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Short term effects of repeated masked priming in stem completion tasks

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SHORT TERM EFFECTS OF REPEATED MASKED PRIMING IN STEM COMPLETION TASKS

By

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USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

This thesis examines the effect of time delay and intervening items on masked repetition studies with word stem completion tasks. In the first experiment a masked priming effect was obtained. The effect was strongest 500 ms after the presentation of the prime, and decreasing in a linear trend seven seconds after the presentation of the prime. The second experiment found that interpolating a naming task between the masked prime and the stem completion task eliminated the effects of the repeated masked prime. This result is a failure to replicate previous research which found a masked repetition effect over a short delay with intervening items. These results are interpreted as supporting the contention that masking a priming stimulus excludes formation of a trace in the episodic memory system and so provides an insight into the functioning of the lexical processing system. It appears that priming the lexicon with a masked stimulus leaves the system activated for at least 7 s and the decay of this activation is a time dependent process.

DECLARATION

I certify that this thesis does not incorporate, without acknowledgment, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where reference is made in the text.

Signed.... Date....11-3-1996

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CHAPTER 1. INTRODUCTION

An area of interest to cognitive psychologists is the nature of the mental lexicon, the knowledge store of all the words in a person's vocabulary. An issue that arises in investigating the lexicon is the concern about the modularity of the lexical system in relation to other cognitive systems (Fodor, 1983). A modular system can function independently from other systems and can only process information relevant to that system.

Tulving's (1972) attempt to distinguish between semantic memory and episodic memory provides a classification of cognitive systems that could display independent functioning. Semantic memory is a record of generic knowledge abstracted from personal experiences. The mental lexicon that contains the memory for properties of linguistic objects can be considered a subsystem of the semantic system. Conversely, the episodic memory system "receives and stores information about temporally dated episodes or events" (Tulving, 1983:21).

A means of investigating the differences between the separate cognitive systems is to examine cognitive performance across different tasks. A different pattern of results may be taken to indicate a difference in the functioning of the two systems. Alternately, comparing two systems on the same task but manipulating a variable which reflects processing in either system may yield an insight

into their differences. It is this paradigm that will be employed in this thesis. While it is beyond the scope of this thesis to explore all the variables that may reflect processing differences between cognitive processing systems this, thesis focuses on the time course of processing.

This issue is addressed in the present thesis by examining the effect of time lag on repeating a stimuli. In particular this thesis focuses on the time course of processing of the lexicon. The results will also provide a point of comparison with a body of research investigating the time course of processing in the episodic memory system.

It is the goal of the experiments presented in this thesis to examine the time course of the activation of lexical memory. Specifically, it will focus on the activation within the first seven seconds as previous research indicates the lexical processor is only activated for this short time frame (Forster and Davis, 1984).

This thesis will now proceed to discuss two of the cognitive tasks used by researchers to investigate these cognitive systems, the lexical decision task and the stem completion task. Following this, the thesis will explain how these tasks have been used to investigate the functioning of the cognitive systems over time. Chapter Two follows with a brief overview of the main findings of repetition delay and some of the thecretical interpretations which have been put forward to explain these results. Chapter Three then proceeds to discuss in

depth the two previous studies which have directly studied the effect of time delay on tasks that report to examine lexical processing. The remaining chapters report on the two experiments conducted for this thesis and the discussions of these studies.

Lexical decision and stem completion tasks.

The lexical decision task is one task used by researchers to explore cognitive functions (Forster and Chambers 1973). In this task, subjects are randomly presented with a series of items, one at a time, on a visual display unit. The items consist of a series of words (e.g. MUSCLE, COLOUR) or non-words (e.g. MUSWER, COLUND). As each item is presented, subjects are required to respond whether the item is a word or not. The speed of responding and the accuracy of the response of the two response measures are recorded.

Researchers frequently employ a repetition paradigm as a variation on this lexical decision task to investigate the functioning of the lexical system over time. This paradigm involves repeating some items again and examining the effects of repetition on the response measures. A variable that can be investigated when the repetition paradigm is used is the time between the first and second presentation of the item.

Another task utilised by researchers is a stem completion task. Subjects are presented with the first few letters of a word (e.g. MUS___, COL___) and they are

required to generate a word that could complete the stem. A variation of this task is to present a possible completion of the stem (e.g. MUSCLE, COLOUR) and examine if subjects are more likely to generate that word. The effects of varying the time between the presentation of the word and the stem can also be investigated.

The following chapter outlines some of the main findings of the research that has investigated the effect of repetition delay on the two tasks.

CHAPTER 2. PRIMING AND MEMORY SYSTEMS

Although earlier studies investigated the repetition effect with a lexical decision task (e.g. Forster & Chambers, 1973), they usually focused on investigating other effects such as cross-modal transfer. Forbach, Stanners and Hochaus (1974) were one of the first groups of researchers to investigate the effect of repetition delay on a lexical decision task. They found a significant decrease in reaction time of around 50-100 ms and the repetition effect lasted for at least 10 minutes.

Scarborough, Cortese and Scarborough (1977) conducted a similar study and again found a repetition effect for the lexical decision task. They examined four short term delay conditions of 2, 6, 14 and 30 s each with 1, 3, 7 or 15 intervening items respectively . All delay conditions showed a significant repetition effect. However, there was no difference between any of the four conditions indicating that the processing of interpolated words does not interact with the repetition effect. It also indicates that the delay does not effect repetition within the 30 s delay period. Scarborough et al. reject the possibility that the repetition effect is due to a short term memory store because successive intervening items would replace items currently in this memory system and they suggest "that the repetition effect may reflect properties of a lexical and, possibly, semantic memory" (p. 14). Other experiments they reported showed repetition effects lasting for at least two days on the lexical decision task.

There is also the possibility that other nonlexical processes are involved in the repetition effect. If the repetition effect involves repeated access to the same lexical entry then it should not matter how the repeated word is first presented to the subject, so long as the word is processed lexically by having the subject read it.

Oliphant (1983) investigated this hypothesis using a lexical decision task. No repetition effect was found for those words repeated from the instructions compared to the repetition effect that was obtained with items which were tested twice within the experiment. The delay between the words repeated from the instructions was approximately 5.5 minutes and the delay between the words repeated within the experiment was approximately 3 minutes. The repetition effect was interpreted not as a simple recency effect or some automatic lexical effect, rather it depends on the subject becoming aware of the repetitions and adopting some strategy which speeds the recognition of repeated words.

Forster and Davis (1984) investigated this hypothesis by examining the repetition effect on lexical decision tasks for items which the subject was not required to make an active response to but were only presented as "filler" items. They tested this condition in two experiments, one with a long delay of 5 to 10 minutes and another with a shorter delay of 1 to 2 s. A significant repetition effect was found for the long delay condition that did not require a response to the first presentation of the word. However this response was much weaker than the effect obtained when

subjects were required to respond to the first presentation of the repeated word. This difference suggests that other nonlexical processes might also be involved in the repetition effect.

The fact a repetition effect for both delay conditions in the Forster and Davis (1984) study contrasts with Oliphant's (1983) failure to find any repetition effect. This could result from subjects realising the items were being repeated in the Forster and Davis study and so could adopt some strategy which increases the speed of recognition of the repeated words. An alternative explanation of the effect is that lexical processes could still be operating but the Oliphant study was insensitive to this effect.

A much stronger repetition effect was obtained for the short delay condition in Forster and Davis's (1984) study when subjects were not required to respond to the first presentation. When compared to the results of the 5 to 10 minute delay condition, these results indicate the repetition effect with lexical decision tasks is sensitive to delay when subjects are not required to respond to the first presentation. This result contrasts with Scarborough et al. (1977) who found the standard repetition effect is insensitive to a short delay of at least 30 s with intervening items.

As it is the aim of this thesis to focus on the properties of the lexicon, the standard repeated lexical decision task may not offer an acceptable means of

investigating the lexicon and an alternative may be required. Forster and Davis (1984) offered a method that could investigate the effects of the functioning of the lexicon. They suggested masking the first presentation of the item (the prime) so that the subject is unaware it was presented. One way of masking the prime is to present it very quickly to the subject (e.g. 60 ms). Forster and Davis argued that masking the prime in this way eliminates the episodic influences so that subjects are not able to recognise it. However they do admit that masking may still produce an episodic trace of the prime, but it is still relatively inaccessible.

The next chapter discusses the findings of research that has employed a masked repetition paradigm.

CHAPTER 3. DELAY AND MASKED PRIMING

Although other researchers such as Evett and Humphrys (1981) previously employed a masked repetition effect, they examined only one short delay period. It was Forster and Davis (1984) who systematically investigated the effect of various delay conditions using the masked repetition effect with a lexical decision task.

Forster and Davis (1984) found a significant 43 ms decrease in reaction time on the lexical decision task for the masked prime condition. In this experiment there was no delay between the repeated masked prime and its subsequent testing. The items presented to the subject consisted of three stimuli, firstly a "dummy" word was presented to the subject for 500 ms (e.g. formal) , secondly the masked word was presented for 60 ms (e.g muscle) and finally the subject was required to make a word/nonword decision about the target word that was presented for 500 ms in capital letters immediately following the mask (e.g. MUSCLE). Half the target items were nonwords (e.g. PORDEN) and subjects were required to determine if the target item was a word or not. For the control condition they compared response measures to an item that was preceded by a different masked word (e.g. formal prison MUSCLE).

Forster and Davis (1984) then extended the delay from immediate testing to a delay of about one second between the masked prime and the target words by including additional dummy words between the mask and the target

(e.g. contact muscle dentist trivial MUSCLE). All items were presented for 500 ms except the masked item (muscle) which was presented for 60 ms.

Again they found a significant decrease in reaction time of 13 ms for experiment five, which was much smaller than the reaction time decrease of their previous experiment which tested the target word immediately following the masked prime. However they did not test a comparable delay condition of one second without any intervening items.

The interpretation they offered to explain the decreased magnitude of the masked repetition effect was due to the increased delay. However, it is possible that the intervening item contributes to the effect and may have confounded these results.

Another condition they tested extended the delay between masked prime and the target to about 20 s. Instead of incorporating more dummy words between the masked prime and the target as in experiment five, Forster and Davis (1984) returned to the procedure used in experiment one. Only three stimuli were presented, a dummy word, the masked prime and then the target. However, they did not test the prime immediately, it was tested seventeen items later and they did not find any repetition effects.

They suggested that the decay of the masked priming effect is a time dependent process and it takes place within the first second. Another explanation also offered is that it was the result of the intervening items and they

admit that "the present results do not permit a choice between these alternatives" (Forster & Davis, 1984:693).

An alternative task to the lexical decision task that could be used to further investigate these claims is the stem completion task. Johnston (1989) also investigated masked priming effects, not with a lexical decision task, but with a stem completion task. Subjects were presented with a sequence of four stimuli. A row of hashes (e.g. ######) was first presented for 500ms to help mask the prime. Then the masked prime (e.g. muscle) was presented for 60 ms and after this a dummy word (e.g. CHARACTERS) was presented for 500 ms to help backward mask the prime because word stems do not serve well as a backward mask. Finally, the word stem was presented (e.g. mus___) for the subject to generate a word that could complete the stem.

Johnston (1989) found that subjects generated the desired stem only 15% of the time for the control condition when an unrelated word was presented as the mask. Subjects generated the masked prime 34% of the time for the masked repetition condition which is a significantly higher proportion. The masked priming condition involved a delay of 500 ms between the mask and the stem with an intervening word. This indicates that stem completion tasks can be used as an effect tool for investigating the masked repetition effect. Johnston did not examine any other delay or intervening item conditions.

Forster, Booker, Schacter and Davis (1990) extended Johnston's (1989) research with masked repetition priming

using the stem completion task. They reasoned this task might be more sensitive to the effects of the masked prime. They examined the effect of delay on the masked repetition priming with the stem completion task. They found that subjects responded with the masked prime for 33% of the time as compared to the baseline condition response rate of 14% which was a significant effect. Another experiment increased the delay between the mask and the prime from 500 ms to 20 s by testing the masked prime four items later and they did not find any masked repetition effect. Forster et al. suggested "that the masked priming effect dissipates rapidly for the stem completion task as well as for the lexical decision task.....hence a lexical interpretation of both effects seems viable" (p.343).

Forster et al. (1990) also considered the possibility that masking the prime weakens the repetition effect so it decays more rapidly. They dismissed this account because the effect at the short delay condition was just as strong as the effect obtained with nonmasked priming. The account they offered to explain their results was that the short term repetition effect is in fact a lexical activation effect which takes place whether or not the prime is masked or presented in the clear. Consequently, this would mean that long term effects are the result of an increased familiarity of the prime produced by the memory trace specific to the episode of the prime.

However, Forster et al. (1990) did not control for the confounding effects of intervening items that may have

interfered with the decay process of the masked prime. The experiments reported below extend the Forster et al study and examine the effects of delay and intervening items.

The first experiment in this thesis examines the time course of the decay process with masked repetition stem completion tasks. It is hypothesised that the decay of the effect of masked priming is a time dependent process that occurs within the first second and will have completely diminished by at least nine seconds. This time period is the shortest delay condition that masked repetition priming has found not to have an effect. If this study finds that the masked repetition effect is short lived within two seconds, it would support the contention that masking the prime prevents formation of an episodic trace and the results would reveal the functioning of the activation of the lexical processing system over time.

The second experiment examines the effect of including an intervening word between the masked prime and the target stem over various delay conditions. It is hypothesised that a masked repetition effect will be found for short delay conditions following Forster and Davis's (1984) suggestion that lexical accessing is insensitive to intervening words. That is, there should be no difference in the masked priming effect between experiment one and experiment two for the shortest delay conditions at least.

CHAPTER 4. EXPERIMENT 1

This experiment examines the effects of the delay between the masked prime and the word stem without any intervening items. Six delay conditions were investigated, 500 ms, 1 s, 2.5 s, 4 s, 5.5 s and 7s.

Method

Subjects

Seventy Edith Cowan psychology students were recruited as subjects.

Materials and design.

The materials consisted of 70 target words and 70 three letter stems of those target words. Because the Forster et al (1990) study used items unsuitable to an Australian population, a new set of items were constructed. All words were six letters in length and had two or more possible completions for the three letter word stem (e.g. mus___, muscle and musket). Plural words were excluded from the list because they greatly increased the possible number of completions of the word stem. To reduce possible confounds of randomly assigning one possible completion as the target word as the masked prime, the most frequent of all the possible completions was used as the prime. The mean number of possible completions of the stem was 4.9 (sd=2.0, range=2-11). The mean frequency of occurrence of the prime was 74.8 tokens per million in text (sd=123.9, range=2-831; Kucera and Francis, 1967).

This experiment involved six delay conditions of 500 ms, 1 s, 2.5 s, 4 s, 5.5 s and 7 s seconds. A control

condition without any masked prime was used as the baseline condition. This range of delays permits a detailed analysis of the time course effect within the first few seconds.

There were seven practice items at the start of the experiment, one for each of the experimental conditions. The same set of practice items were presented uniformly across all versions of the experiment. A list of experimental items can be found in Appendix A-1.

There were seven versions of the experiment, so that every item was counterbalanced across all the experimental conditions. This produced a seven (conditions of the independent variable) by seven (versions) experimental design.

Procedure.

Subjects first read a set of standardised instructions and were then seated in front of a computer monitor linked to an IBM compatible computer. They were also presented with a writing implement and an answer sheet. Subjects were instructed to watch closely the nonsense symbols that served as the cue for the stem and then write down a non plural six letter word that would complete the three letter word stem. For example, some possible completions of the stem mus___ include muscle, musket and muster. They were also instructed to write down the first word that came to their mind and not to waste too much time on items they could not think of immediately. Progression through the experiment was self-paced, prompted by the subject and a different pseudo-random order was presented to each

subject. The nature of the masked stimulus was not disclosed to the subject.

Items were displayed in the center of the computer monitor, appearing when the subject cued the next item by a button press. Each item was presented as a sequence of four stimuli. A row of six nonsense symbols (i.e., #$@#%#) was presented to forward mask the prime. The masked prime was then presented for 60 ms immediately following the forward mask, except for the control condition when no prime was presented and the screen was kept blank for 60 ms when the masked prime should have appeared. This control condition without any masked prime served as the baseline condition. A row of six more nonsense symbols was then presented again to backward mask the prime. This backward mask was retained on the screen for either 500 ms, 1000 ms, 2500 ms, 4000 ms, 5500 ms or 7000ms for each of the experimental delay conditions. The backward mask was retained on the screen for 500 ms for the control condition. Finally, the word stem was presented for the subject to respond to and remained there until the subject prompted the next item. Subjects took approximately 15 minutes to complete the experiment and they were debriefed about the nature of the experiment at the end.

Table 1.
Example of the item stimuli presented to the subject for experiment one.

STIMULI TYPE	MASKED STIMULI	BASELINE STIMULI	TIME ON SCREEN
Forward mask	#$@#%#	#$@#%#	500 ms
Masked prime	muscle		60 ms
Backward mask	#@$%#@	#@$%#@	500 ms
			1000 ms
			2500 ms
			4000 ms
			5000 ms
			or 7000 ms
Word stem	mus___	mus___	Until prompted

Note. The backward mask for the baseline is retained on the screen for only 500 ms.

Data treatment.

Subjects responses were only recorded as "correct" if the masked prime was given as the completed stem.

Any scores lying beyond two standard deviations from the mean score of each delay condition for both the subject and item data were brought back to the level of the cut off to reduce the influence of outliers.

To reduce the risk of Type one errors when conducting multiple comparisons between pairs of condition means, the number of comparisons conducted without any adjustment to the alpha level will be limited to the number of experimental conditions minus one (Keppel, 1991).

In addition to conducting standard statistical analyses on the subject-based data, the item-based data will also be analysed because language is not a fixed factor (Coleman, 1964). Statistical tests must not only

account for the variances between subjects, but also the variances between items. The items in this experiment vary in many dimensions such as relative frequency, number of possible stem completions and phonological pronunciation of the stem. To take account of the variance in response to subject and items, a statistical result will be accepted only if both the subject analysis and item analysis are significant (Clark, 1973).

Results.

All 70 subjects were included in the analysis, with equal numbers in all conditions. A 7x7 repeated measures multivariate analysis of variance was conducted to determine the effects of experimental version on the data. There was no main effect for version for the subject data $F(6,63)=1.16$, $p>.05$ or the item data $F(6,63)=.71$, $p>.05$, however there was a significant interaction of version by condition of the independent variable for both the subject data $F(36,378)=1.84$, $p<.01$ and the item data $F(36,378)=1.88$, $p<.01$ indicating a crossover effect for version. To further investigate the effects of the interaction of version and condition Tukeys honestly significant difference test was conducted between all the version means within each delay condition. No two groups were significantly different within any of the experimental conditions for the item data and only three pairs of

version groups were significant in the subject data, none of which were consistently different across experimental conditions. Considering there was no main effect for experimental version, the fact the items were fully counterbalanced and also considering the relatively small and inconsistent effect of version within each condition the results were collapsed across version for the analyses. Greater caution is required in interpreting these results than if there was no interactive effect of version with experimental condition.

The mean number of masked primes given as the stem completion for both the subject and item data are displayed in Table 2.

Table 2.
Mean number of masked primes given as the stem completion expressed as a percentage. Both subject data and item data included.

ANALYSIS	CONDITION	%RESPONSE
Subject	500 ms	46.6%
	1000 ms	44.0%
	2500 ms	44.1%
	4000 ms	42.9%
	5500 ms	40.1%
	7000 ms	40.0%
	Baseline	29.0%
Item	500 ms	46.7%
	1000 ms	44.7%
	2500 ms	44.3%
	4000 ms	41.0%
	5500 ms	42.9%
	7000 ms	39.9%
	Baseline	26.9%

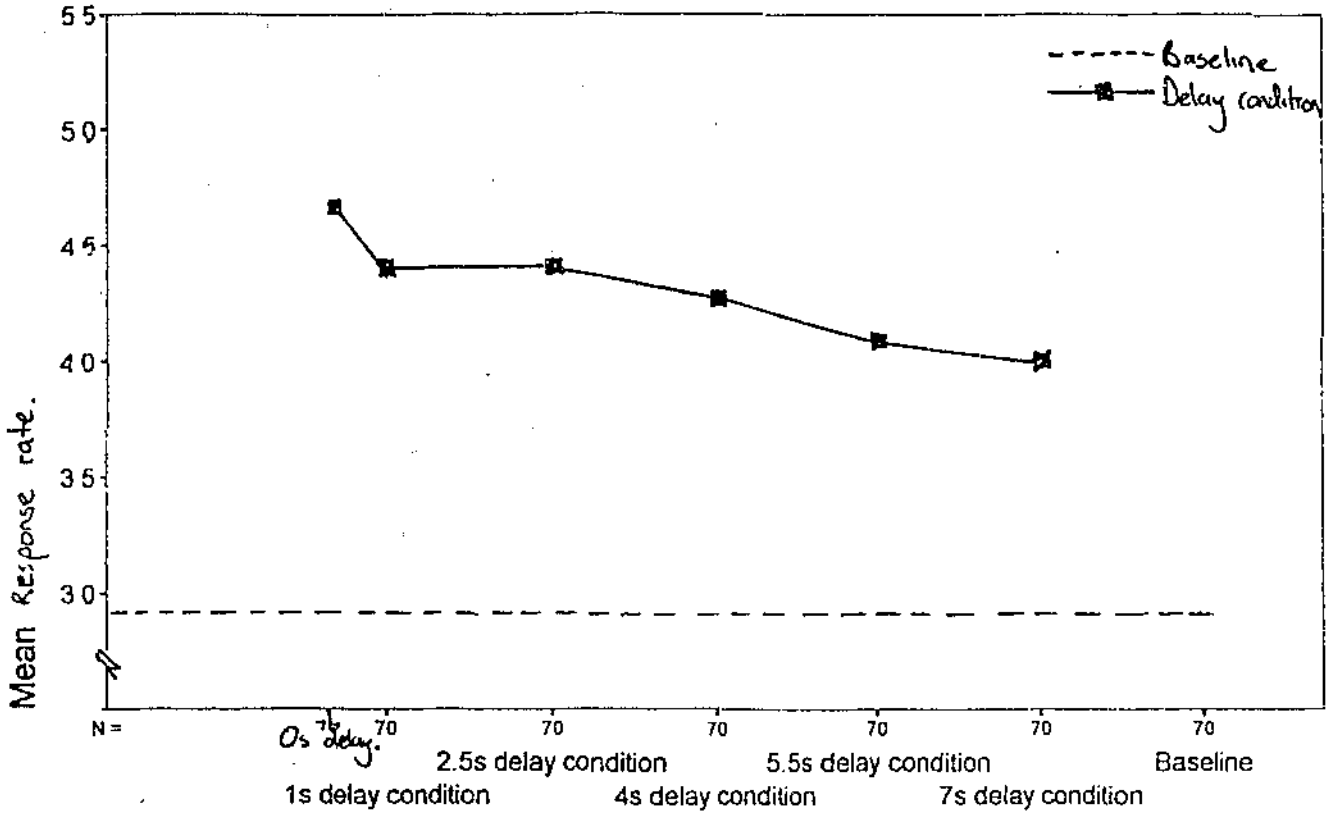

Figure 1. Mean percentage response rate of the masked prime generated as the stem completion for each masked delay condition and the baseline. All conditions were significantly different from the baseline condition.

Paired samples t tests were conducted to determine if any of the delay conditions were significant from the baseline condition. All the delay conditions were significantly increased above the baseline condition for both the subject data, $t(69)=6.13$, 5.44, 5.33, 5.33, 4.85, 4.26 and 3.82, $p<0.001$ for the 500 ms, 1 s, 2.5 s, 4 s, 5.5 s and the 7 s delay conditions respectively. The item data displayed a similar set of results, $t(69)=8.15$, 7.42, 7.33, 6.93, 6.7, and 5.32, $p<0.001$ for the 500 ms, 1 s, 2.5 s, 4 s, 5.5 s and the 7 s delay conditions respectively

A repeated measures linear trend analysis was

performed on both the subject and the item analysis using Gaito's (1965) method of calculating orthogonal coefficients for unequal intervals between conditions. The linear trend for both subjects ($F_{lin}(1,345)=6.98$, $p<.01$) and items ($F_{lin}(1,345)=8.06$, $p,.01$) were significant. This trend accounts for some 76.0% of the variance for the subject data and 76.2% of the variance for the item data. No further trend analyses were conducted on the data as neither the subject ($F_{residual}(4,345)=.56$, $p>.05$) or item ($F_{residual}(4,345)=.63$, $p>.05$) residual variance was significant. This follows Keppel's (1991) recommendation that other trend analyses or higher order trend analyses should not be continued when the residual variance is not significant.

Additionally, a paired samples t test was conducted between the 500 ms and 7s delay condition was found to be significant for both the subject data, $t(69)=2.69$, $p<.05$ and the item data $t(69)=2.29$, $p<.05$.

Discussion.

These results indicate that masked priming shows a significant masked repetition effect for the stem completion task and further, the results show a downward linear trend extending to a seven second delay, which is still significant.

The results replicate Forster et al. (1990) for the short delay condition, however the lack of a significantly steep decrease after one second is a failure to replicate

Forster and Davis (1984) experiment 5. Intervening items could have confounded the masked priming effect in previous studies by interfering with the decay process and experiment two investigates this possibility.

CHAPTER 5. EXPERIMENT 2.

This experiment attempts to determine the effect of having an intervening naming task between the masked prime and the target stem. A naming task was used to simulate an intervening stem completion task because it was not possible to exactly control the time the subject spent performing a stem completion task. For the naming task the subject is required to simply read to themselves the presented word. Three delay conditions were investigated, 2s, 4s and 6s.

Method.

Subjects.

Sixty Edith Cowan psychology student volunteers were recruited as subjects. None of the subjects had participated in the first experiment.

Materials and Design.

The materials consisted of 60 stem completion target items that were selected from the items used in the first experiment. See Appendix A-2 for a list of the items used in experiment 2. The mean number of possible completions of the stem was 5.1 (sd 2.1, range 2-11) and the mean frequency of occurrence of the repeated prime was 74.7 tokens per million in text (sd=128.8, range 2-831; Kucera and Francis, 1967).

There were six versions of the experiment so that every item was counterbalanced across all the experimental conditions. This produced a six (conditions of the independent variable) by six (versions) experimental

design.

Six practice items were presented at the beginning of each experiment, one for each of the experimental conditions. The same set of six practice items were presented uniformly across all versions of the experiment.

Procedure.

Each subject first read a set of standardised instructions and was then seated in front of a computer monitor linked to an IBM compatible computer. Subjects were also presented with a writing implement and an answer sheet. Subjects were instructed to read the intervening word and then write down a non plural six letter word that would complete the word stem. They were also instructed to write down the first word that came to their mind and not to waste too much time on items they could not think of. Progression through the experiment was self-paced, prompted by the subject and a different pseudo-random order was presented to each subject. The nature of the masked stimulus was not disclosed to the subject.

Items were displayed in the center of the computer monitor, appearing when the subject cued the next item. Each item was presented as a sequence of five stimuli. A row of six nonsense symbols (e.g. #$@#%#) was presented for 500 ms to forward mask the prime. The masked prime was then presented for 60 ms immediately following the forward mask in the masking conditions or the screen was left blank for 60 ms in the control conditions. Then one intervening word was presented in capital letters for 500 ms (e.g. COLOUR).

This word was used for the naming task that simulated intervening items. This word was neither semantically or orthographically related to the prime. None of the intervening words were solutions to any of the word stems. Following this, another series of six nonsense symbols (e.g. #$@#%#) were presented until the stem was tested some 2000 ms, 4000 ms or 6000 ms after the prime for each delay condition. There were six conditions of the independent variable, three delay conditions each having a masked prime or a nonmasked prime control condition. Subjects took approximately 12 minutes to complete the experiment and they were debriefed about the nature of the experiment at the end.

Table 3.
Example of the item stimuli presented to the subject for experiment 2.

STIMULI TYPE	MASKED STIMULI	BASELINE STIMULI	TIME ON SCREEN
Forward mask	#$@#%#	#$@#%#	500 ms
Masked prime	muscle		60 ms
Naming Item	COLOUR	COLOUR	500 ms
Backward mask	#@$%#@	#@$%#@	1500 ms
			3500 ms
			or 5500 ms
Word stem	mus___	mus___	Until prompted

Data treatment.

The data for experiment 2 were treated the same way as experiment 1.

Results.

60 subjects were included in the analysis, with equal numbers in all versions. The data was modified for

statistical outliers and the results were then collapsed across versions because a 6x6 repeated measures multivariate analysis of variance was conducted on the data and there was no significant main effect of experimental version for the subject data $F(5,54)=.82$, $p>.05$ or the item data $F(5,53)=1.05$, $p>.05$. Additionally there was no significant interaction of version with the condition of the independent variable for either the subject data $F(25,270)=1.05$, $p>.05$ or the item data $F(25,270)=1.78$, $p>.05$ so the analyses were collapsed across experimental version.

The mean number of primes given as the completed stem are displayed in table 4 below.

Table 4.
Mean number of masked primes given as the completed stem expressed as a percentage.

ANALYSIS	DELAY CONDITION	%RESPONSE
Subject	2000 ms masked	26.0%
	2000 ms baseline	25.2%
	4000 ms masked	29.7%
	4000 ms baseline	25.3%
	6000 ms masked	27.3%
	6000 ms baseline	28.7%
Item	2000 ms masked	26.3%
	2000 ms baseline	27.5%
	4000 ms masked	25.3%
	4000 ms baseline	27.0%
	6000 ms masked	28.7%
	6000 ms baseline	23.9%

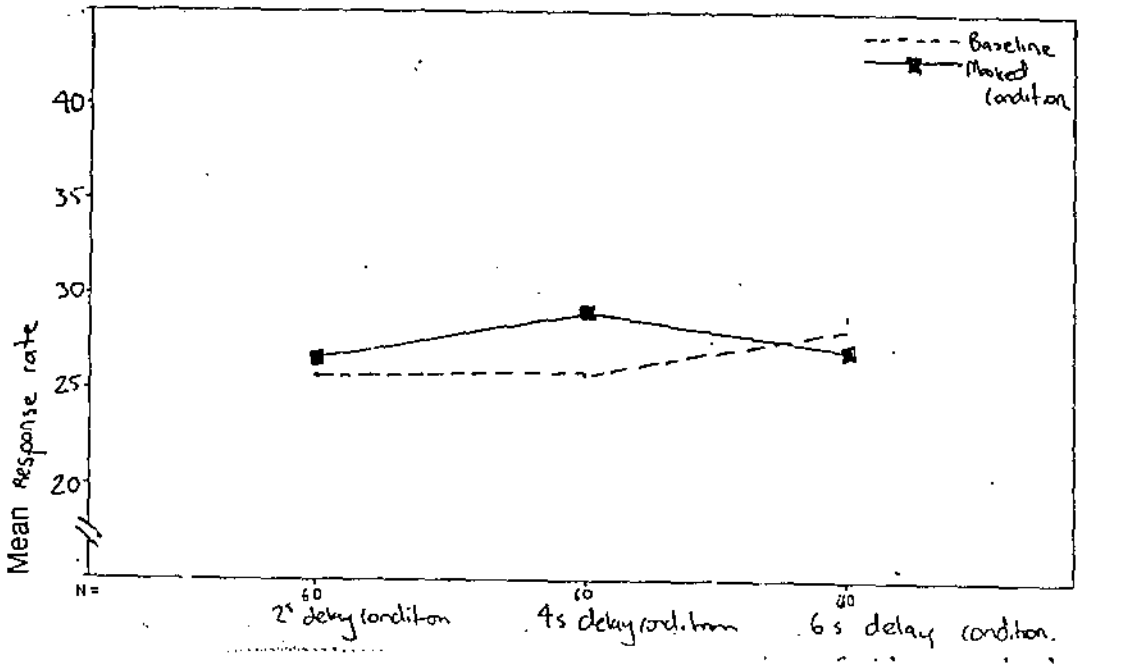

Figure 2. Mean percentage response rate of the masked prime generated as the stem completion for each delay condition and their respective baseline conditions. No masked delay condition was significantly different from the baseline.

Three repeated measures t-tests were conducted on each of the three delay conditions between the masked prime condition and the respective control conditions. The subject data found none of the masked delay conditions were significantly different from the control conditions $t(59)=.31$, 1.35 and .38, $p>.05$ for the 2 s, 4 s and 6 s delay conditions respectively. This was replicated in the item data $t(59)=.47$, .61, .10, $p>.05$ for the 2 s, 4s and 6 s delay conditions respectively.

Discussion

It appears that having the subject perform a naming task between the masked prime and the stem completion task has the effect of completely diminishing any effect of the

masked prime in this experiment. This result is a failure to replicate Forster et al (1990) because their first experiment had one intervening item and this still had an effect, although they did not test any delay conditions without intervening words. Johnston (1989) also found a masked repetition effect for the short delay condition with an intervening word between the mask and prime.

CHAPTER 6. DISCUSSION.

It was hypothesised for the first experiment that masked priming would show a significant effect on the stem completion task, which the findings support. Additionally, it was hypothesised that the process would be a time dependent process, decaying rapidly within the first second and this was not found to be the case. The findings do support the idea that the masked priming effect decays over time, but they suggest a more gradual decay that is still significant at the 7 s delay.

These results are plausible with the contention that they are displaying activation of the mental lexicon, and the activation of the lexicon shows a gradual decay for at least the time period investigated here. Forster et al. (1990) raised the possibility that masking operates with the same processes as standard priming, but it weakens the effect of these processes so it decays more rapidly. One argument against this is the masked prime effect found at short delays was comparable to the clear priming effects found on stem completion tasks found by Schacter and Graf (1986).

The results are also comparable with Forster's et al. (1990) interpretation that short term effects for both the standard repetition tasks and the masked priming task are mediated by lexical activation, which takes place whether the prime was masked or not. It would have to be added that this effect still occurs for at least seven seconds, however Scarborough et al. (1977) found no decay in the

repetition effect for items repeated either 2 s or 6s later. To explain this it would have to be assumed that lexical processes are still operating, but they are completely overridden by other nonlexical processes such as episodic mechanisms. Further research is required to investigate this.

Forster and Davis (1990) also argued that longer term effects of repetition after any short term effects are totally mediated by episodic factors and not any lexical factors. This accounts for Oliphant's (1983) failure to find any repetition effect at all. However it can only account for Forster and Davis (1984) finding of a repetition effect for items when a response was not required for the first presentation if it is assumed that subjects were becoming aware of the repetitions resulting in the increased recognition of the words. Jacoby (1983) produces evidence supporting this finding that as the proportion of words common to the first presentation and second testing presentation were increased, the magnitude of the repetition effect increased. Subjects in this case may have been more likely to realise the items were repeated.

Forster and Davis (1984) also offered a mechanism for the long term repetition effect based on Oliphant's (1983) interpretation of the repetition effect as a strategy of the subjects which speeds up recognition of the word. They argued that the locus of the episodic effect is not at the lexical accessing stage, rather at the decision stage of

the lexical decision task. Increased familiarity results from post access processes that is omitted or reduced for the repeated word.

For experiment two it was hypothesised that intervening items would not have an effect over delays comparable to the first experiment and this hypothesis was not supported. The results indicate any masked priming effect is completely eliminated by an intervening word before 2 s but the results do not distinguish any effects operating within this time period. One possibility is that the intervening dummy word acts as a better backward mask than nonsense symbols for these items, although Forster et (1990) still found a masked priming effect at the 500 ms delay condition with one intervening item. Johnston (1990) also used the same word (e.g. CHARACTERS) as the backward mask for all the items in the experiment and subjects may have ignored this after a while.

The second experiment supports the argument that the Forster and Davis (1984) and Forster et al. (1990) studies on the delay of masked priming may have been confounded because they did not study comparable delay conditions without intervening items. Forster and Davis (1984) may have even found a masked repetition effect for their 9 s delay condition.

The fact that intervening items may influence the decay of masked priming effect contrasts with the Scarborough et al (1977) finding that subsequent items do not interfere with the repetition effect. This adds further

support to Forster and Davis (1984) contention that different processes may be operating between masked priming and clear priming. This contention would require that clear repetition priming involves the episodic system. These episodic traces are not affected by subsequent items tested and many items can be primed simultaneously. Forbach et al (1974) found 36 words could be primed simultaneously over 10 minutes, which is many more than could be possible if they were only lexically activated. Additionally the fact that Scarborough et al. (1977) found a repetition effect occurring over two days also favours an episodic interpretation because this delay is much too long to expect the lexicon to remain activated for.

There are also difficulties in comparing results across different experiments. Johnston (1989) used four letter stem completion tasks with eight letter multi-completion words, but subjects were not restricted in the word length of the completion they could give. No rationale was given as to which of the completions was used as the masked prime. Forster et al. (1990) used three letter stem completion tasks with eight to nine letter multi-completion words and found almost parallel findings to Johnston (1989). These differences between stem completion tasks are not as important as the differences between lexical decision tasks sensitive to word retrieval mechanism and stem completion tasks which have been used in studies of implicit memory. Additionally, Forster and Davis (1984) used four to six letter words and their lexical decision

task used an unrelated word as the forward mask. They also used unrelated words as the control condition instead of using nothing which may have artificially increased their baseline rates. Because of these differences, caution should be used in drawing conclusions from results across experiments.

Rajarm and Neely (1992) replicated Forster and Davis (1984) and found masked repetition priming effects but they also found different mechanisms operating between short term and long term repetition. However, they found evidence from recognition tasks that familiarity may not play such a strong role in the repetition effect.

It is worth considering the reasons for the gradual decay of the masked priming process. One possibility is that the first presentation of the word accesses the lexical entry within the lexicon. This entry is fully activated at first, but when the entry is no longer required, it decays gradually. However other linguistic processes such as lexical parsing are very rapid and do not require the activation to last as long as the first experiment found. It could be that lexical accessing is a finite phenomenon and a subsequent word has the effect of increasing the decay of activation of prior words, or even completely "close" a lexical entry.

It appears that examining repetition priming on stem completions tasks offer a useful paradigm to investigate the modularity of cognitive systems. This thesis tentatively supports the contention that the lexical system

and the episodic system can function independently, however more research is needed to investigate their differences. future research should investigate the occurrence lexical activation in the period between seven seconds to a few minutes after repetition.

To summarise, this thesis has shown that masked priming effects can be obtained with stem completion tasks for at least seven seconds. It appears that these effects decay gradually and they appear to represent the effects of activation of the lexical system. Intervening items eliminate any masked priming effects which is a failure to replicate previous research, however these results require further research.

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Appendix A-1.

List of items used in experiment 1 grouped into item blocks

ITEM BLOCK	ITEM	STEM
1	prayer	pra___
1	accept	acc___
1	depend	dep___
1	finger	fin___
1	kidney	kid___
1	linear	lin___
1	walker	wal___
1	palace	pal___
1	fungus	fun___
1	discus	dis___
2	afford	aff___
2	prison	pri___
2	family	fam___
2	gallop	gal___
2	morale	mor___
2	pillow	pil___
2	vanity	van___
2	skinny	ski___
2	policy	pol___
2	battle	bat___
3	parker	par___
3	decide	dec___
3	former	for___
3	malice	mal___
3	gently	gen___
3	market	mar___
3	pantry	pan___
3	little	lit___
3	locate	loc___
3	demand	dem___
4	career	car___
4	casual	cas___
4	impact	imp___
4	invite	inv___
4	ramble	ram___
4	random	ran___
4	period	per___
4	wreath	wre___
4	liquid	liq___
4	bundle	bun___
5	racial	rac___
5	horror	hor___
5	humble	hum___
5	ignore	ign___
5	magnum	mag___
5	relief	rel___
5	remain	rem___
5	burden	bur___
5	recent	rec___
5	reform	ref___
6	hammer	ham___

6	loudly	lou___
6	madden	mad___
6	saddle	sad___
6	second	sec___
6	office	off___
6	manner	man___
6	regard	reg___
6	reject	rej___
6	junior	jun___
7	unfair	unf___
7	temple	tem___
7	turned	tur___
7	quaint	qua___
7	rabbit	rab___
7	attack	att___
7	ballet	bal___
7	worked	wor___
7	mutual	mut___
7	notice	not___

Appendix A-2.

List of items used in experiment 2 grouped into item blocks.

ITEM BLOCK	ITEM	STEM
1	prayer	pra___
1	accept	acc___
1	depend	dep___
1	finger	fin___
1	kidney	kid___
1	linear	lin___
1	walker	wal___
1	palace	pal___
1	fungus	fun___
1	discus	dis___
2	afford	aff___
2	prison	pri___
2	family	fam___
2	gallop	gal___
2	morale	mor___
2	pillow	pil___
2	vanity	van___
2	skinny	ski___
2	policy	pol___
2	battle	bat___
3	parker	par___
3	decide	dec___
3	former	for___
3	malice	mal___
3	gently	gen___
3	market	mar___
3	pantry	pan___
3	little	lit___
3	locate	loc___
3	demand	dem___
4	career	car___
4	casual	cas___
4	impact	imp___
4	invite	inv___
4	ramble	ram___
4	random	ran___
4	period	per___
4	wreath	wre___
4	liquid	liq___
4	bundle	bun___
5	racial	rac___
5	horror	hor___
5	humble	hum___
5	ignore	ign___
5	magnum	mag___
5	relief	rel___
5	remain	rem___
5	burden	bur___
5	recent	rec___
5	reform	ref___

6	hammer	ham___
6	loudly	lou___
6	madden	mad___
6	saddle	sad___
6	second	sec___
6	office	off___
6	manner	man___
6	regard	reg___
6	reject	rej___
6	junior	jun___

Appendix B-1.

Raw data tables for experiment 1.

Subject analysis. Number of masked primes per subject given as the stem completion.

SUBJECT NO.	VER.	DELAY CONDITION 500ms	1000ms	2500ms	4000ms	5500ms	7000ms	BASE
1	1	4	7	3	4	4	2	4
2	1	1	3	5	7	2	6	4
3	1	8	7	5	7	5	6	1
4	1	9	7	7	7	7	8	4
5	1	6	4	5	4	2	5	2
6	1	2	2	3	1	1	3	4
7	1	5	8	5	5	4	5	1
8	1	8	4	3	5	4	4	3
9	1	1	4	2	1	2	4	5
10	1	4	4	5	7	0	6	3
11	2	5	8	7	1	7	4	4
12	2	4	5	3	4	2	6	2
13	2	3	4	2	2	3	2	5
14	2	10	8	4	8	5	9	6
15	2	2	1	4	1	4	4	0
16	2	2	3	3	1	3	0	1
17	2	6	6	5	5	8	7	4
18	2	4	4	3	3	4	4	3
19	2	3	1	5	2	4	3	3
20	2	3	3	3	4	2	1	1
21	3	6	4	4	2	6	2	3
22	3	4	5	1	4	2	4	4
23	3	3	4	1	4	4	3	2
24	3	7	6	2	4	5	7	2
25	3	1	2	3	2	1	2	3
26	3	4	1	1	3	4	4	4
27	3	5	5	5	5	5	6	2
28	3	4	3	3	3	3	1	2
29	3	1	7	5	5	2	5	3
30	3	4	4	3	4	5	1	2
31	4	5	2	3	5	3	3	4
32	4	3	3	4	7	3	4	2
33	4	6	2	6	2	2	2	1
34	4	5	3	5	5	5	2	2
35	4	7	6	10	3	6	5	3
36	4	5	2	3	1	2	5	3
37	4	5	2	3	3	2	3	1
38	4	9	4	9	5	6	8	2
39	4	7	5	7	4	5	8	4
40	4	9	9	10	10	9	6	2
41	5	4	5	3	4	3	9	1
42	5	8	9	8	9	4	4	4
43	5	9	8	9	7	9	7	4
44	5	5	8	6	7	4	7	4
45	5	1	4	1	1	2	3	4
46	5	4	5	7	2	3	3	4

47	5	5	8	6	4	7	3	3
48	5	9	8	8	10	9	4	2
49	5	3	3	3	4	3	3	2
50	5	3	2	4	2	6	3	5
51	6	2	6	5	6	7	6	3
52	6	4	6	3	3	3	4	3
53	6	5	3	2	4	3	3	3
54	6	1	1	3	6	0	2	1
55	6	4	3	1	2	4	1	2
56	6	7	6	6	7	4	4	1
57	6	4	1	2	3	6	4	3
58	6	4	3	2	4	2	0	3
59	6	5	3	5	7	4	4	3
60	6	6	8	9	9	5	9	3
61	7	4	3	3	5	1	2	2
62	7	5	3	1	2	4	3	4
63	7	7	4	9	7	7	3	2
64	7	6	6	7	6	5	4	5
65	7	5	6	3	1	5	2	1
66	7	0	1	3	0	0	1	4
67	7	6	3	5	4	5	1	4
68	7	6	7	7	6	9	7	4
69	7	3	5	4	3	5	2	4
70	7	4	2	5	4	4	1	4

Item analysis. Number of subjects per item that gave the masked prime as the stem completion. See appendix A-1 for a list of the items grouped into blocks.

		Delay condition.						
ITEM	BLOCK	500ms	1000ms	2500ms	4000ms	5500ms	7000ms	Base
1	1	6	7	6	4	7	3	2
2	1	5	5	3	5	6	3	0
3	1	4	5	5	7	7	6	5
4	1	8	7	6	3	4	3	2
5	1	7	8	5	7	8	7	3
6	1	4	4	5	5	2	3	2
7	1	1	1	0	1	1	0	1
8	1	7	4	4	4	4	7	3
9	1	0	0	5	1	1	0	0
10	1	4	1	2	3	2	1	0
11	2	4	6	5	5	4	5	2
12	2	2	6	5	4	4	5	3
13	2	6	8	9	6	9	9	4
14	2	4	6	2	3	4	4	0
15	2	1	4	2	3	2	4	1
16	2	9	8	5	6	9	5	6
17	2	2	2	5	5	8	2	1
18	2	2	2	3	2	5	3	2
19	2	3	3	4	5	5	2	2
20	2	6	5	3	6	9	7	5
21	3	1	1	5	3	2	2	0

22	3	2	4	8	7	4	6	3
23	3	2	2	0	3	3	3	2
24	3	5	5	4	3	3	8	3
25	3	0	0	1	1	1	0	0
26	3	3	6	6	4	5	5	4
27	3	4	4	1	3	4	4	0
28	3	9	5	6	7	4	5	6
29	3	8	8	8	8	9	6	9
30	3	4	5	5	1	5	5	2
31	4	4	0	3	2	2	3	0
32	4	7	5	5	5	6	4	1
33	4	6	3	1	4	4	2	1
34	4	9	3	5	8	7	4	4
35	4	8	7	5	7	6	7	6
36	4	7	5	6	7	5	3	5
37	4	5	2	2	4	3	3	0
38	4	2	0	2	2	2	1	4
39	4	8	9	7	7	4	7	5
40	4	8	7	6	7	5	6	7
41	5	0	4	2	1	4	4	0
42	5	9	7	6	5	7	6	6
43	5	8	9	6	7	4	5	4
44	5	4	7	8	6	1	4	4
45	5	2	2	1	1	2	0	1
46	5	4	2	0	2	1	2	1
47	5	2	2	0	1	0	2	1
48	5	5	3	4	3	4	2	5
49	5	4	1	2	1	1	0	1
50	5	5	2	0	2	2	0	0
51	6	7	6	7	7	6	9	3
52	6	4	3	4	2	0	3	1
53	6	3	3	4	0	3	1	0
54	6	6	6	5	1	2	2	2
55	6	5	9	9	9	9	9	6
56	6	4	7	7	6	4	5	5
57	6	3	5	4	3	3	2	1
58	6	4	4	4	2	4	4	5
59	6	7	7	9	7	5	9	6
60	6	8	8	6	5	6	3	3
61	7	4	4	7	6	6	7	4
62	7	5	4	5	4	6	5	4
63	7	1	3	2	0	0	1	1
64	7	3	2	3	4	3	3	0
65	7	8	9	9	8	8	7	7
66	7	8	5	3	4	3	2	4
67	7	6	4	7	3	5	3	3
68	7	4	2	4	2	2	4	0
69	7	2	1	2	1	0	2	1
70	7	5	8	8	6	5	7	3

Appendix B-2.

Raw data table for experiment 2.

Subject analysis. Number of items per subject that gave the masked prime as the stem completion.

SUBJECT NO.	VER.	MASKED CONDITIONS 2s	4s	6s	UNMASKED CONDITIONS 2s	4s	6s
1	1	5	3	0	3	1	2
2	1	2	7	4	4	3	5
3	1	1	3	2	5	4	5
4	1	2	5	5	2	2	3
5	1	3	3	1	2	2	4
6	1	1	2	2	3	1	4
7	1	2	3	2	3	1	4
8	1	1	2	3	3	1	6
9	1	3	1	2	1	0	2
10	1	1	2	3	2	3	4
11	2	3	4	5	3	5	2
12	2	1	5	2	2	3	2
13	2	5	3	3	3	3	4
14	2	5	1	4	1	3	1
15	2	6	4	2	0	1	5
16	2	1	5	3	1	2	2
17	2	2	3	1	2	3	2
18	2	2	3	3	4	0	1
19	2	3	4	1	5	4	0
20	2	7	7	6	4	1	2
21	3	2	3	2	3	6	6
22	3	3	1	2	3	1	4
23	3	3	2	2	4	1	4
24	3	4	3	3	1	3	5
25	3	2	7	1	3	3	5
26	3	1	1	2	1	2	6
27	3	5	1	1	3	0	1
28	3	1	2	2	4	5	2
29	3	3	5	5	3	1	2
30	3	3	1	4	2	1	3
31	4	4	5	0	6	1	2
32	4	2	1	2	1	5	1
33	4	2	3	5	0	5	0
34	4	1	3	1	3	3	0
35	4	5	2	3	4	1	4
36	4	5	3	2	3	2	2
37	4	2	1	7	3	7	3
38	4	1	3	1	3	5	5
39	4	3	8	5	3	3	1
40	4	1	2	6	2	2	3
41	5	2	2	1	1	7	1
42	5	2	1	2	3	1	5
43	5	4	4	2	0	1	1
44	5	2	5	6	3	3	0
45	5	1	4	6	3	2	3
46	5	2	3	2	0	3	1

47	5	3	2	1	6	1	4
48	5	3	1	3	1	3	3
49	5	1	3	3	3	1	6
50	5	4	2	4	1	4	7
51	6	5	3	3	3	1	2
52	6	2	1	2	2	5	1
53	6	3	6	0	1	5	8
54	6	3	1	1	1	1	1
55	6	4	1	1	3	3	2
56	6	1	6	1	3	3	1
57	6	2	2	3	1	2	3
58	6	1	1	4	5	2	0
59	6	1	4	1	2	3	2
60	6	1	1	3	1	1	2

Item Analysis. Number of subjects per item that gave the masked prime as the stem completion. See appendix A-2 for a list of the items grouped into item blocks.

		MASKED CONDITIONS			UNMASKED CONDITIONS		
ITEM	BLOCK	2s	4s	6s	2s	4s	6s
1	1	3	2	6	3	3	2
2	1	3	2	4	4	1	2
3	1	2	4	5	4	4	5
4	1	1	4	4	1	2	1
5	1	5	5	6	7	8	1
6	1	1	3	1	4	3	1
7	1	1	2	2	5	1	5
8	1	1	2	2	2	3	2
9	1	1	2	3	1	3	1
10	1	2	3	3	2	3	2
11	2	1	3	2	1	6	7
12	2	2	4	2	3	3	3
13	2	3	2	1	3	2	1
14	2	1	4	6	1	2	3
15	2	1	4	3	2	1	6
16	2	2	2	2	1	2	4
17	2	2	4	4	3	2	1
18	2	2	1	2	3	6	2
19	2	1	1	1	0	0	2
20	2	2	1	0	2	6	1
21	3	3	5	5	6	1	2
22	3	4	3	1	2	1	2
23	3	6	1	6	3	2	1
24	3	2	2	1	2	3	2
25	3	4	3	3	1	4	6
26	3	1	2	1	3	1	2
27	3	3	3	3	2	1	2
28	3	2	0	1	0	2	2
29	3	6	6	3	2	3	1
30	3	2	2	1	5	3	2

31	4	3	3	0	1	0	4
32	4	2	2	2	2	2	1
33	4	4	1	1	0	1	4
34	4	6	1	2	6	2	1
35	4	7	0	2	6	1	2
36	4	6	2	3	4	3	2
37	4	3	3	3	1	2	2
38	4	3	0	4	1	4	1
39	4	3	0	5	4	0	2
40	4	2	3	7	2	1	3
41	5	3	3	6	3	3	2
42	5	3	4	3	4	2	1
43	5	2	5	0	5	5	4
44	5	1	2	2	2	1	4
45	5	3	1	3	3	3	2
46	5	6	6	3	1	1	1
47	5	1	1	2	2	6	4
48	5	1	1	0	0	0	1
49	5	2	3	1	2	2	3
50	5	1	2	4	2	0	4
51	6	1	4	6	6	6	6
52	6	4	3	5	3	5	4
53	6	3	4	0	4	3	3
54	6	4	3	6	6	4	3
55	6	4	2	5	5	2	4
56	6	3	2	3	2	5	0
57	6	2	1	3	1	3	2
58	6	1	2	2	2	3	0
59	6	3	2	1	6	5	2
60	6	1	4	1	1	5	1

Appendix C-1.

Statistical summary tables for experiment 1.

Table C1. Analysis of variance summary table for repeated measures linear trend analysis.

Subject analysis

SOURCE	SUM of SQUARES	df	MEAN SQUARES	F
Delay condition	20.05	5	4.01	6.98*
Subjects	1309.88	69	18.98	
Residual	753.45	345	2.18	
Linear trend	15.24	1	15.24	

*p<.001, therefor reject Ho.

$$R^2 = \frac{SS_{A\ Trend}}{SS_A} = \frac{15.24}{20.05} = 0.76$$

Item analysis

SOURCE	SUM of SQUARES	df	MEAN SQUARES	F
Delay condition	22.36	5	4.47	8.06*
Subjects	1804.63	69	26.15	
Residual	728.97	345	2.11	
Linear trend	17.04	1	17.04	

*p<.001, therefor reject Ho.

$$R^2 = \frac{SS_{A\ Trend}}{SS_A} = \frac{17.04}{22.36} = 0.76$$

Appendix C-2.

Statistical summary tables for experiment 2.

Table C2. Analysis of variance tables for repeated measures t tests.

Subject analysis.

				PAIRED DIFFERENCES					
CONDITION	N	MEAN	SD	MEAN	SD	SEmean	t	df	Sig
2s masked	60	2.60	1.50	.08	2.06	.266	.31*	59	.75
2s control	60	2.51	1.42						
4s masked	60	2.97	1.79	.43	2.49	.322	1.35*	59	.18
4s control	60	2.53	1.68						
6s masked	60	2.73	1.72	-.13	2.75	.355	.38*	59	.71
6s control	60	2.87	1.92						

*p>.05, therefor accept Ho.

Item analysis.

				PAIRED DIFFERENCES					
CONDITION	N	MEAN	SD	MEAN	SD	Semean	t	df	Sig
2s masked	60	2.63	1.54	-.11	1.94	.25	.47*	59	.64
2s control	60	2.75	1.80						
4s masked	60	2.53	1.43	-.17	2.13	.27	.61*	59	.55
4s control	60	2.70	1.82						
6s masked	60	2.90	1.89	.51	2.30	.30	1.70*	59	.10
6s control	60	2.39	1.60						

*p>.05, therefor accept Ho.