HOW DOES STIMULUS DIFFICULTY IMPACT STUDY TIME ALLOCATION IN YOUNGER ADULTS?

The Power of AND

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INTRODUCTION

There are many contexts in which people are allowed multiple opportunities to study new information prior to a test. It is important to understand how people allocate restudy efforts to enhance learning efficiency.

Prior research used homogeneous sets of word pairings (of similar difficulty), but the current research used a mixture of easy-, medium-, and hard-to-remember pairings to determine the degree to which possible memory confidence cues (below) are reactive to stimulus difficulty. Participants will study a set of word pairs (e.g., DOG-SPOON), take a memory test, and repeat this process a second time.

Additionally, metacognitive cues, or sources of information about one's learning, can influence one's perception of their learning and therefore influence study time allocation. The amount of time an individual devotes to study (in seconds) depends on how well they perceive themselves to be learning.

We expect to find relationships between item-specific restudy time and (1) a person's memory of their past test performance (a recollection of getting an answer correct or incorrect previously); (2) participants' impressions of item difficulty following an initial study attempt; (3) objective memory accuracy during an initial test (prior to restudy); (4) subjective memory test confidence; (5) objective response times to test stimuli; and (6) subjective response time estimates (i.e., how fast they think they responded to test questions). The relative weighting of cues is expected to differ based upon the ease of learning each word pair. A preliminary study done last year indicated that weightings differed between easy and hard-to-learn stimuli, but the current study added a medium-difficulty condition to examine the role of possible floor and ceiling effects on learning (i.e., weightings could have differed partially due to the extreme nature of the stimuli in the previous study).

METHOD

Participants were UWEC students who signed up via the SONA online research pool and received extra credit for their participation.

Our two study-test phases. In each phase, participants studied 60 procedure features word pairs and were then tested on their memory for each pair. Conditions were dispersed equally among participants and included sets of 60 word pairs that were classified as easy, medium, or hard-to-learn.

Phase 1: Word Pair Study
- 60 word pairs of unrelated nouns were presented in a randomized order. Study for each word pair was self-terminated.
- After studying each item, participants made a judgment of learning (JOL) on a scale of 0-100% confidence that they would remember a word pair during test.

Phase 1: Recognition Test
- 120 word pairs (60 intact, 60 rearranged) were presented in a randomized order. Intact items were studied word pairs, and rearranged items paired the first word from one pair with the second word from another pair, sampled without replacement.
- Using designated keys on a keyboard, they entered "YES" for a recognized pair and "NO" for an unrecognized pair.
- After each test trial, participants estimated (1) a confidence judgment on a scale of 0-100% (i.e., how confident they were in the accuracy of their prior recognition response), and (2) a response time estimate (on a scale of 0-10s, for the prior recognition response).

Phases 2: Study and Test
- The stimuli and procedure were identical to those of Phase 1.

DISCUSSION

The goal of this pilot study was to determine the effects of an intermediate level of word pairs to build off of previous research done with easy and hard word pair sets. One effect was that average study time differed minimally between conditions, with the easy condition being studied faster than the medium condition. This result could be due to our small population of participants since we expected the lowest average study time to be seen in the easy word pair set; however, further research must be done to ensure that stimuli were constructed appropriately.

Additionally, across conditions, we saw a consistent decrease in study time in Phase 2 for each percent increase in JOL in Phase 1, meaning that increased confidence lead to quicker response times. However, in condition two in item-by-item variation, we saw an increase in study time in Phase 2 for each percent increase in JOL in Phase 1; this could be due to an individual's motivation during study and their desire to remember the word pairs correctly. Comparatively, condition two also produced a significant result for test response time which means that there was a reduction in study time from Phase 1 to Phase 2. The third condition experienced a small reduction in study time from Phase 1 to Phase 2, indicating that longer initial study related to shorter subsequent study.

Overall, we saw a large difference between Phase 1 and Phase 2 throughout all metacognitive cues.

FUTURE DIRECTIONS

In the future, we intend to investigate the possibility of remote data collection. This will enable future studies to collect data faster and yield more reliable data from a much larger group of participants. Additionally, we will re-examine the parameters used to separate the easy, medium, and hard word pairs so that the intended difficulty level is achieved.

RESULTS

Cue	Stimulus Difficulty	Phase 1 M (SE)	Phase 2 M (SE)
Study Time (ST)	Easy	6299.56(1133.37)	1392.28(1133.37)
	Medium	5796.20(1075.21)	1267.40(1075.21)
	Hard	6177.85(1075.21)	1295.75(1075.21)
Judgement of Learning (JOL)	Easy	63.46(5.80)	87.21(5.80)
	Medium	53.32(5.51)	85.46(5.51)
	Hard	49.39(5.51)	81.99(5.51)
Test Confidence Judgement (CJ)	Easy	93.43(2.08)	96.02(2.08)
	Medium	90.90(1.97)	95.78(1.97)
	Hard	86.28(1.97)	92.84(1.97)
Test Accuracy (ACC)	Easy	0.96(0.01)	0.97(0.01)
	Medium	0.93(0.01)	0.96(0.01)
	Hard	0.92(0.01)	0.96(0.01)
Test Response Time (RT)	Easy	1576.42(162.59)	1075.39(162.59)
	Medium	1571.78(154.25)	1088.33(154.25)
	Hard	1859.98(154.25)	1175.60(154.25)
Test RT Estimate (EST)	Easy	2227.78(382.69)	2000.00(382.69)
	Medium	1412.50(363.05)	1010.00(363.05)
	Hard	1647.50(363.05)	1330.00(363.05)

Regression Equation Predicting Item Level Study Time at Phase 2:

Condition 1 - Easy

Effect	Estimate	SE	p
Intercept	1766.26	191.04	0.012

Intercept indicates the average Phase 2 study time across all participants.

Effect	Estimate	SE	p
ST Center	-0.01	0.01	0.44
ST Centergrand	-0.03	0.03	0.33
JOL Center	0.72	3.65	0.84
JOL Centergrand	-65.81	12.51	0.034

For each percent increase in a participant's average JOL in Phase 1, there is a decrease of 66 ms in study time in Phase 2.

Effect	Estimate	SE	p
Test Accuracy (C)	-176.85	340.88	0.60
Test Accuracy (CG)	18611	10334	0.21
Test Confidence Judgment (C)	4.00	4.00	0.31
Test Confidence Judgement (CG)	33.81	112.83	0.79
Test Response Time (C)	0.07	0.05	0.16
Test Response Time (CG)	-1.06	0.39	0.11
Test RT Estimate (C)	0.55	0.11	<.0001

For each second increase in estimated reaction time in Phase 1, there is a 0.5 second decrease in Phase 2 study time.

Effect	Estimate	SE	p
Test RT Estimate (CG)	-0.29	0.19	0.27

Condition 2 - Medium

Effect	Estimate	SE	p
Intercept	1668.01	184.78	0.002

Intercept indicates the average Phase 2 study time across all participants.

Effect	Estimate	SE	p
ST Center	-0.01	0.01	0.40
ST Centergrand	-0.09	0.12	0.49
JOL Center	5.29	2.35	0.025

For each percent increase in average JOL, there is a 5 ms increase in study time in Phase 2.

Effect	Estimate	SE	p
JOL Centergrand	-20.42	23.75	0.45
Test Accuracy (C)	-324.69	222.15	0.14
Test Accuracy (CG)	6094.69	6435.12	0.41
Test Confidence Judgment (C)	-2.55	3.55	0.47
Test Confidence Judgement (CG)	-75.64	104.73	0.52
Test Response Time (C)	0.14	0.064	0.034

For each increase of 1s of Phase 1 response time, you see an increase of 0.14s in Phase 2 study time.

Effect	Estimate	SE	p
Test Response Time (CG)	-0.94	0.89	0.37
Test RT Estimate (C)	0.04	0.08	0.58
Test RT Estimate (CG)	-0.47	0.58	0.48

Condition 3 - Hard

Effect	Estimate	SE	p
Intercept	1765.55	162.88	0.002

Intercept indicates the average Phase 2 study time across all participants.

For each second increase in Phase 1, there is a decrease of 0.02s in Phase 2 study time for a particular item.

Effect	Estimate	SE	p
ST Center	-0.02	0.01	0.056
ST Centergrand	0.05	0.06	0.45
JOL Center	-2.05	3.68	0.58
JOL Centergrand	-11.20	19.64	0.61
Test Accuracy (C)	-108.07	277.02	0.70
Test Accuracy (CG)	4306.24	2846.27	0.23
Test Confidence Judgment (C)	-6.59	3.53	0.06
Test Confidence Judgement (CG)	-12.83	39.55	0.77
Test Response Time (C)	0.02	0.04	0.63
Test Response Time (CG)	0.14	0.20	0.52
Test RT Estimate (C)	0.05	0.08	0.55
Test RT Estimate (CG)	0.24	0.39	0.58

Note:
- Center: Item-by-item variation within an individual
- Centergrand: the grand mean for a person or individual-by-individual variation

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