UNIVERSITY OF PLYMOUTH

PRM/MPsych

Coursework cover sheet for 2018

In submitting this work I confirm that I have read and understood the University of Plymouth regulations relating to Assessment Offences, and that I am aware of the possible penalties for any breach of these regulations. I confirm that this is my own independent work.

Student ID number: 10639669

Module Code: PSY 571

Assignment name: Research protocol

Use of translation software: failure to declare that translation software or a similar writing aid has been used will be treated as an assessment offence. If you have used translation software, please describe it here:

Markers: DO NOT add grades to annotated scripts

Feedback sheet

Markers: DO NOT add grades to annotated scripts

Students: please leave this page unchanged.

General comments:

Areas for improvement:

Please also check the script for further comments and annotations

Notes for your marker

This section is designed to make the feedback you receive more targeted. It is important this is completed before you submit your work.

What aspects of this work do you most need feedback on?

I have found it challenging to organize my background and rationale in a logical way because different studies provide evidence for competing theories. Also, the use of different terminology by different authors can make it difficult to understand.

I also found that I followed the guidance document but kept seeming to be repeating myself in the different sections.

How have you reflected on previous feedback to change the work you have submitted here?

I have tried to make my writing direct and succinct but I have not succeeded.

How does the number of guesses affect recall and recognition of word pairs?

Background and rationale

Enhancing students' learning is a key aim of any educator so it is unsurprising that over the last few decades, considerable effort has been made to discover the principles of effective learning. One such strategy that has attracted particular attention is the use of tests as learning tools (Roediger & Karpicke, 2006; Yang et al., 2018). It is now well established that attempting to retrieve information from memory in a test improves memory performance on a subsequent test. More surprising however, is the growing body of evidence (Potts and Shanks, 2014; Potts et al., 2018), which shows that testing can enhance learning even before the material has been taught. So, when participants are tested on completely unfamiliar material and inevitably get all the answers wrong, this act of guessing helps them when they learn the correct answer. In short, guessing, even incorrectly, boosts learning.

The benefits of incorrect guessing (also called error generation or unsuccessful retrieval) were first demonstrated in a study by Kornell et al. (2009), in which participants learnt a list of weakly associated cue-target word pairs (e.g., *freckle-mole*) by either studying the intact word pairs (Read condition), or by guessing the target for each cue before it was revealed (Generate condition). Since the word pairs were only weakly associated, the participants' guesses on Generate trials were almost always wrong. Nevertheless, on a subsequent cued recall test, the participants recalled more Generate targets than Read targets, even though they had had less time to study them.

Kornell's et al.'s (2009) findings led to an explosion of similar experiments aimed at identifying the underlying mechanisms that might be responsible for this guessing effect. The results of several experiments showing that that guessing improved cued recall for related (e.g., *tide-beach*) but not unrelated (e.g., *pillow-leaf*) word pairs (Grimaldi & Karpicke, 2012; Huelser & Metcalfe, 2012; Knight et al., 2012), led to the development of Search Set Theory (Grimaldi & Karpicke, 2012; Hays et al., 2013; Kornell et al., 2009;). This proposes that the process of generating guesses activates a semantic network of related concepts, including the correct target (even though it is rarely generated explicitly) and that this prior activation enhances encoding of that target when it is subsequently revealed. According to Search Set Theory, there must be a pre existing semantic relationship between the cue, the guess and the target so unrelated targets would not be expected to be activated in the search set and should not, therefore, benefit from prior activation.

Search Set Theory cannot readily explain Potts and Shanks, 2014 data for example, which found beneficial effects of guessing even when there was no pre- existing relationship between cue and target. They presented participants with completely novel and unknown words and asked them to guess their meanings. Potts and Shanks found that guessing enhanced recognition to select the correct meanings as compared with study only. They challenged search set theory and concluded instead that the beneficial effect of guessing is due to more effective encoding of the target by arousing curiosity and increased attention to learn the correct answer when presented. Further evidence (Potts, Shanks and Davies, 2018) comes from participants own ratings of how curious they were to know the meaning of the new words after generating a guess than when no guess was required. In addition, they suggest that feedback that defies expectations generates a feeling of surprise which also results in greater attention being directed to the correct answer when it is presented.

Seabroke et al.'s, 2019, repeated Potts & Shanks' experiment and found that when learning novel word pairs, guessing improved target recognition but impaired cued recall. Neither of the theoretical approaches presented can account for this difference. Search set theory predicts that unsuccessful retrieval should not improve memory for unrelated word pairs in either cued recall or target recognition, because the retrieval attempt should not partially activate the unrelated target in either case. Attentional accounts predict similar effects of guessing for unrelated and related word pairs, because if guessing arouses curiosity, then it should do so for unrelated word pairs in the same way as related word pairs.

In an attempt to disentangle the relative roles of the semantics and attention, Zawadzka & Hanczakowski (2018) designed an experiment using homophone cues (which crucially have 2 different meanings), which assessed both at the same time. They suggest that the theories are not mutually exclusive and both semantic and attentional mechanisms are operating in the guessing task, but their roles are different: semantic relatedness enhances memory for the cue-target associations while increased attention to feedback enhances memory for targets alone.

To test this, Seabroke et al., 2019 investigated the effects of guessing on cued recall and target recognition for related and unrelated word pairs. For related word pairs, they found the expected boost for cued recall and target recognition that semantic theories would predict. More interesting however, is the finding that for unrelated word pairs, guessing did not improve cued recall but it *did* improve target recognition, which is also consistent with Zawadzka & Hanczakowski's (2018) attention idea. The results add to a growing literature suggesting that generating errors for unrelated word pairs improves memory for the targets. Seabroke et al. suggest that when learning word pairs that do not have a pre-existing semantic association, generating errors strengthens memory for cues and targets in isolation, but does not strengthen cue-target associations and concluded that the mechanisms underlying cued recall and target recognition might be quite different. In cued recall, the benefit of guessing lies in semantic relatedness whereas in recognition, the benefit relies on strengthening memory for the target in isolation and so does not rely on semantic relatedness.

Seabroke et al. have recently put forward another idea that could explain the results for both related and unrelated pairs using one underlying mechanism. They propose that cued recall for unrelated target items is suppressed, by competition from other items. When faced with a cue from a previously unrelated word pair (e.g. desk - ?, having earlier guessed "pen" and then seen the target “sky”), participants must search their memory for the associated target. Their target recognition data indicate that guessing did increase the strength of the correct target but it will have also increased all the other Generate (guessed) targets. Thus, increased strength may be accompanied by increased competition. In the case of related pairs, this competition may be overcome because the target is related to the cue, but the competitors are not. Thus, increased competition may affect recall of unrelated pairs more than related ones.

If competition from incorrect guesses is responsible for impaired recall for unrelated pairs, then it could be expected that increasing the number of incorrect guesses would increase the number of competitors and increase interference and so impair cued recall for unrelated pairs even more.

The only previous study to look at the effects of increasing the number of guesses (Vaughn & Rawson, 2012) on learning weakly associated word pairs found that guessing three times did improve cued recall relative to one guess. But it also found that guessing once or guessing three times led to worse performance overall than equivalent numbers of study periods. This finding is at odds with almost all published data and could be due to limitations in the design, which will be addressed by the current study. There was a delay in the presentation of corrective feedback {which has been shown to limit guessing benefits (Grimaldi & Karpicke, 2012)} and crucially the three guesses were made on three separate occasions, separated by an unspecified length of time.

Other differences are that it was a between subjects design and did not investigate either unrelated pairs or target recognition.

Aims and hypotheses

The purpose of the current study is to investigate the effects of increasing the number of guesses on learning related and unrelated word pairs to look at differences between learning word pairs that do and don't have a pre-existing semantic association. We will run two separate experiments in which participants will learn related and unrelated word pairs, similar to Grimaldi and Karpicke's (2012) original materials. On some trials, they will guess once, on others they will guess twice and on others they will simply study the words. Performance will be compared on a recall memory test (Experiment 1) and a recognition memory test (Experiment 2). These materials have the essential component of being able to be manipulated so that so that the degree of semantic association between the cue and target can be strictly controlled

The experimental hypothesis is that increasing the number of guesses will have a different effect on recall and recognition memory for related and unrelated pairs.

Prediction 1: For related word pairs, two guesses will boost target recall and target recognition relative to one guess and to study, so that:

Guess x 2 > Guess x 1 > Study ($G_{2} > G_{1} > S$) for target recall and recognition.

Prediction 2: For unrelated word pairs, two guesses will impair target recall relative to one guess and to study *but* two guesses will boost target recognition relative to one guess and to study, so that:

Study > Guess x 1 > Guess x 2 ($S > G_1 > G_2$) for target recall

Guess x 2 > Guess x 1 > Study ($G_2 > G_1 > S$) for target recognition

The key result is a comparison of the effect of increasing the number of guesses on cued recall and recognition memory for unrelated pairs. This research has theoretical implications for improving understanding of the mechanisms underlying the effect of guessing on learning and teasing out their relative roles and is also of importance for education to identify when unsuccessful retrieval attempts are and are not beneficial.

Method

Design

In both experiments, the independent variables being manipulated are the learning condition (Study, 1 guess, 2 guess) and the semantic relatedness of the word pairs (related and unrelated). In Experiment 1, we will compare the effects of the 3 learning conditions on memory for related and unrelated word pairs on a cued recall test. In Experiment 2, we will compare the effects of the same 3 learning conditions on memory for related and unrelated word pairs with a target recognition test.

This effect we are most interested in is the effect of two guesses on target recognition, so we controlled the time that participants are exposed to the target in all 3 learning conditions - on all trials the target will be studied for 5 seconds. This is because in the recognition test, it is memory for the target that is being tested for and. also because in the 2 guess condition the length of time needed for participants to make 2 guesses would make the study trials too long. This is in contrast to some previous studies in which the total time is equalized resulting in an excessively long target exposure in the study condition. There is also a risk that on the target recognition test, performance is at ceiling which will make any differences difficult to detect.

The design for both experiments is a 2 (pair relatedness: related or unrelated) x 3 design (learning condition: no guess, 1 guess, 2 guesses), in which pair relatedness and learning condition are manipulated within subjects. This allows a within subject comparison of learning condition as function of pair relatedness. It also allows for a comparison of the effects of increasing the number of guesses on cued recall and on target recognition.

EXPERIMENT 1 – 3 BLOCKS (18 trials in each)

INDEPENDENT VARIABLES	**LEARNING CONDITION**		
	Study	1 guess	2 guesses
PAIR RELATEDNESS	3 related/ 3 unrelated word pairs	3 related/ 3 unrelated word pairs	3 related/ 3 unrelated word pairs
	DISTRACTOR TASK		
FINAL TEST	CUED RECALL TEST		

EXPERIMENT 2 – SINGLE BLOCK OF 54 TRIALS

INDEPENDENT VARIABLES	**LEARNING CONDITION**		
	Study	1 guess	2 guesses
PAIR RELATEDNESS	9 related/ 9 unrelated word pairs	9 related/ 9 unrelated word pairs	9related/ 9 unrelated word pairs

	DISTRACTOR TASK
FINAL TEST	TARGET RECOGNITION TEST

Participants

Plymouth University undergraduates will be recruited for each experiment in exchange for course credits. Cued recall: an a priori power analysis was carried out to estimate an appropriate sample size for the effect of learning condition (Read versus 1 Guess) on related and unrelated pairs. A projected sample size of 22 participants provides 80% power at Cohen's $d_z = 0.63$, which is the effect size seen for Generate (guess) versus Read comparisons in previous cued recall studies (Seabroke et al., 2019). The procedure was repeated for Target recognition, giving a projected sample size of 10 participants, which provides 95% power at Cohen's $d_z = 1.33$, which is the effect size seen for Generate versus Read comparisons in previous studies (Seabroke et al., 2019). The main effect of interest in the current study is that of increasing the number of guesses. The only study to have done this (Vaughn & Rawson, 2012) used a between subjects design and did not report effect sizes so cannot be used. Instead, sample size will be based on previous studies in which participant numbers are commonly in the range of 20-30 when within participant designs are used (eg., Kornell et al., 2009; Yang et al., 2017; Seabroke et al., 2019)

Participants who do not describe themselves as fluent in written and spoken English will be excluded because a native level understanding of English words is necessary for this study since an awareness of the semantic relationship between word pairs in the related condition is important and is consistent with participant selection in previous studies (Grimaldi et al., 2012).

Apparatus and materials

The experiments are programmed in E-Prime 2.0 and presented on a 22-inch computer monitor with a standard keyboard. All stimuli are presented on a white background in size 16 Verdana font. For Experiment 1 (cued-recall), 30 related and 30 unrelated word pairs have been selected from Nelson, McEvoy, and Schreiber's (1998) norms. In Experiment 2 (target recognition), 36 related (including 9 cue related foils) and 36 unrelated (including 9 unrelated foils) word pairs were similarly selected.

The cues selected have frequencies between 1 and 81 and concreteness values between 4.70 and 6.93 eg. related: shoulder-lean or unrelated: sugar – lecture. The targets selected have frequencies between 1 and 88 and concreteness values between 4.75 and 7. The challenge has been to ensure that for the related and unrelated word pairs, the frequencies and concreteness of the cues and targets are matched. This has been achieved by selecting a cue for a related pair and testing it against the norms for frequency and concreteness and then finding a cue for an unrelated pair which had similar frequency and concreteness ratings and then repeating this process for the target words which they were each paired with.

Since this study is interested in the effects of error generation, it is important that when presented with a cue that participants do not guess the target word correctly. Forward associative strength (FSG) represents the likelihood that a word will be the first word generated (in response to a particular cue) on free association test. According to the Nelson et al. (1998) norms, the likelihood of this happening in response to a particular cue for the unrelated word pairs is 0, so there is no associative relationship.

For related word pairs, the levels for forward associative strength (FSG) in previous studies has usually been set at between 0.050 and 0.054. In this study however, participants have an increased chance of correctly guessing the target word on the 2 guess trials, so the program has been designed to respond to the guesses and to generate a new and different target word thus ensuring that the participant’s guess is always wrong. This means that for the related pairs, FSG has been raised to between 0.05 – 0.065, so target words have about a 5% to 6% chance of being guessed correctly. This will be tested and adjusted depending on the results of the pilot study.

In each experiment, 27 related and 27 unrelated word pairs have been randomly selected for each participant for presentation at encoding. One third of these word pairs (9 related and 9 unrelated) will be presented on no guess trials; one third (9 related and 9 unrelated) on 1 guess trials and the final third (9 related and 9 unrelated) on 2 guess trials. Three additional pairs from each relatedness condition will be used for practice trials. In Experiment 2, the targets from the remaining 9 related word pairs and 9 unrelated word pairs will act as foils in the target recognition test. A decision was made to include 9 target foils which are semantically related to some of the cues in order to increase the challenge and make the test more sensitive. This is based on recognition memory results from previous studies (Seabroke et al., 2018), which have shown that participants can perform near ceiling for related word pairs, which reduces the chance of there being a detectable effect of the learning condition ie 1 guess versus 2 guesses (Grimaldi & Karpicke, 2012; Hays et al., 2013; Vaughn & Rawson, 2012).

Procedure

Learning phase

The participants will read the following instructions on the computer screen.

Thank you for taking part in this study.

In this experiment, you will see some pairs of words.

For some word pairs, you will see both words at the same time eg. fireman – engine

Some of the word pairs will be related eg. sun – beach and some will not eg. ring – bottle

For some words pairs, you will see one word and a blank box, where you should type 1 guess of the word it is paired with, before you see the correct answer eg. house __________

You can use the Backspace to change your guesses if you need to.

For some words pairs, you will see one word and 2 blank boxes, where you should type 2 different guesses of the word it is paired with, before you see the correct answer eg. weapon ________

____

Please try to learn the correct word pairs.

You will have 6 practice goes before the experiment begins so you know what to do.

You can ask questions whenever you need to.

Press the Space bar when you are ready.

During the learning phase, participants are presented with related (e.g. *tomato - lettuce*) and unrelated (e.g. rotten - tower) word pairs. On Study trials, the complete word pair is presented for five seconds for the participants to study. On 1 guess trials, the cue (e.g., *bowl*) is presented alone with one blank text field, where the participants type their guess of the target word. Their guesses appear on-screen as they type, and they can use the Backspace key to change their answer during the guessing period, which finishes when participants press the return key to confirm their guess. The complete word pair (e.g., *bowl-plate*) is then presented for participants to study a further five seconds. Two guess trials are identical except that the cue is presented with 2 blank text fields, where participants type 2 different guesses of the target word. If participants make the same guess twice, the same cue will be presented again until they make 2 different guesses. At the end of each trial, participants will also be asked to make a Judgment of Learning (JOL) to indicate on a scale of 1 to 10 how likely they are to remember the word pair. Two practice trials for each learning condition will be administered first, one with a related word pair and one with an unrelated word pair.

Experiment 1 (Cued recall): will be run in 3 blocks with a learning phase of 18 trials followed by a test phase. This is to try to prevent target recall for unrelated word pairs being “at floor” with the risk that any differences in performance, that might be present, are difficult to detect. There are 6 trials for each learning condition (6 read trials, 6 x 1 guess trials and 6 x 2 guess trials). Half the trials will present related word pairs and half will present unrelated word pairs. The trials are randomly intermixed for learning condition and word pair relatedness and are separated by a 1 second interval.

After the learning phase, participants complete a distractor task (lasting approximately 30 seconds), in which a series of maths problems (e.g., *(4 x 7)* + *1 = 29*) are presented on the computer screen. The participants indicate whether the answers provided are correct or incorrect by means of a button-press.

Testing phase

Experiment 1 – Cued recall test

Instructions for participants to read on the computer screen.

You will now do a memory test to see how many of the words you can remember. You will see the first word in the pair and a blank box eg. cheese ___________ Please type the correct word it was paired with (do not type your guess). Do not worry if you cannot remember a word, have a go! You can use the Backspace key to change your answer if you need to. After each go, you will see a scale from 1-10. Please choose a number for how confident you are that you have remembered the word correctly. You will have 6 practice goes before the test starts so you know what to do. You can ask questions whenever you need to. Press the Space bar to continue.

In the cued recall test, the cues from each word pair are presented on the screen and the participants type in the target word it was paired with, as they did in the learning phase. They are reminded not to type their guesses. They also give a score out of 10 (confidence rating) to indicate how confident they are about their answer. There are 6 practice trials using the cues from the practice trials in the learning phase. The 18 cues from the learning phase are then presented in a random order. The test phase is self-paced, so responding is not time-limited. On completion of Block 1, participants complete Blocks 2 and 3 in the same way. At the end of Block 3, participants are asked to report on their experience of being required to make two guesses and their perception of how it affected their memory for the correct words. The following four questions are presented one at a time on the screen and participants type their responses.

Please type your answers to questions 1 – 4.

For some of the word pairs you did not guess and for some word pairs you made one or two guesses:

1) How did you find guessing?

2) Did it help you remember the words?

3) Was it different for one guess or two guesses?

4) Were you more interested to know the answer after you had guessed?

Experiment 2 - Target recognition

The learning phase for Experiment 2 is identical to Experiment 1 except that all 54 word pairs are presented in one block (with 18 trials for each learning condition) followed by a single test phase. On half the trials related word pairs are presented and on half the trials unrelated word pairs are presented.

Experiment 2 – Target recognition test

Instructions for participants to read on the computer screen:

> You will now do a memory test to see how many of the words you can remember.
>
> You will be shown words that you have seen before eg. cheese and other words that you have not seen before eg. light
>
> Please choose “Yes” if you remember the word and “No” if you do not remember the word.
>
> You can use the Backspace key to change your answer if you need to.
>
> After each go, you will see a scale from 1-10. Please choose a number for how confident you are that you have remembered the word correctly.
>
> You will have 6 practice goes before the test starts so you know what to do.
>
> You can ask questions whenever you need to.
>
> Press the Space bar to continue.

In the testing phase, a target word (e.g., *bike*) is presented on each trial with the question, “Did you see this word before?”. The participants select between “YES” and “NO” options using the mouse. Six practice trials, using targets from the practice trials of the learning phase, are first presented. The 54 targets from the learning phase, plus 9 semantically related foils and 9 novel foils, are then presented in a random order. Participants also complete a JOL to say how confident they are that they have remembered the word correctly.

Responding is not time-limited at test in either experiment, and the trials are separated by a 1 second interval.

At end of the experiment subjects are debriefed verbally about purpose of experiment and given the opportunity to ask any questions.

Data collection

In the cued recall test, the accuracy of participants responses to recall the correct target in response to a cue will be recorded and for the recognition test, the accuracy of correctly recognising previously seen targets will be recorded. Any spelling or typing errors will still be considered as correct responses. Participants in this study cannot guess the target correctly because it changes according to their guess, so none of the trials will need to be excluded on that basis. Participants' confidence scores on each trial (JOLs) are also recorded as are responses to the 4 questions about their experience of guessing.

Analysis of results

Please see Appendix i for predicted results graphs and for G power analysis.

Participants' mean percentage accuracy for correct target recall (Experiment 1) and correct target recognition (Experiment 2) will be calculated as a function of learning condition (study, 1 guess, 2 guesses) and as a function of pair relatedness (related and unrelated). This means that each participant will generate 6 different means: 1) study + related 2) study + unrelated 3) 1 guess +

related 4) 1 guess + unrelated 5) 2 guess + related 6) 2 guess + unrelated which can be combined across participants and analysed to test for significant effects.

Experiment 1: Cued recall Mean % of correctly recalled targets	Experiment 2: Target recognition Mean % of correctly recognised targets
study + related	study + related
study + unrelated	study + unrelated
1 guess + related	1 guess + related
1 guess + unrelated	1 guess + unrelated
2 guesses + related	2 guesses + related
2 guesses + unrelated	2 guesses + unrelated

The results of each experiment will be analysed using a 3 x 2 repeated measures ANOVA with learning condition (study, 1 guess, 2 guesses) and pair relatedness (related, unrelated) as within subjects factors. This test is appropriate because it allows multiple means to be compared simultaneously and for any interactions between variables to be detected.

Returning to the predictions made in the introduction, the comparison we are most interested in this study is whether there is a significant interaction between learning condition and pair relatedness – ie. to discover if the effects of 2 guess versus 1 guess is different for related and unrelated pairs. We predicted that 2 guesses will boost cued recall for related pairs relative to 1 guess, but that for cued recall of unrelated pairs, that 2 guesses will lead to even worse performance than 1 guess which will be worse than study.

This study is also particularly interested in is any difference between the effect of 2 guesses on cued recall compared with target recognition. An Anova of the target recognition data, could expect that for recognition memory there will be no significant interaction between learning condition and pair relatedness because if the predictions are correct, 1 guess once will boost memory relative to study for both related *and* unrelated pairs and 2 guesses will boost it even more.

To test whether there is a statistically significant interaction, between learning condition, pair relatedness and test format, a 3way mixed factorial ANOVA could also be carried out.

The mean JOL scores will be calculated as a function of learning condition and a 1 x 3 repeated measures ANOVA will be carried out to find out if there is a significant difference between the confidence ratings for 2 Guess versus 1 Guess versus Study. Based on the results of past JOL data (Potts & Shanks, 2018), it could be expected that participants will not give higher ratings after guessing once or guessing twice as most studies show that participants choose lower levels of confidence after guessing.

The final questionnaire data will be gathered and analysed manually for each subject and any themes which emerge will be recorded.

Ethics

This study has been granted ethical approval by the Department of Psychology Ethics Committee at the University of Plymouth in February 2019. The following ethical considerations have been taken into account during the design of this study in accordance with BPS guidelines:

Deception: participants are not told the true purpose of the experiment because this could interfere with the results. They are debriefed with a written sheet which they take away and given verbal feedback after it is finished.

Informed consent: participants are given a written information sheet, which outlines what will happen in the experiment. They are given time to read it carefully and to ask any questions. They are then given an informed consent form which states what they can expect and explains their rights as participants. They are formally asked to indicate that they agree to participate in exchange for university credits, by signing the consent form. This is also signed by the researcher. Participants are informed that they are taking part in a laboratory based experiment investigating how different word pairs are learnt which involves studying word pairs on a computer screen and that there will be a final test phase to assess how well they have learnt the word pairs.

Do no harm: participants will suffer no physical or psychological harm from taking part. Participants are not exposed to any risks greater than those encountered in their daily life studying at university. If participants experience discomfort or fatigue while completing any of the tasks or tests, they are free to withdraw at any point.

Withdrawal: participants are free to withdraw from taking part at any point of the experiment and also to decide to withhold their data during or at any point after the experiment has finished

Confidentiality and anonymity: participants will be identified as numbers and names will not be recorded. Their data will stored on secure systems provided by the university and will not be shared with third parties

Privacy: subjects will take part in small groups in a room with other subjects working at individual computer terminals

Scientific value: the research is designed and conducted so as to ensure its quality, integrity and contribution to the development of knowledge and understanding

Conclusion

This study seeks to explain how for semantically unrelated word pairs, guessing impairs target recall but boosts target recognition. If, as predicted, two guesses boosts recognition more but impairs recall even more, this provides support for the idea that the incorrect guesses lead to more interference, which impairs retrieval of the correct target. Because recognition memory relies only on identifying a previously seen target, the effect of 2 incorrect guesses can still boost recognition memory by enhancing encoding of target at feedback. By investigating the effect of increasing the number of guesses, on recognition and on recall, we hope to gain insight into the way in which guessing affects these two types of memory. The finding that the beneficial effects of guessing can still exist in the absence of semantic relatedness means that the results of this research have wider implications for anybody interesting in learning and memory and testing and applications in education settings.

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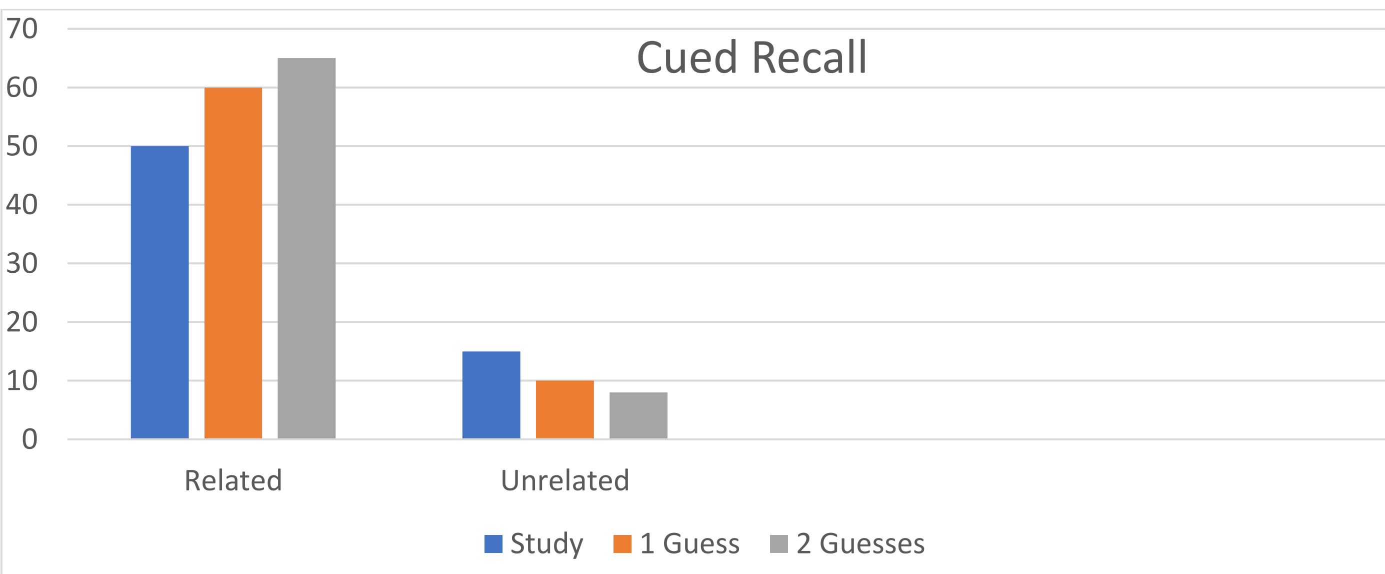
Appendix i

Predicted results – Experiment 1

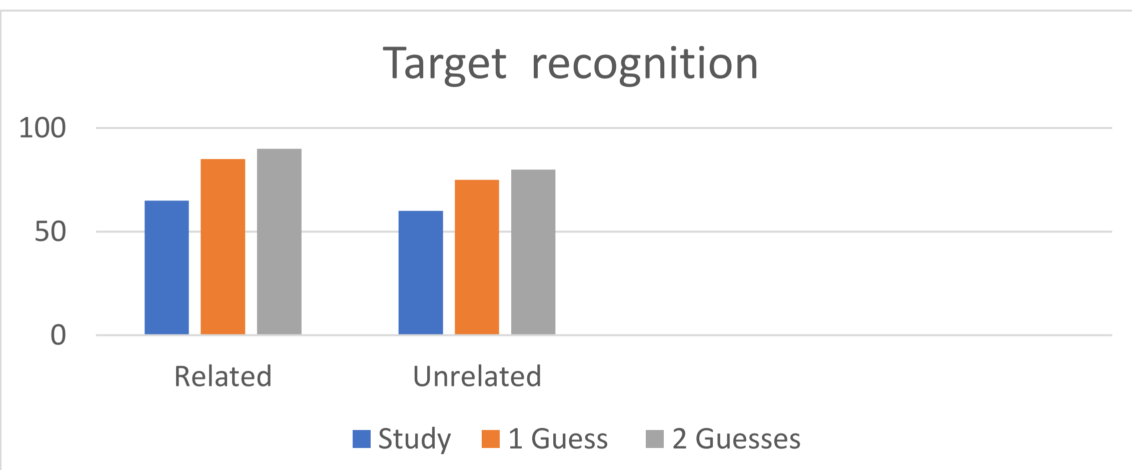
Mean % correctly recalled targets



The bar graph chart shows that 2 guesses is predicted to improve cued recall for related word pairs but impair it for unrelated word pairs, relative to 1 guess and to Study.

Predicted results – Experiment 2

Mean % correctly recognised targets



The bar chart shows that for target recognition, 2 guesses is predicted to improve target recognition for related and unrelated pairs, relative to 1 guess and to Study.