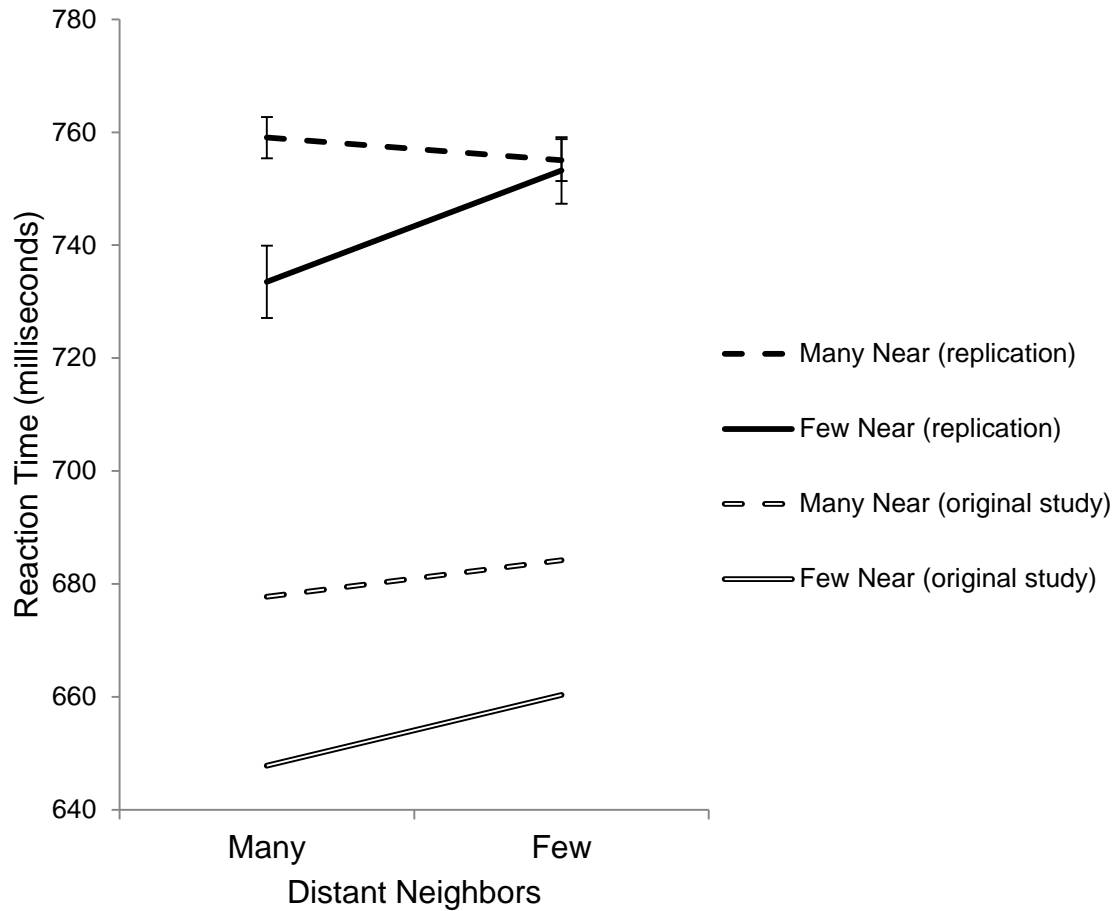


Figure 1. Reaction time as a function of number of near neighbors (many vs. few) and number of distant neighbors (many vs. few). Original study data are from Mirman and Magnuson (2008). Replication study data are from the present study, with error bars as one standard error for within-subjects repeated measures designs (Morey, 2005).