The Effects of Associative, Phonological, Semantic, and Linguistic Properties of Words Upon Recall:

An Experiment on Verbal Memory

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Abstract

To test what associative, semantic, linguistic, and habitual factors affected verbal recall in long term memory, 37 participants (11 male, 26 female) performed a three part experiment on verbal memory. The first part involved memorising as many words as possible from a list of 59 words presented on-screen. This was followed by an interfering text to read that was either partially relevant or irrelevant to certain words on the recall list. Participants were then presented with a recognition task to test their recollection of the 59 words alongside 60 other distracter words. Reading habits were also briefly evaluated. The text's relevance had no noticeable effect on recall ($t(35) = .29$, $p = .59$, $d = .18$). Self reported reading habits were related to increased recall numerically, but not statistically ($r = .2$, $p = .23$). A word's phonological length and concreteness facilitated higher rates of recall, albeit statistically insignificant in interpreting variance in recall ($p = .09$, $p = .11$). The single most predictive factor of a word's likelihood of being recalled was it's rarity in the language ($\beta = .56$, $p < .001$). This alongside other results are discussed with relevance to interference theories of memory and forgetting, and relating to the novelty effect with regard to rarity predicting recall In conclusion measuring a word's frequency of occurrence in a language may be an important measure to include in studies of verbal memory for the aforementioned reasons.

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Contents

Introduction

A very effective and natural means of communicating cognition in humans is done through the medium of language (Gentilucci & Corballis, 2006; Tomasello, Carpenter, Call, Behne, & Moll, 2005). A single words represents the sensation of a thing, or the the numerous stimuli or sensations from which the word is sourced. Asides from its communicative value as a means of understanding cognition, there is the additional value of how language and memory systems demonstrate significant neurological overlaps within the brain (Yokoyama, 2012). Therefore it would seem apparent that if one were to study elements of cognition such as memory, that language would be an effective means of doing so. From here forth the contents of the literature presented shall be related to memory and the study itself shall evaluate memory through the lens of verbal mediums, addressing the various theoretical and observed correlates, predictors, and evidence that comprise an understanding of the dynamics of verbal memory.

One may present that learning is the term we give to creating memories, and that to learn and create a memory one needs a stimulus. Early theories in Behaviourist studies successfully demonstrated that stimuli were both quantitatively and qualitatively learned, and that not all stimuli were equal in contribution to memory formation (e.g. Hull, 1952; Konorski and Miller 1937). Despite much success in animal studies, the strict behaviourist criteria to evidence the original stimulus and its response for every case of learning and behaviour proved unwieldy when interpreting and measuring higher cognition and behaviours as known in humans. Although like in animal studies a reliable way to consolidate a memory in complex human cognition is through repeated exposure to it's original stimulus (Grill-Spector, K., Henson, R., & Martin, A. 2006; Roediger & Karpicke, 2006), a more complex behaviour such as words and language represent objective stimuli on some level, yet are rather subjective in expression and lack exact meaning from person to person. One may perceive the issue presented to the very objectively minded early behaviourist parameters of research. Such an issue lead to the need to develop well grounded theories that could make up for this methodological shortcoming. An attempt to theorise how one organises all these various stimuli into one effective system in a predictable manner was presented in McGeoch's (1942) and Hebb's (1949) theories on learning by latent association. Asserting that reinforcement of neurons was key to memory as behavioural theory effectively had, the theory further presented that memories are structured by association, organised according to the collective pattern of neurological activity evoked by a stimuli. Hebb (1949) also posited that mature learning and memory would be inclined to rely upon association to old memories rather than the creation of new ones. Such a theory can attempt to explain how things that evoke similar sensations or meanings may facilitate one another in learning and memory. Furthermore there is an element of physiological or cognitive efficiency in relying upon familiar memories to learn, as less neural activity is required to process frequently encountered stimuli (Grill-Spector, et al., 2006). Therefore regarding association amongst stimuli or memories, the closer in sensation several separate items are to one another, the less neural effort is required to learn and remember any single item due to such cognitive facilitation. An alternative perspective of this process is can be observed in theories of heuristic thinking, where associations are consciously or unconsciously used to facilitate recollection of specific memories and reduce cognitive effort (Shah & Oppenhaimer, 2008). One may suppose along this line of reasoning that the same number of separate items unrelated in sensation would require greater neurological demand to retain, which shall be examined in the following paragraphs evaluating theories of forgetting.

In measuring the qualities of memory through its retention or lack thereof, there are two prime extant arguments found in the literature. To briefly illustrate the two, the temporal theory asserts that memory has a life span of sorts thus decaying over time unless it is renewed (Baddely, 2000; Peterson & Peterson, 1959), whilst interference theory presents that it is the interferences of stimuli encountered over time that account for the decay or supplantation of memories (Berman, Jonides & Lewis, 2009; Lewandowsky, Brown, Wright, & Nimmo, 2006; Lewandowsky, Geiger, Morell, & Oberbrauer, 2010; Oberauer, Farrell, Jarrold, Pasiecznik, & Greaves, 2012). The interference effect is visible in behavioural and neural activity, where increased cognitive workloads (i.e. increased input of stimuli) are associated with increased activity in the pre-frontal cortex and decreased activity in the hippocampus, which amounts to poor recall due to a lack of neural resources being dedicated to memory formation in the hippocampus (Axmacher, Haupt, Cohen, Elger, & Fell, 2009; Blumefeld & Ranganath, 2006; Dudovic, DuBrow, & Wagner, 2009; Iidaka et al., 1996; Ma, Husain, and Bays, 2014; Narayanan, et al., 2005; Veltman, Rambouts, & Delon, 2003). However the two theories are mutually intelligible with consideration, as one may assert that the temporally based theory can be reasonably considered as a factor of interference theory. For if memories are formed based upon stimuli encountered over time, then increased time should allow more opportunities for stimuli both associated and dissociated to arise and be neurologically received. Further worth observing is that sensations need not entirely occur due to external stimulation, as one may simply take the time to think an abstract though, recall a memory, or even a dream to demonstrate sensation in the absence of a direct object. Therefore even in the absence of direct external stimuli, the reasoning generated from research literature would indicate that sensory interference occurs nonetheless. To otherwise prove a purely temporal decay of memory, one would have to isolate the distinct material of a memory, and demonstrate that it decays in what is essentially a cognitive vacuum, free of influence from the effects of interfering cognitive processes. Therefore logically it would appear that the premises of interference theory are a more logical explanation of memory, and that time is most likely a rough quantifier of how much interference can occur between memory formation and recollection (e.g. Berman et al., 2009; Lewandowsky et al., 2010). One may observe that the interference paradigm in the case of associative stimuli and facilitation can be viewed as a means of reinforcing memories, lending to it the strength of reinforcement theory. Thus it is hypothetically likely , that the consequences of interfering stimuli present a reasonable theory to account for forgotten memories.

Further study into learning and memory over the years has revealed that however does time plays an important roles in memory formation and consolidation. These observations between the interaction of time elapsed and memory give us the concepts of long-term, short-term, and working memory. Long-term memory refers to memories that are recalled some time after the source of the memory is encountered, ranging from several minutes to years by its definition. As such memories can be recalled long after their formation, they are evidently strongly formed memories. Short-term memory accounts for memories that have a short lifespan as memories, and seem to disappear from recollection after a short length of time. Working memory is another concept that has a short timespan regarding the persistence of memory. One simple example of working memory is the action of mental arithmetic, where on remembers a handful of numbers, while counting additional numbers, thus working and holding a though or memory simultaneously. However under scrutiny of the interference theory, it is important to recognise difference between short-term and long-term memories as strictly a matter of conditions in which they are formed and the temporal parameters drawn. One may consider upon rejecting time for interference as the more important factor in memory preservation after formation, that a working or short-term memory with that is remembered over a long period time is no longer short-term but long-term by definition, and that to define short-term memories as a distinct process runs the risk of assigning a whole system to what may simply describe the nature of fleeting memories interrupted by the surrounding environment. Indeed these different memory forms are subjected to different methods, with Short-term memories typically being measured through simple span tasks, whereby one memorises span of single items; whilst the complex span tasks measure working memory, where one is required to memorise a span of multiple items. Increasing cognitive demand through multiple interfering items as used in simple and complex span tasks, one may guess that complex span results in poorer permanence of memory than simple span, hence working memories poor persistence (e.g. Lewandowsky, 2010; Oberauer et al, 2012). Furthermore the lower the cognitive load the better the quality of long-term memory formation and recall in both behavioural and neurological observations (Axmacher et al., 2009; Blumefeld & Ranganath, 2006; Dudovic et al., 2009; Iidaka et al., 1996). To support such a proposition, neurological evidence shows correlations between working and long-term memory in addressing the same or similar stimuli across regions brain (Acheson & MacDonald, 2009; Raganath, Johnson, & D'Esposito, 2003). Additional evidence includes the observation that reinforcing or practising particular items improves short, long term and working memories without discrimination (Brown, Neath, & Chater, 2007; Kapricke & Roediger, 2007; Roediger & Karpicke, 2006; Rose, et al. 2010).

Therein appears to be a plausible explanation towards the lack of persistence in working and short-term memories, seemly restricted by an apparent limited capacity to efficiently organise stimuli for recall at any given instance. Thus by increasing attentional demands through interference, one decreases memorising capacity. Developing upon this, if memory in general is impaired by interference, then working memory would posses a high interference per second rate during a complex span task. Thus arguably if increasing cognitive loads or interfering stimuli can negatively effect recall accuracy in long-term memory time spans, then short-term and working memory faculties may simply be the result of a high rate of irrelevant stimuli per second, resulting in the lack of permanence and clarity of a memory, being displaced by more prominent stimuli that take the focus of attention. Such a hypothesis would fall in line with the theory of interference based memory decay. Furthermore, as previously mentioned, neural activity would demonstrates how increased working memory loads, which can be viewed as increased interferences reduce activity in the hippocampus associated with long-term memory encoding, and increase pre-frontal activity (Axmacher, et al., 2009). It is therefore noteworthy to distinguish these memories is due to their permanence as a consequence of facilitatory or inhibiting conditions to learning and memory acquisition.

Further concerning short-term and working memory is interference from long-term memories There is evidence for associative or semantic representations in long term memory memory are activated when one needs to acquire or retrieve verbal information during working memory tasks (Nishiyama, 2013; Rose, at al., 2010), much in line with Hebb's (1949) theory of mature learning. A more recent incarnation of this concept can be seen in the “levels of processing” models of memory, where immediate so called “primary” memory formation (i.e. Working and short-term) retrieves information from the more complex and matured “secondary memory” (i.e. Long-term memory) to derive meaning and representations of stimuli (Rose, & Craik, 2012). This retrieval concept can supported somewhat by findings that interference is not entirely detrimental to memory preservation, therefore interfering memories may too have some potential facilitatory effect. As touched upon conceptually by associative learning theories, interference from resemblant word lists can facilitate the recollection of similar verbal stimuli (Barnes & Underwood, 1959; Saint-Aubin, Ouellette, & Poirier, 2005; Tehan, 2010). The greater the associative or in other terms semantic similarity between lists of words the greater the extent of successful recall, an effect that gradually decreases into a negative recall effect with increasing differences between these lists (Saint-Aubin, Ouellette, & Poirier, 2005; Tehan, 2010).

As established and asserted in the above mentioned, the general nature of the memory forming process appears to be an interaction between competing stimuli and their reception, and whether these interfere with recently formed memories. Considering that stimuli engage different regions of the brain, one may question whether certain aspects of a stimuli affect how it's acquired and maintained, and possible it's vulnerability to or perpetration of interference. As mentioned earlier, the focus of this particular study shall be upon verbal stimuli and shall attempt to measure the qualities of words that demonstrate an effect upon or predict their representation in long-term memories through measuring recollection. However it is worth noting that in this instance memory shall be measured with a several minute interval between the stimulus, interference, and recall task, and shall therefore be considered an experiment on long-term memory according to typical temporal distinctions of memory.

Regarding the effect of reinforcement, association, or facilitation and the influence of interference, these qualities shall be evaluated in the context of a partially facilitating and an entirely interfering stimulus to demonstrate whether there are certain differences or consistencies related to these conditions. Typically studies of interference use lists against lists to procure interference and recall effects. In word lists the presence of facilitating interferences assist in cuing recollection of associated words (Unsworth, Spillers, & Brewer, 2012). However despite facilitation effects, the mere presence of irrelevant interfering material distorts recall, triggering irrelevant memories thus reducing overall recall ability (Unsworth et al, 2013). The implications appear to indicate that in memory and recall experiments, that the minimisation of interfering stimuli of any kind produces superior recall conditions, with support from studies testing such a hypothesis (Dewar, Alber, Butler, Cowan, & Della Sala, 2012; Dewar, Della Salla, Beshcin, & Cowan, 2010). Word lists although efficient and direct, are relatively uncommon amongst everyday encountered varieties of verbal stimuli. Although there are examples of prose being used to measure interference, they rely upon comprehension questions to assess memory, which are rather subject to qualitative interpretation by participant and researcher (e.g. Crouse, 1971). To attempt to find a balance, this study proposes a quantitative measure of recall by the use of a list of target words to memorise and recall, and a more naturalistic interference context through a prosaic text. This, rather than lists and single word distractions, enables an insight into the interaction amongst semantic, associative, phonological, and other relevant linguistic elements of language related to memory. Another aspect of this study shall be the focus on long-term memory aspects rather than the more common short-term and working memory studies, and whether a similar pattern of results carries on from such conditions, as the literature review above as implied. With all this considered the first hypothesis shall be address associative facilitation of recall:

> Hypothesis 1: Participants who read a text containing some of the target words will demonstrate greater recall of these words than that of participants reading a text bearing none of the target words.

Beyond associative or semantic effects upon memory, there are also various other linguistic elements that influence recall. Many studies find phonologically short words are more easily recalled over longer words, commonly referred to as the word-length effect (e.g. Baddely, Thompson, & Buchanan, 1975; McAlpine, Olson, Tsouknida, & Martin, 2005). However such a theory is rooted in the time decay theory of memory which as earlier mentioned has its critical issues, and furthermore there studies that find the word-length effect does not provide evidence for time based decay (Lewandosky & Oberauer, 2008; Neath & Nairne, 1995). If the premise upon which the effect is founded upon is questionable then one must question the interpretation of the effect itself. Furthermore the word length-effect is frequently contradicted in studies, particularly those with larger sample sizes, leading to the suspicion that there is likely an alternative underlying linguistic factor that affects recall probability for words (Lovatt, Avons, & Materson, 2000; Jalbert, Neath, Bireta, & Surprenant, 2011; Katkov, Romani, & Tsodyks, 2014). Finally considering studies have observed that the effect is limited to a very short span of time, and decreases in seconds in favour of longer words, particularily in recognition tasks such as those that shall be used in this study to measure recall (Fournet, Juphard, Monnier, & Roulin, 2003; Tehan & Tolan, 2007). This considered, the study to be undertaken shall most likely find a word-length effect that is the inverse of the original term, whereby phonologically long words shall facilitate recall, presenting the following hypothesis:

Hypothesis 2: Increased syllabic or phonological length facilitates recall, therefore long words shall be more frequently recalled than short words.

However there are questions as to whether a word's morphology or length may be better explained by a latent factor such as semantics (Hoffman, Jeffries, Ehsan, Jones, & Ralph, 2009; Romani, McAlpine, Olson, Tsouknida, & Martin, 2005; Rose & Craik, 2012). It is a relatively consistent finding that concrete words are more easily recalled than abstract words (Borges, Lewis, & Lillich, 1977; Romani, McAlpine, & Martin, 2008; Walker, & Hulme, 1999). Therefore to study this linguistic concrete and abstract dynamic of words the following hypotheses shall be presented:

Hypothesis 3: Concrete words are more easily recalled than Abstract words, therefore concrete words shall be more frequently recalled than abstract words.

In addition to morphology and semantics, this study shall also consider frequency of a words occurrence in the English language. Frequently repeated words words are more easily recalled, theoretically due to being better represented in and therefore more easily retrieved from long term memory (Demb, et al., 1995; Hoffman, Jeffries, Ehsan, Jones, & Ralph, 2009; Martin, Lesch, & Bartha, 1999;). This may likely be related of the efficiency of recalling items from long-term memories as earlier mentioned (Grill-Spector et al., 2006; Nishiyama, 2013; Rose, & Craik, 2012; Rose, at al., 2010). That said uncommon words or with a low frequency of occurrence in an experiment can demonstrate an advantage in recall tasks over high frequency words (Fiebach, 1995; Guttentag & Caroll, 1997). This is linked to the increased neurological stimulation generated by the presence of novelty (Clark & Wagner, 2003; Ranganath & Rainer, 2003). To what extent the interactions of familiarity and novelty pose to one another remains inconclusive. However such an effect may possibly occur due to the more novel stimuli obscuring one's focus from more familiar stimuli that are processed with less neural activity, therefore superimposing upon the less neurologically stimulating simuli. Considering all of the above, hypothesis four shall assume that more common words may benefit from learning effects or reinforcement and retrieval from in long-term memory, and therefore be more easily retrieved in a recall task:

Hypothesis 4: More common words shall be more frequently recalled than less common (i.e. rare) words.

Additionally reading skill predicts verbal memory scores for immediate and delayed recall in the Weschler Memory Scale (Frick, Wahlin, Pachana, & Byrne, 2011; Wechsler, 1997). Hypothesis five shall propose that participants who report reading frequently will be more adept at processing and memorising verbal stimuli as indicated by the aforementioned statements.

Hypothesis 5: Participants who report reading more often will recall more words than those who read less often.

In summary of the objectives of this study, the primary objective is to investigate what aspects of a verbal stimulus affects or possibly predicts its probability of being clearly memorised and recalled. In addition a more natural context in the form of prosaic text rather than word lists as an interfering stimulus will offer insight to whether the effects typically found in studies investigating similar matters in working and short term memory studies shall emerge under these conditions. Finally reading habits although not a verbal factor, may contribute to the patterns of recall in individual participants. Specifically each of the five hypotheses shall address different factors that may be reasoned to affect memory and recall, in the form of association, morphology or phonology, semantics or concreteness-abstractness, linguistic frequency or rarity-commonality, and the possible influence of reported reading habits.

Method

Participants

37 participants (11 male, 27 female) were conveniently sampled. All participants were students qualified for third level education, ensuring a high level of literacy for the experiment's tasks. The two potential experimental conditions were assigned via consent forms organised in pre-randomised blocks of ten. In doing so the benefits of convenient sampling and randomised assignment were achieved.

Materials

Both texts for the interfering stimulus were sourced from the same author (Hemingway, 1926, 1929) to minimise possible differences in writing style. Text one consisted of 423 words, and text two of 427 words. To evaluate the difficulty ratings of these texts the Flesch-Kincaid reading ease scale was used (Added Bytes, 2015), text one scored 81.4 and text two 91.6, evaluating both texts as easy to read. Both short excerpts were occupied with primarily descriptive motifs, with no written dialogue.

Of the words generated for the list, 19 were present in text one, and the other 40 present in neither, giving a total of 59 target words to memorise. The words themselves were selected and evaluated with considerations to their measurable linguistic components relevant to the hypotheses; specifically syllabary, concrete or abstract meaning, and their frequency of occurrence in the written language according to the Collins (2015) English dictionary. These different features were roughly balanced as within the limitations of the English language, and in the case of the 19 relevant words, within limitations of the relevant text. Syllabary or phonological length consisted of 27 monosyllables, 13 disyllables, and 19 polysyllables (3 syllables n = 13, 4 syllables n = 4, 5 syllables n = 2). Regarding concrete and abstractness were 29 abstract and 30 concrete words. The rarity-commonality spectrum consisted of 8 rare, 13 occasional, 14 common, 16 very common, 8 extremely common words. An additional 60 words were generated along similar lines to be present in the recognition or recall task after the assigned interfering text.

To briefly evaluate participants self-reported reading habits a brief and simple six item, five point likert scale rating from not very often to very often was generated. Item 1 inquired "*How often do you read?*" to evaluate self perceived frequency of reading. To investigate alternative potential relationships between reading habits and recall, items 2-5 questioned "*Of the type of things you read how often would you read from the following categories?* " for the categories of fiction (item 2), non-fiction (3), news (4), and academic (5) reading. For item six a six point nominative scale variation with the options of "*once a year*", "*every few months*", "*once a month*", "*once a week*", "*several times a week*", and "*every day*" was used. The answers to these items were to be applied in conjunction with the experimental results to evaluate the relationship, if any, amongst individual reading habits verbal memory. There were two additional questions simply to identify gender and age.

The experiment itself was accessible online, however participants were recruited in person and given a brief explanation to the procedure alongside the consent form (see appendix c). In doing so all participants were assured informed consent before by the author of this study before participating. Furthermore the online nature of the materials allowed for flexibility in administration of the experiment, minimising the requirements to internet access and appropriate experimental conditions (i.e. a relatively non-distracting environment). The materials themselves were assembled using google forms software (Google, 2015). Brief instructions were provided for each stage of the experiment. Materials for the word list were designed to allow only one word on-screen at a time, and all words were shuffled at random for each participant to minimise unwanted primacy and recency effects (Gupta, 2005; Murdock, 1962).

Completing the word list provided a link to the next parts of the experiment. The next stage presented the assigned text as a reading task, which was followed the recognition task where words were shuffled at random. Upon completion of the three stages of the experiment, the questions illustrated earlier were presented. After all of these tasks, a small excerpt explaining the role of each task and a word of thanks for participation was presented on screen.

Design

An experimental design was applied to measure memory in this study. The experiment consisted of a memory task, followed by an interference task, followed by a recall task with target and distracting variables. The dependant variable of this study consisted of the target words accurately recalled in the recognition task. Independent variables included the target words, the text condition, and the linguistic properties assigned to these words. This was followed by a brief scale to evaluate reading habits to provide an additional cross-sectional perspective to these results (i.e. the dependant variable).

Procedure

Participants were given a brief overview of the study and a consent form that provided an internet link to one of the two experimental conditions designed. The first part of the experiment consisted of a set of 59 individual words shuffled at random, which participants were instructed to memorise. The second part consisted of a reading task featuring the texts assigned to the selected condition, which they were instructed to carefully read. Following this was the recognition task with a set of 119 words shuffled at random, where participants were instructed to check the words they recalled appearing the initial set of 59 words. Once the experiment was complete a brief questionnaire on one's frequency of reading was presented. Consent forms were collected upon completion of the study. The data acquired was automatically logged onto a spreadsheet, which was configured for input and into the SPSS software for statistical analysis.

Results

Interference and Facilitation Effects

The basic descriptive statistics for recall in the recognition task for the relevant text condition (text 1), irrelevant text condition (text 2), and overall for participants were as follows (see table 1): For Text 1 (i.e. relevant text, n = 21), Relevant words M = 9.62, SD = 3.69, Irrelevant words M = 20.10, SD = 20.63. Overall M = 29.71, SD = 9.95. For Text 2 (i.e. irrelevant text, n = 21), Relevant words M = 8.84, SD = 3.87, Irrelevant words M = .63, SD = 6.75, Overall M = 29.56, SD = 10.09.

To test the difference between the two conditions an independent samples t-test was applied (see table 1). The difference in recall scores for relevant words was $t(35)$ = .29, p = .59, d = .18, for irrelevant words $t(35)$ = .06, p = .817, d = .08, and overall differences in recall were $t(35)$ = < .01, p = .964, d = .01. From these results it would appear although the strongest effect was the relevant text facilitating relevant words, although it is nonetheless both a very weak and insignificant one. This is followed by irrelevant words facilitating irrelevant word recall to a lesser degree, and an entirely negligible overall recall difference. There is little evidence to distinguish any effects between the two conditions upon recall in a recognition task.

Table 1, Descriptives and t scores of Word Recognition in Relevant and Irrelevant Text Conditions

Recall	*M*		*SD*		*Range*		*t*	*d*
Condition	Text 1	Text 2	Text 1	Text 2	Text 1	Text 2		
Relevant Words	9.62	8.94	3.69	3.87	2-19	3-18	.29	.18
Irrelevant Words	20.10	20.63	6.93	6.75	10-38	9-31	.06	.08
Overall	29.71	29.56	9.95	10.09	13-50	17-50	< .01	.01

Linguistic Properties

To address hypotheses 2-5 relevant to linguistic properties of words, frequencies for individual linguistic components were analysed (see table 2). Further details regarding the full list and descriptives for each target word are illustrated in *Appendix a*. Regarding syllabary the mean hit rates were as follows (see table 2): Monosyllables M = 46 (SD = 13.69), Disyllables M = 48.62 (SD = 12.96), and for Polysyllables M = 56.53 (SD = 16.68). Abstract words demonstrated a hit rate of M = 47.28 (SD = 14.44), and Concrete words M = 52.57 (SD = 15.47). The mean hit rates for rarity-commonality were as follows: Rare words M = 65.38 (SD = 10.48), Occasional M = 58.23 (SD = 10.93), Common M = 48.43 (SD = 15.38), Very Common M = 43.88 (SD = 12.18), Extremely Common M = 36 (SD = 9.90). For illustrated plots of these mean hit rates see *figures 1 to 3* in *appendix b*.

Although frequencies alone appeared to confirm hypotheses 2 and 3, and reject 4, a further analysis of variance was investigated to discern the statistic power of these results in relation to the hypotheses. The results of the ANOVA revealed the support for hypothesis 2 and 3 to be insignificant (Syllabary: $F(2) = 2.58$ $p = .09$, $\eta_p^2 = .132$; Concrete-abstract: $F(1) = 7.24$. $p = .11$, $\eta_p^2 = .176$) and the opposite hypothetical stance for hypothesis 4 to be quite significant and the greatest explanation of variance in the data *(*Rarity-commonality: $F(4) = 7.05$. $p = <.001$ $\eta_p^2 = .453$*)*. Therefore it would appear rarity-commonality best accounted fro explained the variance in the recollection of target words.

Considering the frequency patterns of recall appeared to progress in a rather linear fashion throughout (see table 2), and that the rarity-commonality dynamic appeared to be the most significant factor of the variance in recall, a multiple linear regression analysis of all three linguistic factors was calculated to see if an effect could be statistically inferred to explain this pattern in relation to its predictive value towards recall (see table 3). Preliminary correlation analysis to investigate potential multicollinearity found a weak correlation of $r = .241$, $p = .033$ between syllabary and rarity-commonality, which likely reflects the apparent relationship visible between the two in the descriptive statistics (see table 2), correlations amongst other independent variables was negligible and insignificant (concrete-abstract & syllabary: $r = .153$, $p = .124$; concrete-abstract & rarity-commonality: $r = .01$, $p = .46$). Other preliminary analyses revealed no concerning deviation from acceptable levels of normality, linearity and homoscedasticity. The regression coefficient indicated the rarity-commonality dynamic as the most significant and strongest predictor of recall (β = .56, p < .001), with the factors of syllabary (β = .18, $p = .068$) and the abstract-concrete dynamic (β = .19, p = .057) demonstrating relatively low beta values and significance in comparison.

Table 2, Mean Hit Rates Regarding Linguistic Properties of Recalled Words

		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	Rare	65									
2	Occasional	-	58								
3	Common	-	-	48							
4	Very Common	-	-	-	44						
5	Extremely Common	-	-	-	-	36					
6	Monosyllable	65	61	39	43	38	46				
7	Disyllable	68	50	46	41	32	-	49			
8	Polysyllable	64	63	63	45	33	-	-	57		
9	Concrete	66	60	55	41	44	48	51	61	53	
10	Abstract	65	56	44	42	31	44	43	48	-	47

Table 3, Linear Regression Coefficient of Linguistic Components on Recall

	B	*Std. Error*	β	*p*
Rarity-Commonality	6.67*	1.24	.56*	<.01
Syllabary	3.364	1.8	.18	.07
Concrete-Abstract	5.95	3.06	.19	.06

Note: Adjusted $R^2 = .406$. * $p = <.001$.

Reading Habits

Increased frequency of self reported reading from almost never to very often was associated with an increase in total recall recognition of the target words (see table 4). The means for the number of target words recognised were as follows from 1 almost never to 5 very often: (1) M = 24, SD = 7.07; (2) M = 28.29, SD = 7.25; (3) M = 28.10.95, SD = 10.95; (4) M = 30.7, SD = 10.85; (5) M = 32.38, SD = 11.76.

Investigation of correlations revealed no any significant correlation between reading habits and recall, with the highest correlation of for “Do you read often?”, presenting the highest values at $r = .2$, $p = .23$. Thus there was little to indicate a relation beyond that observed in the descriptives.

Table 4, Descriptives of Reading Habits and Recall in Recognition Task

Frequency	N	M	SD
1 (Almost Never)	2	24	7.07
2	7	28.29	7.25
3	9	28.89	10.95
4	10	30.7	10.85
5 (Very Often)	8	32.38	11.76
Total	36	29.78	9.96

Discussion

Both groups demonstrated similar patterns of recall as reflected in their mean scores, which alone indicate little difference and were further supported by the lack of statistical significance to suppose otherwise. One interpretation of this is that any facilitatory effects offered by the relevant text, is offset by the sheer number of other words present when it is read. However there was a very minute preference for relevant words in the relevant text condition (mean difference = .68, t =.29, Cohen's d = .18) although such effects were small and held no significance. However such a small effect may be the lingering remnants of the facilitatory effect found in experiments using list against list interference (e.g. Unsworth et al, 2013). An argument can be made that there were simply not enough target words given to discern a significant associative effect, or that possibly by increasing the sample size an effect may have been statistically inferred. Overall however, if such an effect is present it is relatively weak in the case of interfering texts. Also worth note was that mean recall was near indistinguishable between both conditions, further hinting against any discussable effects of either text conditions influence beyond that it likely interfered with recall (Dewar et al., 2012). Overall one may confidently confirm that *hypothesis 1* is rejected in this study, as a prosaic text containing a selection of target words did not show any significant effects on the facilitating recall of relevant words. To refer to the theoretical reasoning presented in the introduction, it is probable that any discernible facilitation effect for recalling words may be nullified by the interference presented by the words in the text, therefore in a body of text there is no observable facilitatory effect on recall.

Concrete words were more frequently recalled than abstract words to although to a statistically insignificant degree (p = .11). However the descriptive data reflects the typical result found in the literature of concrete words being more frequently recalled than abstract words (Borges et al., 1977; Romani, et al., 2008; Walker & Hulme, 1999). Therefore *hypothesis 3* was supported in this study by the pattern of recall hit rates, but strictly speaking is subject to rejection due to lack of statistical strength to support the effect despite its congruence with other studies. Increased phonological length or syllabary demonstrated an increase on recall when observing hit rate frequencies alone. Although insignificant (p = .09) the finding of phonologically longer words being more frequently recalled was congruent with a number of past studies supporting a long word recall effect (Fournet et al., 2003; Katkov et al, 2014; Tehan & Tolan, 2007). It would seem plausible to consider that *hypothesis 2* was likely insignificant due to a lack of statistical power from the small sample size in contrast to the large number of dependant variables. Based upon descriptive statistics this result is largely consistent with research on word-length effects supporting word length as a predictor of recall, and also with the effect of a word's length in upon recall inlong term memory studies. It is curious to note that in this long term memory experiment with the prosaic text as interference and a large a varied word list, that these two effects are indicated to the naked eye, but are statistically dilute compared to short term and list based experiments on memory. Therefore based upon congruence of frequencies and the lack of statistic power one may posit that these effects are present as in working and short term memory studies with list based interference, but may be more weak due to the increased opportunity for interfering stimuli to weaken memory as present in this experiment. However considering the further findings regarding a words frequency of occurence in the language, there may be an possible alternative perspective that can be added to explain the above.

The dichotomy between rare and extremely common words demonstrated that increasing rarity was associated with increased rates of recognition in the recall task ($p = <.001, \eta_p^2 = .453$). Such result gives supporting evidence for the novelty effect, as rarity is a factor that influences novelty (i.e. something commonly encountered cannot be defined as novel). Hence *hypothesis 4* was refuted outright, with a clear pattern of increased rarity of a word facilitating recall in the recognition task of this experiment, the opposite of the hypothesis that was posited.. This result however provided the most detailed insight into the dynamics of verbal recall from the experiment. When all selected linguistic factors were observed together, the pattern of recall across all three syllabic categories and the abstract-concrete dynamic generally resembled that of the rarity-commonality pattern, whereby rarer words were typically more frequently recalled than more common words regardless of concreteness or syllabary. Such a finding motivated the multiple linear regression analysis to investigate and infer whether this may be the underlying factor that influences recall not only by its own merit, but also across the other factors. When investigated in more detail, application of linear regression analysis confirmed such suspicions that the rarity-commonality dynamic probably played the more important role in predicting what qualities of a word facilitated recall in the recognition task. This factor possessed both the highest predictive value ($\beta = .56$) and the sole indication of statistical significance ($p = <.001$) alongside the variables of syllabary and abstractness-concreteness. Thus the rarity-commonality dynamic can be confirmed in the context of this study's results to be the most predictive factor of recall.

Such a finding grants support to the novelty effect as important to recognition based recall in a natural and familiar language. From this observation, the rarity-commonality dynamic appeared to be mediating factor in recall. One may consider that longer words are particularly few in extremely common usage, and it would seem people are statistically economic with the length of such frequently used words. To indicate this point, of the 100 most common words of the English language as reported by Oxford Dictionaries (2015), 97 are monosyllables and 3 are disyllables. Thus there is the possibility that monosyllables may be most poorly recalled due to their better representation in the more common end of the linguistic spectrum, therefore being more common than polysyllables therefore weakening the novelty effect in such words. One may compare the mean recall rate of monosyllables overall ($M = 36$) to that of the rare monosyllable “dye” ($M = 65$) to illustrate this idea. Furthermore the minor correlation observed between rarity-commonality and syllabary ($r = .241$, $p = .033$) may indicate this hypothetical relationship amongst the words selected in this study. In Jalbert et al.'s (2011) and Katkov et al.'s (2014) conclusions, they noted an indication of other likely latent linguistic properties or features that contribute to the probability of word recall. The dynamic of linguistic rarity-commonality or in other terms a words frequency of use in the language, would according to this study, appear to be this underlying feature.

It would appear the effect of novelty protects a verbal stimuli that is read from being superimposed in one's memory by new verbal stimuli, likely by superimposing itself upon other stimuli a possibility considered in the paragraph addressing hypothesis 4 in the introduction, and akin to the concept discussed by Oberaur et al. (2012). Considering the neural explanation earlier referred to (Clark & Wagner, 2003; Ranganath & Rainer, 2003), this would support the idea that stimulation dictates the strength of a memory. Such a manner of explaining this would place the novelty effect observed in this study on the spectrum of stress enhancing memory (e.g. Hupbach & Dorskind, 2004; Parfitt, Barbosa, Campos, Koth, & Barros, 2002). If one were to take this mechanism to its logical extreme one may predict an outcome of extreme stress producing extremely potent memories, an effect one may find present in the vivid re-experiencing of memories symptomatic of post-traumatic stress disorders (e.g. Marshall, Schell, Glynn, & Shetty, 2006; Schell, Marshall, & Jaycox, 2004). However pertinent to the results of this study is that the novelty related cognitive stress due to the simple reception of the linguistic aspects of words alone is detectable in a test of recall in the form of a word recognition task. Such a process would indicate that such a widespread phenomenon as the novelty effect potentially plays and important role in recalling words written language follows the same simple mechanism as other varieties of stimuli.

However it is worth consideration that if no rare or occasional words were present in the initial word list, that a different magnitude of recall for the other increasingly common words may possibly have come through. However based upon the results at present, one could predict that the effect woul still affect the rarest and most common word in a selection. Therefore such reasoning returns to the core principle of competing stimuli being integral to the nature of memory and learning in a natural stimulus rich environment. One may even return to Hebb's (1949) theories for example, as a words rarity and commonality are still matters of association with familiarity. Thus the potential larger implications of this finding is the support for the theory that for perceivable stimuli in the form of words, there is a relatively simple dynamic for complex memory in its verbally written form that manifests through a large variety of expressions.

Regarding reading habits, self-reported frequency of reading had a superficial relation to recall, but lacked any statistical significance. Considering the relation between reading and verbal recall mentioned earlier (Frick et al., 2011) there are several potential explanations for this result. Firstly it is likely the questions were insufficiently rigorous and in the case of item six, poorly phrased. Secondly the study was primarily experimental and likely lacked the numeric strength to obtain valid cross-sectional data. Thirdly self perceptions of reading may not be accurate indicators of reading ability. Overall although there is a small observable effect ($\beta = .20$), *hypothesis 5* is rejected due to lack of significance ($p = .23$).

It is important to note that the findings are only relevant to stimuli that are newly or relatively newly encountered, as studies demonstrate that directed learning efforts dominate recall patterns over time (Brown, Neath, & Chater, 2007; Kapricke & Roediger, 2007; Roediger & Karpicke, 2006; Rose, et al. 2010). One reasonable limitation however is the use of a recognition task. Although such a task had a logical basis to compensate for the sheer number of target words presented to participants ($n = 59$), it is important to note that a large amount of the literature on verbal memory referred to used free of serial recall tasks rather than recognition. However as these results demonstrate resultant effects congruent with those of other memory tasks or measures, one may argue that these effects are supported as they are detectable using in a variety of measures. An additional limitation is that presented by the particular set of target words presented in this task, as there is the possibility that these results are largely unique to the particular selection of words. Should future studies create a list of words with better balance across the factors of phonological length and rarity-commonality than that of the present study or simple produce a different list of words with a similar evaluative procedure, one could possibly produce stronger support for the role of this novelty effect due to frequency of general linguistic usage. Alternatively may find an alternative emergent effect or contradict these results. Therefore the limiting issues of balancing the three properties of rarity-commonality, syllabary, and abstractness-concreteness that have limited this study may be improved upon in later work with more balanced or simply through arranging different target words relatively aligned across this rarity-commonality evaluation.

In conclusion it would appear that verbal stimuli are vulnerable to distractions and interference from other words, and that in texts of a couple of hundred words the interference negates the observable benefits of relevant association. Additionally many of the effects found in short term and working memory studies using lists to list experiments, are more quite likely to be more subtly present in the context of long term memory and more voluminous verbal interference. In context of the results of the linguistic properties of words, the single strongest finding is that a word's overall linguistic frequency has the most potent influence on recollection of verbal stimuli. Such an effect appears to the author's knowledge have been largely overlooked in previous research and possibly offers a good contribution to the question of the underlying factor that influences verbal recall for written words. It would also appear that the dynamic of novelty and its neurological or cognitive impacts occur in natural language and offers a wider theory to explain this memory effect. Considering that verbal memory is part of the overall neurological system it seems sensible that the effect of neural stimulation applies similarly to words. The indication of the novelty arousal generated by novelty in a purely verbal measure of memory allows one to further relate verbal memory to wider theories of cognition, learning, and memory.

Furthermore under this proposed interpretation the effects observed in this study demonstrate a finding that is consistent with concepts neural stimulation and memory across psychological and other disciplines that study human memory. A final recommendation in addition to the conclusion of this study, is that future studies of verbal recall may consider evaluating the broader linguistic frequency of a word's usage in the language when evaluating them in research and experiments.

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Appendices

Appendix a

Linguistic Components and Recognition Hit Rates for Target Words across both conditions.

Word	Usage	Concrete / Abstract	Syllabry	Hit Rate % (*M*)	*SD*
act	Extremly Common	Abstract	Monosyllable	.32	.48
allophone	Rare	Abstract	Polysyllable	.68	.48
amphitheatre	Occasional	Concrete	Polysyllable	.73	.49
anything	Extremly Common	Abstract	Polysyllable	.38	.45
ball	Common	Concrete	Monosyllable	.22	.42
book	Extremly Common	Concrete	Monosyllable	.46	.51
boots	Common	Concrete	Monosyllable	.62	.49
brooch	Occasional	Concrete	Monosyllable	.65	.48
cantaloupe	Rare	Concrete	Polysyllable	.76	.44
carpet	Common	Concrete	Disyllable	.43	.50
child	Extremly Common	Concrete	Monosyllable	.54	.51
chocolate	Common	Concrete	Polysyllable	.65	.48
chunk	Occasional	Abstract	Monosyllable	.54	.51
cloud	Common	Concrete	Monosyllable	.43	.50
consequences	Very Common	Abstract	Polysyllable	.65	.48
correspondent	Common	Abstract	Polysyllable	.54	.51
deep	Extremly Common	Abstract	Monosyllable	.24	.44
divided	Very Common	Abstract	Polysyllable	.54	.51
dresser	Occasional	Concrete	Disyllable	.49	.51
dye	Rare	Abstract	Monosyllable	.65	.48
edge	Very Common	Abstract	Monosyllable	.38	.49
elephant	Common	Concrete	Polysyllable	.68	.48
elm	Occasional	Concrete	Monosyllable	.65	.48
enervate	Rare	Abstract	Polysyllable	.49	.51
floor	Very Common	Concrete	Monosyllable	.43	.50
frost	Common	Concrete	Monosyllable	.41	.50
guile	Occasional	Abstract	Monosyllable	.62	.49
health	Extremly Common	Abstract	Monosyllable	.35	.48
hubris	Occasional	Abstract	Disyllable	.36	.51
invigorating	Occasional	Abstract	Polysyllable	.54	.51

magazine	Very Common	Concrete	Polysyllable	.46	.51
money	Extremly Common	Concrete	Disyllable	.32	.48
mountain	Very Common	Concrete	Disyllable	.43	.50
narrow	Very Common	Abstract	Disyllable	.38	.49
nice	Very Common	Abstract	Monosyllable	.46	.51
ossuary	Rare	Abstract	Polysyllable	.78	.42
patience	Common	Abstract	Disyllable	.49	.49
patrimony	Occasional	Abstract	Polysyllable	.62	.51
pine	Common	Concrete	Monosyllable	.43	.50
porcelain	Common	Concrete	Polysyllable	.76	.44
quart	Occasional	Abstract	Monosyllable	.70	.46
rain	Common	Concrete	Monosyllable	.49	.51
ring	Very Common	Concrete	Monosyllable	.38	.49
rut	Occasional	Concrete	Monosyllable	.51	.51
sharp	Very Common	Abstract	Monosyllable	.38	.49
similar	Extremly Common	Abstract	Polysyllable	.27	.45
steel	Very Common	Concrete	Monosyllable	.59	.50
steeply	Common	Abstract	Disyllable	.54	.51
tamarind	Rare	Concrete	Polysyllable	.51	.51
tragedy	Common	Abstract	Polysyllable	.54	.46
train	Very Common	Concrete	Monosyllable	.30	.51
tune	Common	Abstract	Monosyllable	.24	.44
vermouth	Rare	Concrete	Disyllable	.68	.48
vineyard	Occasional	Concrete	Disyllable	.70	.46
washbowl	Rare	Concrete	Disyllable	.68	.48
wheel	Very Common	Concrete	Monosyllable	.43	.50
wicker	Occasional	Concrete	Disyllable	.46	.51
winding	Common	Abstract	Disyllable	.36	.48
wonderful	Very Common	Abstract	Polysyllable	.16	.37

Appendix b

Figure 1, Mean Hit Rates across Syballic properties

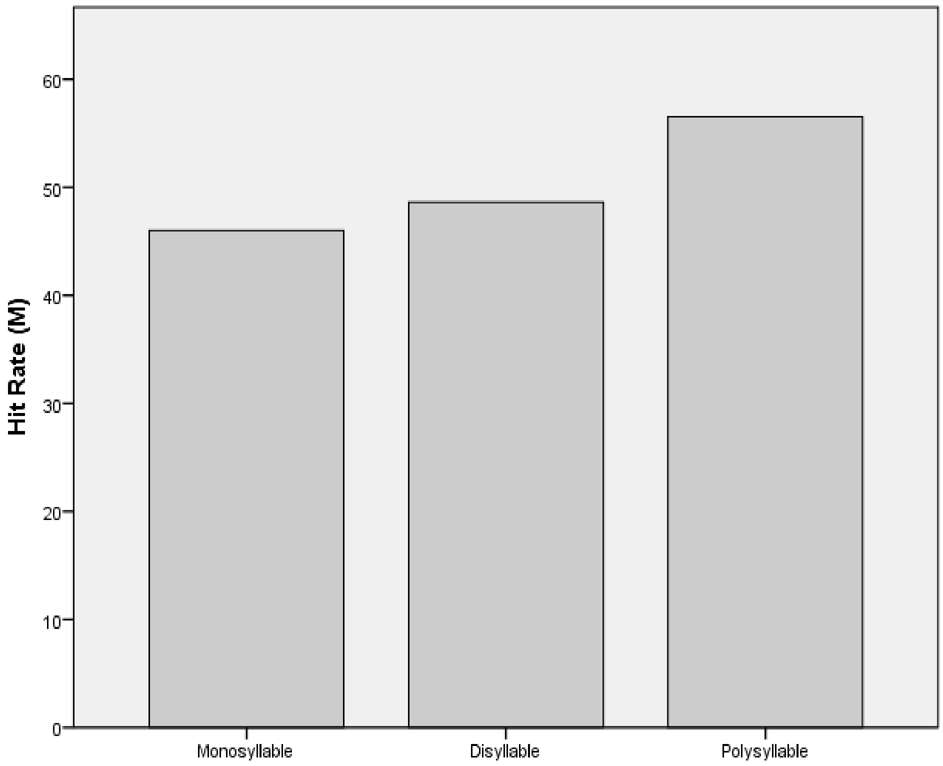


Figure 2, Mean Hit Rates across the Concreteness Abstractness properties.

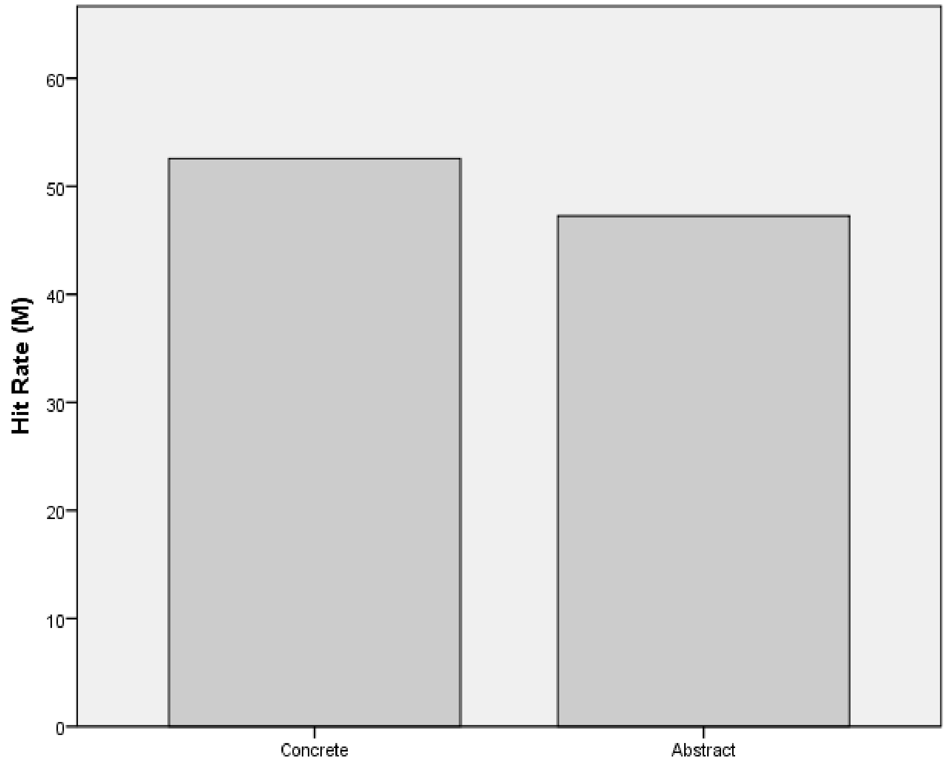


Figure 3, Mean Hit Rates across Rarity-Commonality properties.

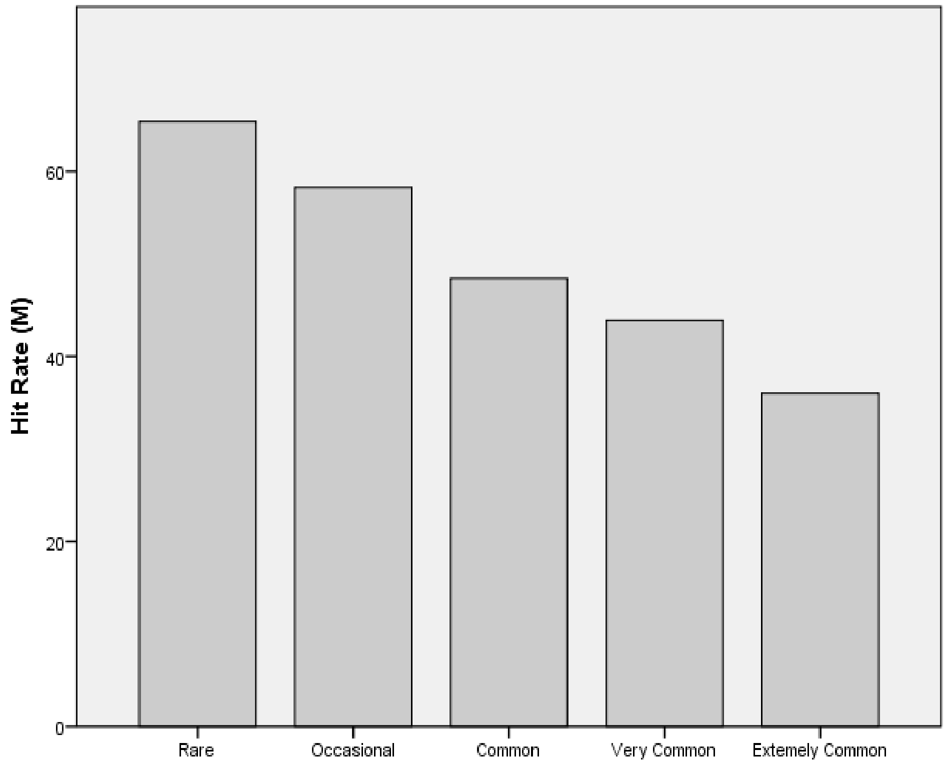
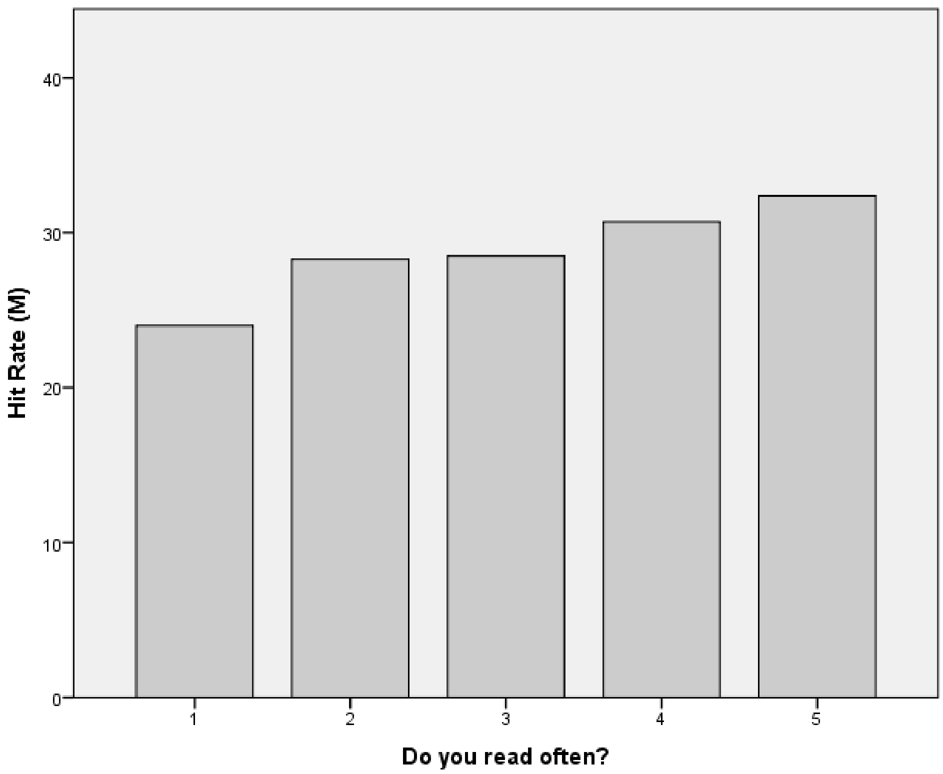


Figure 4, Mean Hit Rate Across Reading From Almost Never (1) to Very Often (5).



Appendix c

Consent Form

This study is investigating what influences verbal memory in a reading context. You will be presented with a three part online experiment related to reading and memory that should take under 10 minutes to complete. After the experiment you will be asked briefly about your gender, age, and six questions on reading habits.

All information collected will be kept anonymous. If you would like to volunteer to participate in this study please sign below.

I ______________________________________ hereby consent to participate in this study.

To begin the experiment please access [*link to the experiment*].