Qualitative Differences in the Immediate Recognition Memory for Wine and Visual Matrices

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Introduction

There is a general paucity of literature concerning how memory for the chemical senses (olfactory and gustatory memory) may differ to that of more established domains such as verbal and non-verbal memory. A small number of studies have examined olfactory short-term memory and reported task-dependent effects. Two-alternative forced choice (2AFC) recognition memory for odours produced the single-item recency function (Johnson and Miles, 2007; Miles and Hodder, 2005) characterised by other stimulus types (Phillips and Christie, 1977; Ward, Avons, and Melling, 2005; Johnson and Miles, 2009a). In contrast, serial position recall of odours produced functions that were qualitatively different to that of both non-verbal visual and non-verbal auditory stimuli (Johnson and Miles, 2009b). This contrasts the proposition by Ward et al. (2005) that the serial position function is task, rather than stimuli, dependent.

One might predict analogous patterns of memory performance across the chemical senses due to perceptual similarities. It has been suggested that both olfactory (Engen and Ross, 1973) and gustatory stimuli (e.g. wine: Chin and Schooler, 2007; Lewis, Seeley and Miles, 2009) are processed holistically, and that both stimulus types are characterised by impoverished vocabulary for the perceptual experience (e.g. Lehrer, 1975; Hughson and Boakes, 2002). Indeed, the potential verbal re-coding of both olfactory and gustatory stimuli is of concern in this domain, since verbal re-coding would result in patterns of memory characteristic of verbal rather than olfactory/gustatory memory. In order to limit verbal recoding, the present study examines gustatory memory using wine. Melcher and Schooler (1996) reported disruption of gustatory memory following the labelling of wine (i.e. verbal overshadowing). This effect was argued to illustrate that wines are represented perceptually and not verbally.

Serial position memory paradigms have not previously been applied to wine. Mantonakis, Rodero, Lesschaeve, and Hastie (2009) did, however, examine the role of position on preference judgments for sequences of identical wines. They reported a primacy advantage for the first wine in the sequence and argued that this trend was due to greater attention being allocated to the first item coupled with proactive interference. Although applied to a preference judgment paradigm, these factors might also be applicable to memory performance leading one to predict a primacy advantage in memory for wines. The current study applies wines to a memory paradigm that is traditionally characterised by an absence of primacy but a recency advantage (immediate single probe yes/no recognition: e.g. Kerr, Avons, & Ward, 1999; Neath and Knoedler, 1994; Wright, Santiago, Sands, Kendrick, and Cook, 1985) in order to investigate if gustatory memory operates qualitatively differently to that of more researched memory modalities.

Recognition Task

A single probe yes/no recognition task was employed for 3-item lists wherein stimuli were presented for 5s with a 5s inter-stimulus-interval (ISI). Following a 5s retention interval, participants received a test probe that was either an item from the list or an item novel to that list. For that test probe, participants were required to make a binary familiarity judgment specific to that sequence. The task involved 18 trials of which half comprised distracter novel trials. For the familiar probe trials, each serial position was tested on three different trials.

Method

Forty-eight (24 male, 24 female: mean age 20.17 years) undergraduate volunteers from Coventry University participated in a (2x3) mixed design, wherein they were tested with a single probe yes/no recognition task for 3-item sequences of gustatory or non-verbal visual stimuli.

Each modality task (gustatory and non-verbal visual) employed the same 4-items (i.e. 4-wines and 4-abstract matrices). The position of these stimuli within the each sequence was randomised. The gustatory stimuli comprised four wines: two red (*Australian Shiraz and Chilean Merlot*) and two white (*Australian Viogner and Chilean Sauvignon Blanc*). In order to limit visual cues participants wore blue tinted goggles and the wines were presented in opaque cups with lids. The abstract matrices comprised 4 (4x4) black and white matrix patterns (see Figure 1).

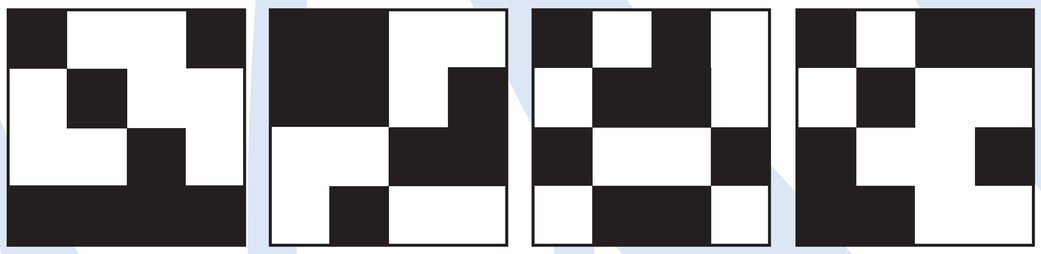

Figure 1: Matrix stimuli employed in the non-verbal visual recognition condition.

Results

Recognition performance for the gustatory and non-verbal visual stimuli was 70.14% and 65.75%, respectively. To accommodate for response-bias and examine signal detection sensitivity, d′ was computed (as described by Mondor and Morin, 2004): z(hit)-z(false-alarm). Figure 1 demonstrates recognition performance (d′) across serial positions (1-3) for wine and matrices.

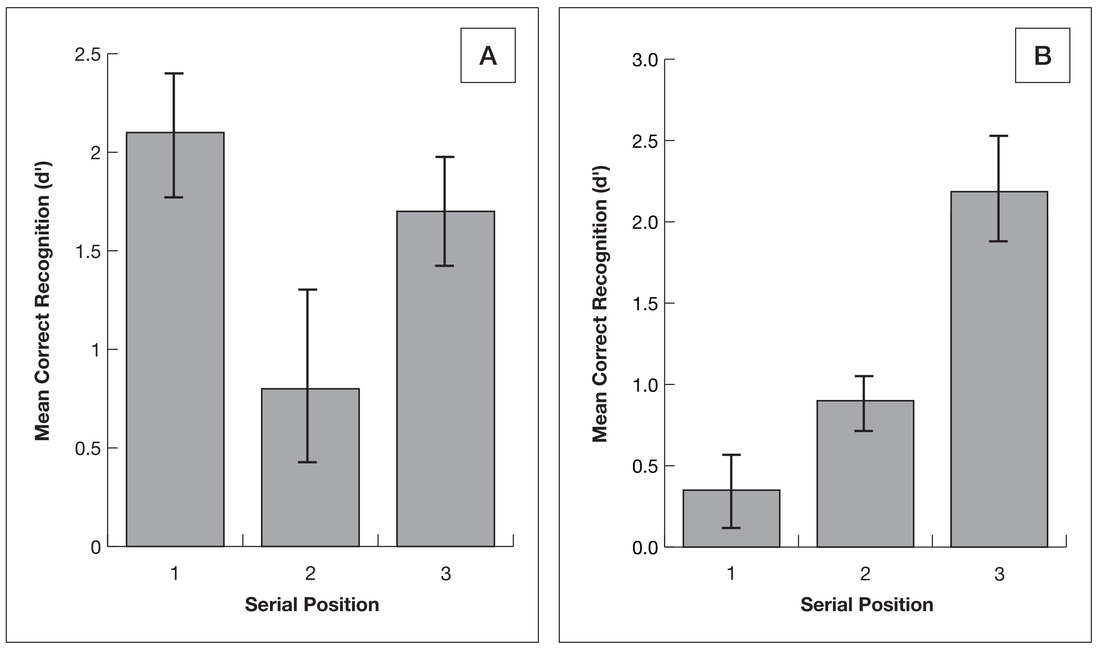

Figure 2 (a-b): Mean correct recognition (d′) for wine (a) and matrices (b) as a function of serial position (1-3). Error bars denote +/-SEM.

To examine if qualitatively different serial position functions were produced for wine and matrix stimuli, recognition performance (d′) was converted to Z-Scores and compared in a 2x3 mixed ANOVA. The ANOVA revealed a main effect of serial position $F(2,92)= 16.00$, $MSe = 0.47$ $P<0.001$, partial $\eta^2=0.26$, and, importantly, a significant stimulus type by serial position interaction, $F(2,92)= 18.57$, $MSe = 0.47$ $P<0.001$, partial $\eta^2=0.29$. Further analysis of the interaction (t-test comparisons with Bonferroni correction: $P=0.017$), revealed that memory for wines produced primacy and memory for matrices produced recency.

Discussion

The present study employed a single yes/no recognition task and replicated the established recency effect found for visual stimuli with this task (e.g. e.g. Kerr et al., 1999; Neath and Knoedler, 1994; Wright et al., 1985). In contrast, gustatory stimuli revealed a primacy advantage and trend towards recency.

The observation of primacy for the wine stimuli is consistent with the first-item preference bias reported for wines (Mantonakis et al., 2009). This trend was argued to be due to greater attentional allocation to that item. Since primacy is not found for matrices, one might argue that such an attentional bias does not exist for non-verbal visual stimuli. It is, therefore, unclear why the first-item attentional bias is limited to gustatory stimuli. Furthermore, an additional mechanism (beyond attention) is required to explain the trend towards recency in the current gustatory data.

The present data stands in stark contrast to the proposition (Ward et al., 2005) that the pattern of memory performance is determined by task parameters, and not the stimuli. We have shown qualitatively different serial position functions across non-visual verbal and gustatory stimuli despite equivalence across memory task. The present observation of gustatory primacy is of particular interest considering the failure to obtain primacy across a range of olfactory memory studies (Miles and Hodder, 2005; Johnson and Miles, 2007, 2009b). This difference is curious considering the perceptual overlap (e.g. Melcher & Schooler, 1996) and may suggest that, within the cognitive domain, olfaction and taste warrant separate consideration in terms of mechanisms/processes underpinning short-term recognition.

Key References

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