Evidence against memorial facilitation and context-dependent memory effects through the chewing of gum

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Abstract

The experiment examined the prediction that chewing gum at learning and/or recall facilitated subsequent word recall. Chewing gum at learning significantly impaired recall, indicating that the chewing of gum has a detrimental impact upon initial word encoding. In addition, a context-dependent memory effect was reported for those participants who both learned and recalled in the absence of gum, however a context dependent effect was not found with chewing gum. The findings contradict previous research.

Keywords:

Chewing gum; Context-dependent effects; Memory;

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Introduction

The facilitative effect of chewing gum on memory for both immediate and delayed word recall has proven controversial (Wilkinson, Scholey and Wesnes, 2002; Stephens and Tunney, 2004a; Tucha, Mecklinger, Maier, Hammerl and Lange, 2004). For example, Scholey (2004b) suggests that the absence of a facilitative effect of gum reported by Tucha et al (2004a) resulted from a shift in context, where continuous chewing throughout the 40min interval between learning and recall of the words altered the nature of the gum sufficiently to thereby produce a change in context. It is well documented that in addition to encoding of the to-be-remembered materials, the participant will also associate the context in which the item is learnt, with representation of that learning context at recall facilitating retrieval (e.g. Godden and Baddeley, 1975; Goodwin, Powell, Bremer, Hoine, and Stern, 1969; Miles and Hardman, 1996). In this instance, if the gum context has sufficiently changed, any context-consistent benefit will be lost. Baker, Bezance, Zellaby and Aggleton (2004) explored the possibility of gum chewing inducing a context-dependent memory effect through instructing participants to either chew or not chew gum whilst learning and then recalling a list of words. After a 24hour delay, superior performance was reported for the group that had chewed gum at both learning and recall, compared to the two inconsistent conditions and the group which received no gum at both learning and recall (Experiment 1). The finding demonstrates that chewing gum can produce context-dependent long-term memory effects, with a change in context producing a detrimental effect on recall. However, there is a caveat to this conclusion: the between-subjects design adopted by Baker et al allows for the possibility that group differences influenced the findings; therefore the current study reports a replication of the Baker et al. Experiment 1.

Method

Ninety-six (38 male, 58 female, mean age 20 years and 7 months) Cardiff University undergraduates from a variety of disciplines participated. Each participant was given a sheet of paper with a single list of 15 words selected at random from a corpus of 30 disyllabic nouns matched on scores of frequency and imagine-ability (Morrison, Chappell and Ellis, 1997). The gum used was Wrigley's Extra (sugar-free) spearmint chewing gum.

The design and procedure followed that described by Baker et al (2004). The 4 experimental groups differed with respect to whether they were instructed to chew gum at learning and/or recall. Participants were told that the experiment was a measure of word recall rates and were not informed that the study aimed to assess the effect of chewing gum on context dependent memory and memorial facilitation. Prior to presentation of the word list a 15s interval was employed in which those in the gum conditions began chewing (participants without gum sat in silence). They were then presented with the 15-word list and given 2 min learning time, with those with gum at learning instructed to chew throughout the learning phase. Those in the gum at learning conditions (Gum-Gum, Gum-No Gum) were then instructed to remove their gum. Those with gum at recall (Gum-Gum, No Gum-Gum) were given a new piece of chewing gum, with another 15s interval employed to start chewing and were instructed to continue chewing throughout recall. Following the interval all participants were given 2 min to write down as many of the 15 words that they could remember. Participants returned 24 h later and repeated the recall procedure specific to their condition.

Results

Figure 1 demonstrates the mean number of words recalled at both immediate and delayed testing in the four learning/recall conditions. Consistent with the methods of Baker et al (2004), the facilitative benefit of chewing gum at initial learning was investigated through a 2x2 mixed ANOVA, comparing those who received gum at learning (gum-gum and gum-no gum; mean recall = 9.85) versus those who did not (no gum-no gum and no gum-gum; mean recall = 11.20) across both testing intervals. The ANOVA revealed that significantly more words were recalled when gum was absent at initial learning, $F(1,94)=7.51$, $MSe=11.54$, $P<0.05$).

Figure 1 about here please

A 2x2 mixed ANOVA investigating context-dependent effects compared recall for consistent (no gum-no gum and gum-gum; mean recall = 11.16) versus non-consistent conditions (gum-no gum and no gum-gum; mean recall= 9.90) across both testing

intervals. The ANOVA revealed significantly superior word recall in the consistent conditions, $F(1,94)=6.55$, $MSe=11.65$, $P<0.05$, suggesting the presence of a context-dependent effect. However, further analysis (Newman Keuls) of the main effect of experimental condition at immediate testing ($F(3,92)=4.56$, $MSe=4.60$, $P<0.05$) and following the 24h interval ($F(3,92)=4.99$, $MSe=8.05$, $P<0.05$) revealed the only significant difference concerned superior recall for those participants who received no gum at both learning and testing (i.e. performance in the NG/NG condition was significantly greater than G/G, NG/G and G/NG at both testing intervals). This finding suggests that this context effect is driven through superior recall for the no gum-no gum condition rather than through a more general facilitative effect of context.

Discussion

The present study failed to replicate either a memorial benefit through chewing gum at learning or a context-dependent memory effect. There were, however, some methodological differences between the present study and Baker et al (2004) which may have inhibited replication. Firstly, the present experiment incorporated a 15s gap between both chewing commencement and learning (silent control interval used for non-chewing conditions), and between learning and recall, rather than 0s at both junctures. Secondly, those in the gum/gum condition were given a separate piece of gum for both learning and recall, whereas in Baker et al (2004) participants chewed the same piece throughout the experiment. This modification was introduced because continuous gum chewing through both the learning and recall phases is likely to result in inconsistent contexts at learning and recall with respect to consistency and flavour of the gum. This difference is particularly important following suggestions that mint flavour can produce context dependent memory effects (Baker et al, 2004, Experiment 2) and benefit memory (Stephens and Tunney, 2004a). This methodological inconsistency does not explain the current disparity: one would predict a greater context effect in the present data due to increased similarity of context in the gum/gum condition. This was not found.

It is possible that the context effect reported by Baker et al (2004) was not driven through the context of chewing per se but through intense initial flavour. With a 0s

interval between chewing commencement and learning, participants in Baker et al (2004) learned the words whilst experiencing the intense initial flavour context of the gum. The 15s interval between chewing and learning and between chewing and recall employed in the present experiment allowed participants to begin chewing and bypass the initial intense flavour of the gum prior to learning/recall, therefore attenuating any effect of flavour. Thus, the absence of context effects reported by Baker et al (2004) may be due to an absence of flavour context at immediate recall since the same piece of gum was chewed at learning and recall in day 1. However, on Day 2, those in the gum/gum condition receive a new piece of chewing gum and began recall immediately, therefore reinstating the intense flavour context of Day 1 learning and thereby producing a context effect. In the present experiment a 15s interval was employed on Day 2 between chewing commencement and recall limiting any effect of flavour.

Commenting upon the conflicting reports of chewing gum, Scholey (2004b) noted that "all of the studies used tests, which differed slightly; thus, differences in task demands and characteristics may have interacted differentially with the effects of chewing a gum" (pg. 222). We report a very close replication of the Baker et al (2004) study using British participants and employing the same brand of gum but nevertheless fail to demonstrate either a facilitative effect of chewing gum at learning or a context-dependent memory effect, suggesting that both findings are unreliable and influenced by chance variables.

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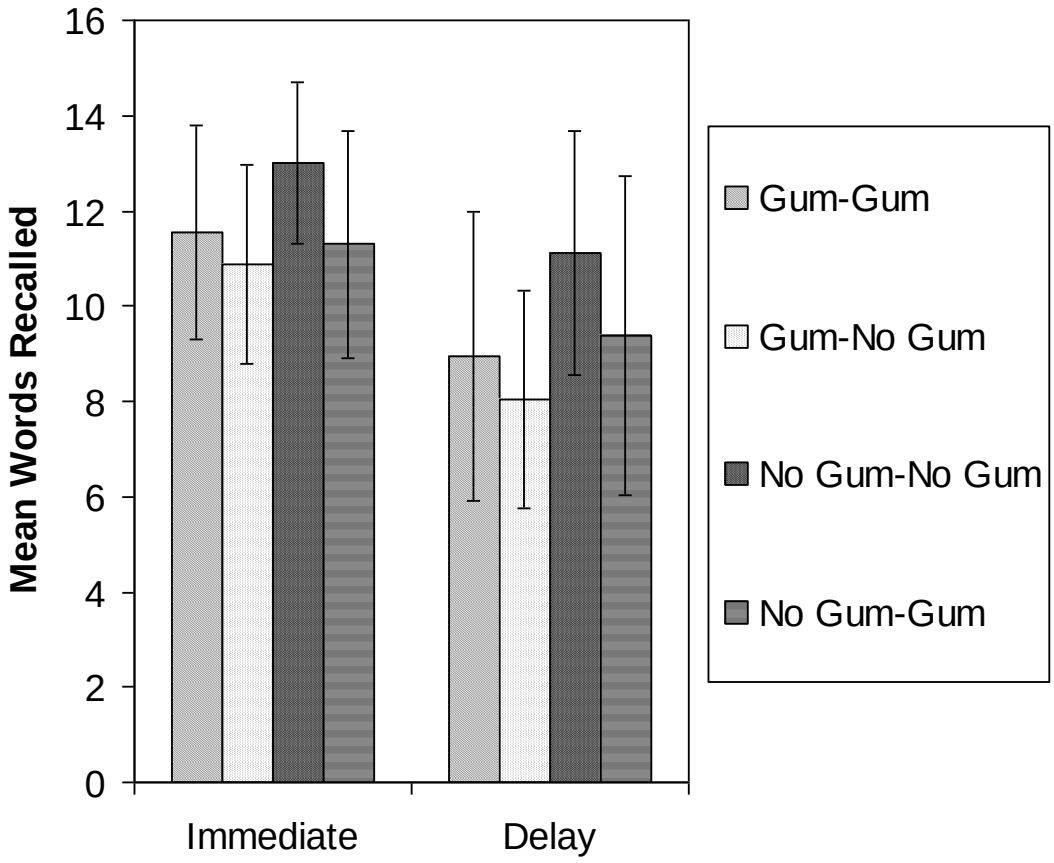

Figure 1: Mean number of words recalled (maximum 15) after a 15 second retention interval (immediate) or after 24 hours (delayed). The participants either chewed gum at both learning and recall (Gum-Gum), chewed gum at learning but not at recall (Gum-No Gum), neither chewed gum at learning or recall (No Gum-No Gum) or did not chew gum at learning but did at recall (No Gum-Gum). Errors bars denote the standard deviation.