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The categorical structure of semantic memory for famous people: a new approach using release from proactive interference

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Abstract

Memory for familiar people is essential to understand their identity and guide social interaction. Nevertheless, we know surprisingly little about the structure of such memory. Previous research has assumed that semantic memory for people has a categorical structure, but recently it was proposed that memory for people consists only of associations and lacks any categorical structure. Four experiments are reported that use a novel approach by adapting the 'release from proactive interference' (RPI) methodology for use with lists of famous names. Proactive interference occurs when items presented on successive trials are drawn from the same category. Recall can improve following a change to a different category. Sets of names were selected relating to aspects previously demonstrated, on the basis of reaction time data, to form a category (occupation) and a property (nationality) of celebrities (Johnston & Bruce, 1990). RPI was observed for a change at both levels of representation but was only present without explicitly cueing the change of set when the stimuli differed at the category level. At the property level, RPI was only evident when change of set was explicitly cued. RPI was absent at the set change in a novel, *ad hoc* distinction suggesting that the effect reflected the underlying memory structure.

Keywords: Semantic memory; Proactive interference; Memory categorisation

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The idea that semantic memory may contain information within structures which are categorically organised is one that arguably dates from Aristotle (Baddeley, 1991). In more recent times, the idea has been incorporated in the theoretical positions of Collins and Quillian (1969) and to some extent in schema based models of semantics (e.g. Schank & Abelson, 1977). The kernel of this idea is that items within semantic memory are connected on the basis of shared attributes. A logical consequence is the likely emergence of categories of related items. Activation of one category member spreads to other category members, thus facilitating responses to those items. Spreading activation predicts the existence of categorical semantic priming, by which items preceded by the presentation of a exemplar of the same category are responded to more quickly or more accurately. Several studies have demonstrated the existence of semantic priming effects in object processing (Barry, Johnston, & Scanlan, 1998; Humphreys, Riddoch, & Quinlan, 1988; Huttenlocher & Kubicek, 1983; Kroll & Potter, 1984; Neely, 1976; Sperber, MacCauley, Ragain, & Weil, 1979).

A similar phenomenon has also been observed in processing the faces and names of famous people (e.g. Bruce, 1983; Bruce & Valentine, 1986; Young, Flude, Hellawell, & Ellis, 1994) although in this case the primes are associatively related to the target face or name (i.e. are often seen together) in addition to being semantically related (i.e. sharing the same occupation). Understanding the structure of identity-specific semantics for people is of particular interest because the mental representation of such information underlies social functioning, and hence is highly relevant to understanding social cognition. The aim of the present study was to investigate category structure in semantic memory for familiar people. There are three reasons to test the hypothesis that that the processes involved in semantic memory for people may differ from general semantic memory. First, neuropsychological evidence suggests that semantic memory for people is subserved by a separable neurological system. Second, behavioural studies and connectionist modelling have suggested that there are structural differences in recognising and naming objects and people. Third, priming from semantic but not associative relationships is much weaker in face and name processing than in object processing.

There is good neuropsychological evidence that knowledge of familiar people is represented by a separate neural subsystem from that which represents knowledge of objects (Kay & Hanley, 1999; Lyons, Hanley, & Kay, 2002; Miceli et al., 2000). Patient FH is unable to give detailed semantic information about many objects, but can recall identity-specific semantic information about people (Lyons et al., 2002). This case, and the case of ML reported by Kay and Hanley (2001) appears to form a double dissociation with patient APA who had a proper name anomia and was unable to provide detailed identity-specific semantic information about people she could not name (Miceli et al., 2000).

Valentine, Brennen, and Brédart (1996) developed an information-processing model that made explicit structural differences in the access to semantic memory and lexical representations between processing faces and names and processing objects. Subsequently, Valentine, Hollis, and Moore (1998) confirmed predictions derived from the model that production of people's names would prime recognition of their names, and that priming of people's names crossed modality. Neither effect is observed in analogous tasks

involving object names. Hollis and Valentine (2001) demonstrated that the effects extended to processing the names of landmarks but not country names.

The differences in the structure of access to semantic memory for people and objects described by Valentine et al. (1996) was based on an interactive activation and competition (IAC) model of face processing developed by Brédart, Valentine, Calder, and Gassi (1995) from an original model by Burton, Bruce, and Johnston (1990). These models predict that a purely categorical (i.e. semantic) relationship between two items (e.g. two newsreaders who read the news for different TV channels) should be sufficient to produce priming in recognition of their faces or names. The rationale is thus: access to any information about an individual is only possible via a single 'person identification node' (PIN). Each representation of a person has only one PIN, and it is the sole point of access between the perceptual system and the semantic system. This is unlike the arrangement of object related semantics (Valentine et al., 1996) which does not rely on a single node to connect perception to semantics and the lexical system. The PIN is, in turn, connected to a range of different attributes about a person such as their name, their occupation, their date of birth and their nationality. These attributes are stored in semantic information units (SIUs), and each SIU can be connected to a number of PINs, which represent individuals who share that attribute. All links between levels of representations in the model are excitatory and bi-directional. Units within each level of representation or pool (e.g. FRU, SIU, PIN) are linked to all other units of the same type via inhibitory connections. Categorical effects are presumed to emerge when these SIUs are connected to more than one PIN; for example activating one PIN (e.g. 'David Beckham') might activate a range of SIUs including 'footballer', which would then in turn pass activation on to other items sharing that attribute, for example, 'Michael Owen'. Hence, the models clearly predict categorical effects within identity-specific semantics for people.

Evidence that 'semantic' priming can be observed in the domain of identity specific-semantics for people has been reported in several studies. Bruce (1983) and Bruce and Valentine (1986) reported priming of familiar face recognition and Young et al. (1994) reported priming of familiar face naming by primes of closely associated celebrities. However, these studies reported used prime-target pairs that were often both categorically (i.e. the pairs were members of the same general category for example 'Paul McCartney' and 'David Bowie') and associatively related (i.e. the pairs were directly linked by frequent association, for example 'Paul McCartney' and 'John Lennon'). In Bruce's (1983) study a post-hoc analysis of the prime-target pairs noted that there was no difference in priming between those items that were both associatively and categorically related and those that were just categorically related.

Despite the data from Bruce (1983), the existence of categorical non-associational semantic priming for people has proved elusive. Young et al. (1994) demonstrated the existence of priming between associated pairs of famous people, but they failed to find priming between items that were only categorically related.

Barry et al. (1998) carried out an investigation in which priming of both naming and familiarity was investigated for faces and objects. Whilst they found evidence of associative priming effects for both faces and objects for both naming and familiarity, they only observed categorical non-associative priming for objects. There was no evidence in either the familiarity or naming tasks for categorical priming of faces. They interpreted this

as implying that the organisation of items in identity-specific semantic memory for people was not categorically based, as in object semantic memory, but that identity specific semantics for people was ordered according to networks of associative relationships between different individuals.

In contrast, an earlier study by Brennen and Bruce (1991) had demonstrated categorical priming effects. These were only apparent when a double decision familiarity task was used. Two faces were presented and participants only responded 'yes' if both faces were familiar. Brennen and Bruce argued that the double decision task is more sensitive to priming effects than the single decision task in object recognition and hence that it was a better task to use to detect categorical priming of people. Brennen and Bruce demonstrated that categorical effects appeared to operate via inhibition of response by non-categorically related primes. Typically, they argued, priming by associates occurs as a result of facilitation by related primes. Therefore, Brennen and Bruce concluded that the mechanism of categorical priming was qualitatively different to that involved in associative priming.

Although the studies by Barry et al. (1998) and Young et al. (1994) failed to support the existence of categorical priming, Carson and Burton (2001) point out that the data from these studies contained small trends in the direction of categorical priming that did not achieve significance. They argued that one possible interpretation of these trends, especially when the Bruce (1983) and Brennen and Bruce (1991) data were considered, was that a categorical priming effect did exist, but that it was weaker than the associative effect. They demonstrated that priming of name familiarity decisions could be induced by priming a target with four categorically but not associatively related primes. In further experiments it was found that this effect operated cross-modally when the prime was a name but the familiarity decision was to a face, and also when a face naming task was used. They concluded that the categorical priming effect operated similarly to the associative priming effect, but that it was less strong, a conclusion that is consistent with IAC models described previously, because associated individuals share more SIUs, through which priming can occur, than individuals who belong to the same category, but are not associated.

One clear difference between experiments probing object priming and person priming is that the nature of object naming and person naming is different. Naming of objects typically requires the production of a type label which refers to a general class of items (e.g. dog), whilst naming people almost invariably refers to token labels referring to a specific exemplar (e.g. 'Snoopy'). This issue may underlie the relative difficulty in observing categorical priming effects for peoples' names in one of two plausible ways. Firstly, it may be that types and tokens represent qualitatively different levels of the semantic hierarchy, and secondly individual participants' familiarity with individual token labels is likely to be lower than their familiarity with type labels. However, it seems unlikely that the type vs. token distinction encapsulates completely the differences between object and person naming: in Hollis and Valentine's (2001) study, cross modal priming effects, which are present in person naming but not object naming (Valentine et al., 1998) were not observed for country names, a set of items that take token labels. Furthermore, it is clear from the priming studies described above that tokens as well as types are prone to categorical effects (Brennen & Bruce, 1991; Carson & Burton, 2001).

Most research that has probed semantic memory for people has used occupation as the basis for assigning celebrities to categories. Occupation has been used in studies of semantic (associative) priming and interference tasks (e.g. Young, Ellis, Flude, McWeeney, & Hay, 1986). Nevertheless Barry et al. (1998) have suggested that occupation is not a useful descriptor of celebrities. For example, are Pavarotti and Kylie Minogue similar to each other because both are singers? In spite of the recent research in this area we still know surprisingly little about the organisation of semantic memory for people. In this paper we report a novel approach to studying identity-specific semantics using a paradigm based on proactive interference that was developed by Wickens, Born, and Allen (1963), and applied to semantic memory by Loess (1968).

Proactive interference (PI) refers to the phenomenon whereby, if a series of memory trials is presented, performance on the later items becomes worse as a consequence of interference to the current item from previous items (Underwood, 1957). PI may often be experienced in everyday life, for example when trying to remember the names of a large number of new colleagues. Loess' technique involved the presentation of a sequence of memory trials where the participant had to retain a small (well below memory span) number of stimulus items over a short delay which was filled by a counting task. The counting task prevented the use of working memory (Baddeley, Lewis, & Vallar, 1984), and hence the long-term memory phenomenon of PI built up over trials, resulting in a decline in performance as the trials progressed. The key factor of interest that Loess reported occurred if the category from which memory exemplars were drawn was changed (for example from bird species to tree species), then PI was abolished and performance returned to near baseline level. This is an example of release from PI (RPI). The interpretation of these findings was that items in semantic memory were organised categorically, and that RPI present in the memory data could serve as an indication of a change in a relevant category. Unfortunately for the current discussion, Loess (1968) confounded proper names and common name categories in his experiments (using the categories birds, trees, countries and US Presidents).

Gardiner, Craik, and Birtwistle (1972) extended these findings by investigating the nesting of categories and subcategories. They demonstrated that whilst a shift between superordinate categories (e.g. flowers vs. games) was sufficient to cause RPI, a shift between subcategories (e.g. garden flowers vs. wild flowers or indoor vs. outdoor games) only elicited RPI when the specific category type was made clear to the participant during testing. Gardiner et al.'s studies did not use any proper names as stimuli.

Marques (2000) has recently used the RPI technique in order to address the underlying cause of the living/non-living things distinction in semantic memory for objects. In four experiments he contrasted an uncued condition, in which RPI was elicited by a category shift from non-living to living things, with a cued condition where participants were cued to perceptual attributes of the stimuli. Results showed some evidence, at least when memory items were presented as words rather than as pictures, that cueing caused RPI effects to shift from the categorical to the cued perceptual dimension. In both Marques' and Gardiner et al.'s data it is clear that cueing items in RPI procedures can cause the release effect to shift to a non-default category. In both studies, however, the cued dimensions were unlikely to be completely novel to participants. One important benefit of the RPI task is that it is covert-it is opaque to the participant what the intended purpose of

the experiment is, conferring the advantage that the data are unlikely to be polluted by any effects of conscious expectation.

In their model of semantic memory Collins and Quillian (1969) drew an important distinction between categories and properties by which concepts are represented by nodes in memory and properties represented at the appropriate node in the semantic network. For example, knowledge that a canary is a bird is represented by node for the concept 'canary' and a node of the concept 'bird' connected by a labelled link for the relationship 'is a'. Thus categorical relationships between concepts are represented by the relationship 'is a' but properties are represented by relationships such as 'has' 'can' 'is' or 'must'. (e.g. must breathe, can fly, is yellow are properties of animals, birds and canaries, respectively). Collins and Quillian found that people were faster to verify sentences involving concepts ('A canary is a bird.' 1160 ms) than they were to confirm sentences about properties ('A canary has wings.' 1395 ms). Hampton (1984) reported a similar result.

Johnston and Bruce (1990) drew a similar distinction between two types of semantic knowledge for people. One type of knowledge analogous to Collins and Quillian's 'concepts', which they termed categorical descriptors, was the type of information, such as an individual's occupation, that can form superordinate organisational categories (e.g. Paul McCartney is a musician). Such information usually defines why a celebrity is famous and was produced invariably when participants were asked to give information about a famous face that they recognised (Johnston & Bruce, 1990). The other type of knowledge analogous to Collins and Quillian's 'properties', termed property descriptors, represented the type of knowledge that was more specific to an individual, such as a spouses' name or an address. Property descriptors are somewhat idiosyncratic, so Johnston and Bruce used information such as nationality or whether a person was living or dead as examples of property descriptors (e.g. Paul McCartney is British). This was justified by an experiment in which it was found that matching latencies for same category pairs were significantly faster for categories (occupation) than for properties (nationality and living/dead). It is noteworthy here that the pattern of data underlying descriptions of categories and properties in object and person naming should be so similar, despite the fact that the object naming task was based on types, whilst the person naming task was based on tokens.

It is necessary to consider what predictions can be derived from the IAC model for a memory experiment designed to induce RPI in recall of peoples' names. The first problem encountered when applying the IAC model to a memory paradigm is that the model, which was designed to model recognition, has no mechanism for producing a response in the absence of a current input of a face or name. However, it is reasonable to assume that the task could be completed by searching for the most active PIN or PINs activated above a threshold. Activation at a PIN would spread to related PINs via shared SIUs. Hence, any PIN with residual activation from encoding will have a 'head start' and be more likely to be accurately retrieved. However, during the RPI technique when items in the memory trials have been specifically selected to share semantic information, activation of PINs would become less and less efficient as a strategy to retrieve names from the last trial, because items from earlier trials will continue to receive activation via the shared SIU(s). However, if the category of items is switched, then fewer SIUs will be shared with previous memory trials, and hence items from the new category should be more likely to

be retrieved. Therefore a prediction can be derived from the IAC model that performance in a memory task should decline with increasing numbers of potentially interfering items from the same category that have been recently activated. However, if the category is changed so that different SIUs are activated, the previously active SIUs will be inhibited and recall of the currently activated items would recover.

Two further predictions follow from this: firstly, that the degree of recovery following a category shift should be proportionate to the number of SIUs shared between the two categories; in other words, RPI should be stronger in a shift between two relatively unrelated categories (e.g. historical figures and reality television celebrities) than in a shift between closely related categories (e.g. guitarists and singers). Secondly, PI should establish more quickly the greater the number of shared SIUs recruited by list items. Hence PI should be greater in a list composed entirely of contemporary American female vocalists than it would in a list composed of a wide range of musicians.

We describe four experiments in which RPI based techniques were used to investigate the structure of identity-specific semantics for people. In particular we focussed on establishing if it was possible to identify underlying category and property level descriptors within semantic memory for people, and the potential relationship of these to each other.

1. Experiment 1

Experiment 1 represented an attempt to identify categorically related release from proactive interference in identity specific semantics for people, using occupation as a descriptor to compile the stimulus sets. (Johnston and Bruce, 1990) claimed that occupation represented a category level descriptor. The two occupations selected were those which had been best recognised by pilot participants, specifically, actors and musicians.

Gardiner et al. (1972) demonstrated that, in order to observe PI and release effects with subcategories of objects such as ‘wild’ and ‘garden’ flowers (sub categories of ‘flowers’), participants needed to be provided with an explicit disambiguating cue. In the present study, it can be argued that ‘actors’ and ‘musicians’ are both subcategories of ‘entertainers’ or even ‘celebrities’, and that this might reduce the strength of the effects observed. Therefore, in one condition, participants were explicitly cued as to the categories. Half of the participants were informed of the category from which the stimulus exemplars were drawn, and half were not.

The methods used in this experiment were based, with some modifications, on those used by Loess (1968). The experiment included an *alternating* category control condition. In this condition the category that exemplars were drawn from was alternated on a trial by trial basis, rather than being clustered into same-set sequences. The *alternating* categories provide a control against the possibility that RPI occurred as a consequence of practice or fatigue rather than of the category shift. Hence, there were four experimental groups in a between-participants design; a *cued* and an *uncued* group who were presented with a series of trials comprising only items from one set followed by a series of trials comprising items from the other set (‘*blocked’* order); and a *cued* and *uncued* group who received

the *alternating* set trials. The experimental hypothesis was that participants in either one or both of the *blocked* groups would manifest RPI on the trial following the category shift; in which case, performance on trial six would be significantly better than on trial five. Meanwhile, participants in the *alternating* conditions would not manifest any sort of significant performance improvement at the equivalent serial position.

1.1. Method

1.1.1. Participants and apparatus

There were 72 participants in Experiment 1, 37 were male and 35 were female. Their mean age was 34 years and 3 months (SD = 11 years 3 months). 37 were male and 35 were female. Participants were visitors to the 'who am I?' gallery in the Wellcome Wing of the Science Museum, London who attended the 'Live Science' initiative, which is intended to give members of the general public the opportunity to participate in ongoing scientific research.

The experiment was conducted in the 'Live Science' arena, an area partitioned off from the main gallery area so that participants would not be disturbed during the experiment. The testing location was well lit by artificial means.

Participants sat at a desk and viewed a 17 in. computer monitor adjusted to a screen resolution of 800 × 600 pixels. The monitor was used to make all visual presentations. A 233 MHz Pentium™ II personal computer was used to run the experiment, which was compiled using E-Prime™ (Psychology Software Tools, Inc., PA) experiment generation software. Tones were presented using a pair of speakers attached to the computer.

1.1.2. Materials

Items were presented in sequences of four items, of which five sequences were composed entirely of famous actors and five comprised the names of popular musicians and singers. Half of the names selected for each sequence were of UK nationality, whilst half were from the US, as the issue of nationality was to be addressed in a subsequent experiment using the same stimuli. All of the items selected were shown to be suitable by a pilot study in which eight or more out of 11 participants could correctly identify whether each item was an actor or a musician and additionally whether he or she was from the UK or the USA. The names are listed in Appendix A. All text was displayed in white text at a size of 14 pt and in the 'Arial' typeface. The screen background in all experimental trials was black.

1.1.3. Design and procedure

Each trial in this experiment comprised three parts: presentation, counting and response. The structure of a trial is illustrated in Fig. 1. During the presentation phase participants were shown the names of four individuals from one sequence. These names were presented one after the other in the middle of the screen. Each name was displayed for 1500 ms, and participants were instructed to try and remember all of the names. The display of names was preceded by an introductory display comprising the message 'Next Trial:' presented above 'READY' in the centre of the screen. After 1000 ms the two

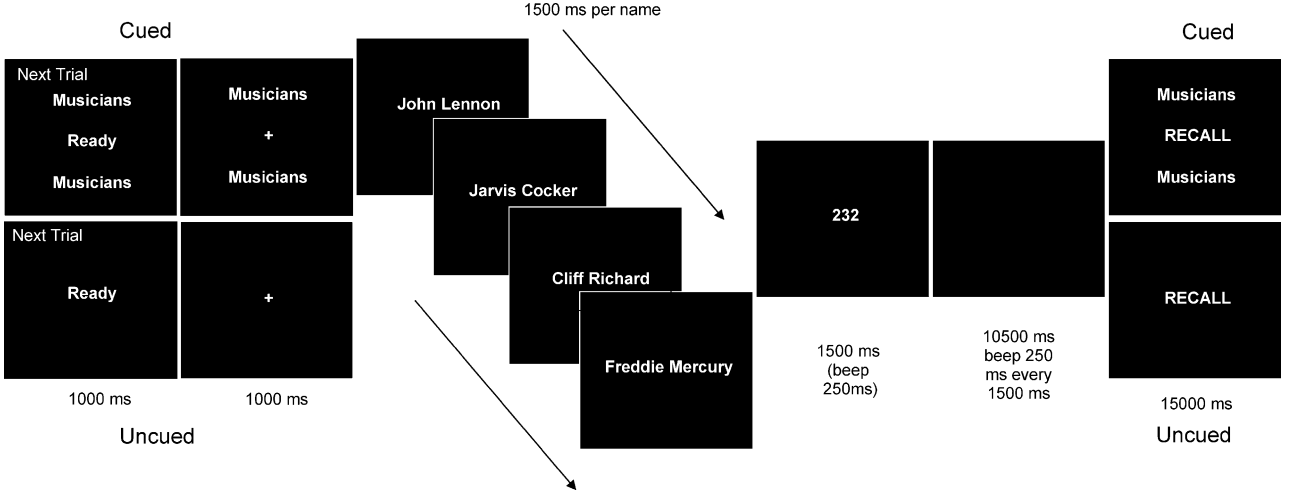

Fig. 1. Schematic representation of a single trial in Experiment 1.

messages were cleared and a single fixation cross was presented in the middle of the screen for a further 1000 ms.

Following the presentation of the fourth name, the interference task was initiated with the presentation of a single three digit seed number between 133 and 999. This number was visible for 1500 ms and then the screen became blank. The onset of the number display coincided with the onset of a tone of 250 ms duration which was repeated six more times every 1500 ms, forming a regular metronomic beat. Participants were instructed to subtract three from the number displayed and say the result, and then to subtract three from this number and say the result, and to continue in time with the tones until the tones stopped.

After a final delay of 1250 ms after the final tone, and therefore 10.5 s after the onset of the seed number and the interference phase, the response phase began. The message 'RECALL' was presented centrally on the monitor and participants were required to say out loud and in no particular order as many names from the presentation list as possible. Participants were given 15 s to respond, following which the screen went blank. Responses begun after the 'RECALL' message was cleared were deemed too slow and not counted as valid responses. There was an interval of 1 s before the next trial began, and all participants carried out a sequence of ten trials without interruption.

Half of the participants received one of the lists of actors first whilst the remaining half saw a list of musicians first. For the blocked-order participants trials two to five utilised lists from the same category as trial one. On trials six to ten lists from the other category were used. For *alternating* order participants each list after the first was drawn from the other category from the immediately preceding list. Thus the blocked ordered trials used a sequence where the categories of items presented remained discrete, with a sudden change from one to the other on trial six, whilst the *alternating* order trials were not discrete beyond each individual trial.

The above description applied to trials in the *uncued* conditions. Trials for participants in the *cued* conditions were almost identical to those described, except that these participants were presented with extra information.

Coincidentally with the presentation of the 'READY' message, identical captions appeared both above and below, reading either 'Actors' or 'Musicians', depending on the composition of the upcoming list. The cue remained on screen whilst the fixation cross was shown and was only cleared at the onset of the first name of the list. Subsequently the cue message was also shown in the same locations throughout the recall phase.

All participants undertook two sets of practice trials; the first set entailed carrying out the counting task on its own, whilst the second set of practice trials required participants to carry out four trials which were identical to those that they would carry out in the experimental trials, except that the names used were not drawn from the experimental lists.

1.2. Results

1.2.1. Memory performance

The profile of memory performance over trials for each of the four experimental groups is illustrated in Fig. 2. The confidence intervals used are of 95% and were calculated according to the method of Loftus and Masson (1994), based on $MS_{(S\times C)}$ appropriate to

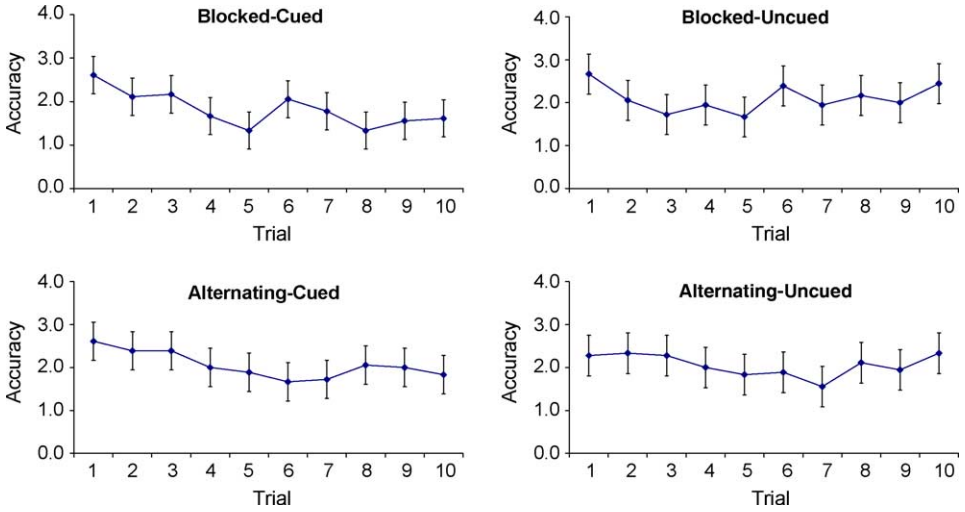

Fig. 2. Profiles of memory accuracy (/4) against serial position for all groups in Experiment 1. Confidence intervals are 95%.

the experimental design for within-participants comparisons. These intervals do not account for multiple comparisons, so it is important to note that inferences should only be drawn from the critical trial predicted comparison between trials five and six. As is evident from the serial position profile, there was clear evidence of a release from this PI on trial six for the *blocked-cued* participants. Mean performance of participants on trial six was outside the 95% CI for trial five, indicating a significant improvement in performance after the category change compared to that before, although the release effect did not result in performance returning to the levels seen on trial one. The mean improvement in accuracy from trial five from trial six was 0.72 items. Of the 18 participants in the group, 11 improved in accuracy on trial six compared to trial five, 4 scored the same, and 3 scored less. The profile of the *blocked-uncued* group was similar, and the release effect was again observed: there was a significant increase in accuracy between trials five and six. The mean improvement in accuracy from trial five from trial six was 0.72 items. Nine participants improved in accuracy on trial six compared to trial five, 5 scored the same, and 4 scored less. In this group, performance on trial six was similar to performance on trial one.

A $2\times(10)$ analysis of variance (ANOVA) was applied to the data from these groups, with cueing condition as a between-participants factor and serial position as a within-participants factor. Cueing condition was not a source of a significant main effect ($F(1,34)=2.076$, $MSE=6.944$, $p>0.05$) and neither was the two-way interaction ($F(9, 306)=1.346$, $MSE=1.346$, $p>0.05$). However, there was a significant main effect of serial position ($F(9,306)=3.823$, $MSE=3.489$, $p<0.001$). A planned comparisons analysis using *t*-tests (as all predicted comparisons in this paper were directional, one tailed *p* values are reported throughout) indicated that performance on trial six was significantly better than that on trial five in the *cued* condition ($t(17)=2.853$, $p<0.01$) and also in the *uncued* condition ($t(17)=2.247$, $p<0.05$).

The profiles of both *alternating* groups were similar to each other. Both seemed to show a slower build up of PI over initial trials, although some later trials appeared to have been performed more poorly than the first. There was no performance spike around trial six in these sequences. As a comparison with the *blocked* groups, there was a decrease in accuracy from trial five from trial six of 0.22 items in the *alternating-cued* group (4 participants improved on trial six compared to trial five, 7 scored the same, and 7 scored worse) and a small increase of 0.06 in the *alternating-uncued* group (4 improved, 8 scored the same and 6 scored more poorly). The performance of the *alternating-uncued* participants showed a tendency to improve over the last few trials, a finding that was rather unexpected.

A $2\times(10)$ ANOVA of the data from the alternating groups indicated no main effect of cueing ($F(1, 34)<1$, $MSE=0.000$) or of the two-way interaction ($F(9,306)<1$, $MSE=0.463$) but serial position was significant ($F(9,306)=2.546$, $MSE=2.488$, $p<0.01$). A predicted comparisons analysis of the difference between performance on trials five and six indicated no significant differences in either the *cued* or the *uncued* group (*cued*, $t(17)=1.074$, $p>0.1$; *uncued*, $t(17)=-0.195$).

1.2.2. Item accuracy

In order to ensure that there was no possibility that item related effects may have influenced the results, the number of correct responses was obtained for each individual name item. It was found that overall, 50.28% of actor items were correctly answered and 50.00% of musician items were correctly answered. There was no significant difference between the number of correctly answered actor items and musician items ($t(38)=0.702$). Thus it is highly unlikely that effects related to the individual stimulus items caused any of the effects observed in this experiment.

1.2.3. Arithmetic performance

In order to establish that the effects seen in memory performance did not arise out of variations in performance of the interference task, profiles were created of arithmetic performance (i.e. the number of correct items produced) over each serial position (Fig. 3). As can be seen, the profiles themselves indicate relatively constant arithmetic performance. In particular there was no evidence of any trade off between counting performance and memory performance having occurred.

1.3. Discussion

The principal finding in this experiment was that on instigation of a set shift on the sixth trial, both *blocked* groups manifested a clear improvement in performance, consistent with a release from proactive interference. The fact that no corresponding performance increase was registered by either *alternating* order group suggests that this effect was indeed a consequence of RPI, rather than an unexpected order effect. There was some, limited, evidence for build-up of PI in the *alternating* groups. This is in line with the results of Loess (1968), who also identified build-up of PI in alternating conditions (although, of course, there was no release from the PI). In terms of the IAC model, it is not surprising that some PI build-up occurred, because although the *alternating* list varies by trial on

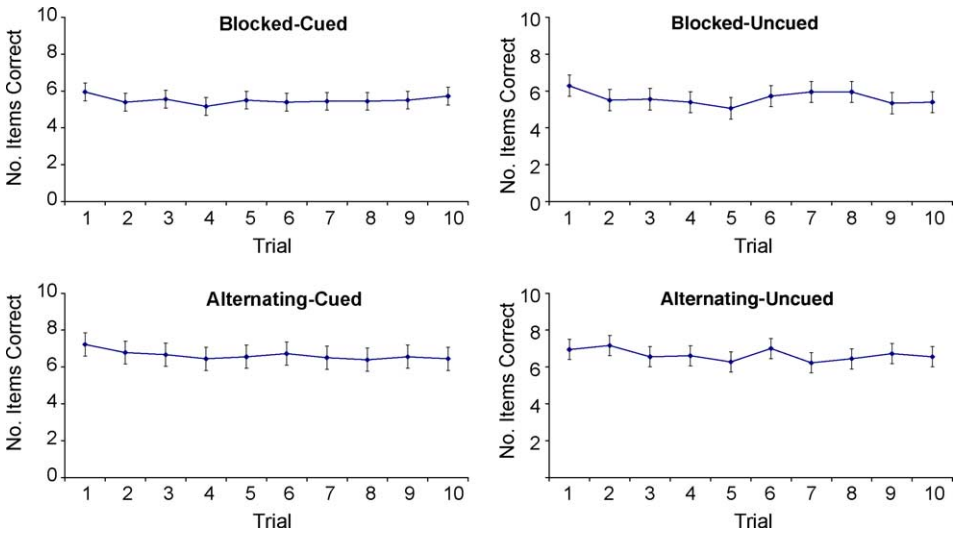

Fig. 3. Profiles of counting performance (no. items correctly produced) against serial positions for all groups in Experiment 1. Confidence intervals are 95%.

the critical category, such that there is no possibility of a marked release effect, there remained in the memory items a substantial overlap of shared SIUs between the items, leading to PI build-up as the experiment progressed. It was clear from the arithmetic task performance that these effects were not the consequence of a performance trade off with the interference task in the experiment.

The emergence of RPI on *blocked* order presentations represented a clear demonstration of categorically related memory effects. Such effects have been interpreted as evidence for categorically organised memory structures in the object domain (Gardiner et al., 1972; Loess, 1968; Marques, 2000). This experiment demonstrated that such effects can be observed within semantic memory for people. The data support the argument that identity-specific semantic information for people has a categorical structure within LTM in which occupation is a factor, at least for celebrities.

In this experiment, the serial position profile was very similar for both *cued*- and *uncued-blocked* groups. It was clearly the case that the RPI effect emerged irrespective of whether or not participants were specifically informed of the categorisation principle. This suggests that internal category structures were the underlying cause of the RPI effects. In the terms of Gardiner et al. (1972), it would seem likely that the two occupations formed different categories, rather than subcategories, because of the effect was not dependent on cueing.

It should be acknowledged that the PI related suppression of performance, and the release related improvement seen in this experiment were somewhat less marked than those reported by Gardiner et al. (1972) and Loess (1968). There is no reason to assume that it would be valid to compare the size of effects between name and object domains. Knowledge of famous individuals varies quite substantially in the general population in

comparison with knowledge of many objects; this is a potential source of noise in the data that may have attenuated experimental effects. Carson and Burton (2001) argued that categorical priming effects are weaker with peoples' names, and the results of this experiment could reflect weaker categorical effects in the domain of names.

2. Experiment 2

Experiment 1 offered clear evidence of categorical effects in identity-specific semantic memory for people on the basis of occupation. There are, however, a number of potential principles by which people can be categorised. It is possible that any of these potential categorisations might result in RPI effects if presented in a task like that used in Experiment 1. In Experiment 2 the opportunity was taken to investigate whether this was the case. According to Johnston and Bruce (1990), occupation represents a descriptor at the category level. Experiment 2 investigated whether nationality, which, according to Johnston and Bruce represents knowledge at a property level, would elicit PI and RPI effects in a similar manner. If the results of Experiment 2 mirrored those of Experiment 1, and both *cued* and *uncued* groups demonstrated RPI effects, the distinction suggested by Johnston and Bruce (1990) would be questionable. However, if Experiment 2 produced qualitatively different results from Experiment 1 it could provide converging evidence for the category/property distinction.

2.1. Method

2.1.1. Participants and apparatus

There were 72 participants in Experiment 2, 33 were male and 39 were female. Their mean age was 28 years and 6 months (SD = 11 years 2 months). Participants were visitors to the 'who am I?' gallery in the Wellcome Wing of the Science Museum. The experiment was conducted in similar conditions to Experiment 1, using exactly the same apparatus.

2.1.2. Materials

The lists of names used in this experiment were created by rearranging the lists from Experiment 1. Ten lists of four items were compiled, of which five lists were composed entirely of celebrities from the UK and five lists were comprised of celebrities from the USA. Within each list, two of the names were of actors and two were of musicians. The items had all been piloted to determine that the nationality of the celebrities was sufficiently well known.

2.1.3. Design and procedure

The design and procedure were identical to Experiment 1, except that the categories used for creating the lists and for clustering in the two blocked groups were based on the nationality of the celebrities concerned. In the *cued* conditions the cues used were 'UK celebrities' and 'US celebrities' instead of 'Actors' and 'Musicians'.

2.2. Results

2.2.1. Memory performance

Fig. 4 shows the profiles of performance over serial position for all four experimental groups, with unadjusted 95% CIs calculated according to Loftus and Masson (1994).

In this experiment the *blocked-cued* group showed clear evidence of a significant RPI effect on trial six. Mean performance of participants on trial six was outside the 95% CI for trial five. The mean improvement in accuracy from trial five from trial six was 0.50 items (10 scored better in trial six than trial five, 4 scored the same, and 4 scored worse). Performance on trial six, the first trial of the second category, was of a comparable level to that on trial one. The profile of this group was broadly similar to that observed with the equivalent group in Experiment 1; showing evidence of PI build up over the first five trials, with an associated release effect on trial six.

The profile of the *blocked-uncued* group was different to its equivalent in Experiment 1 and to the *blocked-cued* group described above. There was no evidence of a set-shift related RPI effect. Mean accuracy on trial six was only very slightly higher than on trial five (a mean improvement of 0.17 items, with seven participants scoring better on trial six than trial five, 6 scoring the same and 5 scoring more poorly) and this difference was not significant, lying well within the 95% CI.

A 2×(10) ANOVA was run on the data from these groups, with cueing condition as a between participants factor and serial position as a within participants factor. Cueing condition was not a source of a significant main effect ($F(1,34)<1$, $MSE=0.069$) and neither was the two-way interaction ($F(9.306)<1$, $MSE=0.557$). The only significant effect was a main effect of serial position ($F(9,306)=2.668$, $MSE=2.458$, $p<0.01$).

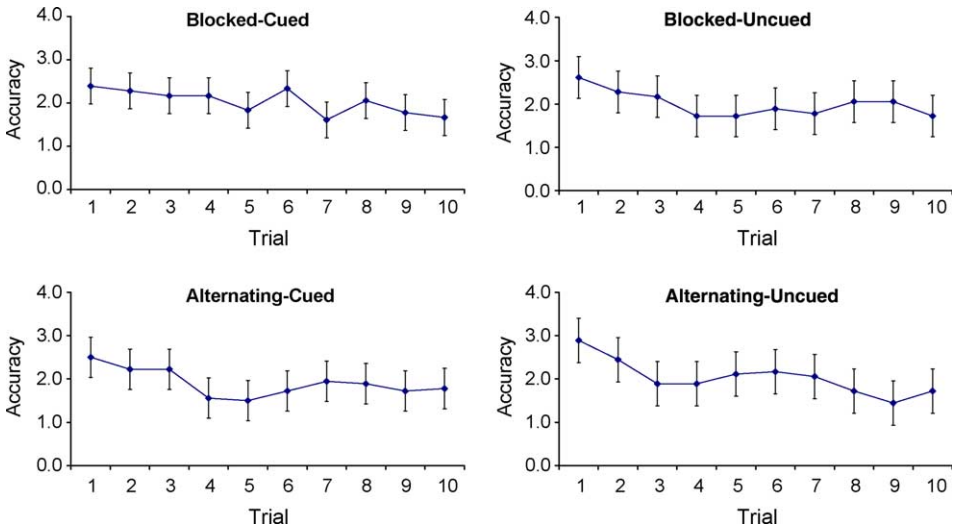

Fig. 4. Profiles of memory accuracy (/4) against serial position for all groups in Experiment 2. Confidence intervals are 95%.

Predicted comparisons indicated that performance on trial six was significantly better than that on trial five ($t(17)=2.034$, $p<0.05$) in the *cued* condition but not in the *uncued* condition ($t(17)=0.546$).

The profiles of both *alternating* groups were quite similar to each other. Both profiles seemed to show a build up of PI over the initial trials. There was no performance spike around trial six in either of these groups. For the purposes of comparison, the mean improvement in accuracy from trial five to trial six was 0.17 items for the *alternating-cued* group (6 participants scored better on trial six than trial five, 4 scored the same and 8 scored worse), and 0.06 items for the *alternating-uncued* group (7 scored better on trial six than trial five, 4 scored the same and 7 scored worse).

A $2\times(10)$ ANOVA of the data from the *alternating* groups also indicated no main effect of cueing ($F(1,34)<1$, $MSE=1.469$) or of the two-way interaction ($F(9,306<1$, $MSE=0.951$), but again serial position was significant ($F(9,306)=3.568$, $MSE=3.916$, $p<0.001$). Predicted comparisons analysis of the difference between performance on trials five and six indicated no significant differences in either the *cued* or the *uncued* group (*cued*, $t(17)=-0.606$; *uncued*, $t(17)=-0.236$). There was no evidence of the (unexpected) slight improvements over later trials that were observed in the *uncued* conditions of the previous experiment.

2.2.2. Item accuracy

Overall, 48.33% of UK items were correctly answered and 51.25% of US items were correctly answered. There was no significant difference between the number of correctly answered US items and UK items ($t(38)=0.590$). Thus it is unlikely that effects related to the individual stimulus items caused any of the effects observed in this experiment.

2.2.3. Arithmetic performance

The serial position profiles (Fig. 5) of arithmetic performance indicate relatively constant arithmetic performance. As in Experiment 1 there was no evidence of any trade off between counting performance and memory performance having occurred.

2.3. Discussion

In this experiment, category shift related RPI was observed with blocked order presentations, but only when the categories were *cued*. When the categorisation was *uncued*, PI built up as in the *cued* condition, but there was no performance spike on the trial after the category shift, with no evidence for RPI. The results demonstrate that RPI is observed using nationality as a basis for stimulus set selection, but only when participants are *cued* to attend to nationality. In Experiment 1 when occupation was used as a criterion for blocking the trials, participants demonstrated RPI effects irrespective of whether or not occupation was *cued*. Thus it appears that occupational subsets of 'Actors' and 'Musicians' are more likely to reflect an important underlying semantic structure than the nationality subsets of 'US entertainers' or 'UK entertainers'. As in Experiment 1, the performance on the interfering task suggests that these results did not arise from trade offs of attention or performance with the arithmetic task. Furthermore the number of correctly recalled US celebrities was similar to the number of correctly recalled UK celebrities, so it

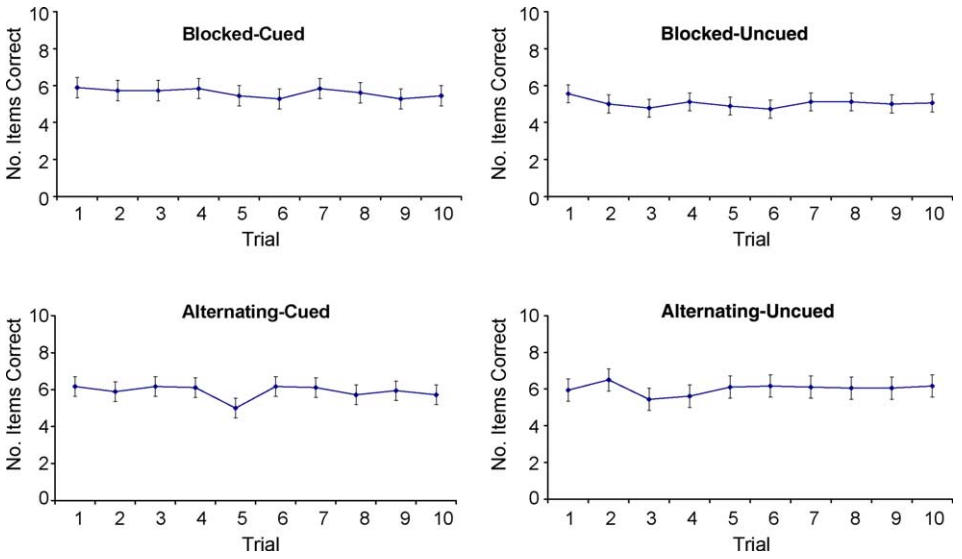

Fig. 5. Profiles of counting performance (no. items correctly produced) against serial position for all groups in Experiment 2. Confidence intervals are 95%.

is difficult to argue that item related effects were the cause of the observed PI and release effects.

The possibility was raised previously that category and property level knowledge might have a different relationship with semantic categorisation structures. The results of Experiments 1 and 2 support this argument. More specifically it appears that both categories and properties can form the basis of stimulus organisation that give rise to RPI, but that properties only do so when explicitly *cued*. Category level knowledge, it seems, can elicit categorical effects implicitly. This would tend to suggest that category level properties such as occupation are of greater importance in the organisation of categories within semantic memory for famous people.

3. Experiment 3

If the difference in RPI at a category and a property level is genuine a difficulty of interpretation for Experiment 2 arises. The stimuli in Experiment 2 were drawn equally from the occupational categories of actors and musicians. This enabled the same stimuli to be used in both experiments, to eliminate the possibility that uncontrolled differences in the stimulus names might influence the results. Experiment 1 demonstrated that category level organisation of stimuli could implicitly influence memory. Hence the possibility remains open that the failure to identify RPI on the critical trial in the *blocked-uncued* condition in Experiment 2 may have been caused by the presence of items from more than one occupational category. The difference in the results of Experiments 1 and 2 could

therefore have been due to the mere presence of another categorical dimension that is more salient than the criterion for blocking trials in Experiment 2. To address this issue, Experiment 3 was a replication of Experiment 2, employing a set of stimuli that were all drawn from the same occupational group. Experiment 3 used only musicians as stimuli. Piloting indicated that it was not possible to compile a suitably sizeable list of actors for the experiment, without introducing a number of systematic differences between the two groups of names. The majority of US actors that could be added to the list were predominantly Hollywood actors, whilst the UK actors were less-well known television actors. This problem did not apply to musicians.

Data from the *alternating* conditions in Experiments 1 and 2 both satisfactorily determined that there was no evidence for serial position related increases in performance on trial six that could confound the RPI effects. Hence the *alternating* condition was omitted from Experiment 3. The remaining comparison was simply between *cued* and *uncued* presentations.

3.1. Method

3.1.1. Participants and apparatus

Thirty six participants took part in Experiment 3, 15 were male and 21 were female. Their mean age was 26 years and 8 months (SD = 8 years 7 months). Participants were all students at Goldsmiths' College or the University of Kent. The experiment took place in a laboratory but in all other important respects used the same apparatus as that described for Experiments 1 and 2.

3.1.2. Materials

Stimuli in Experiment 3 were the names of 40 musicians, of whom 20 were American, and 20 were British. The items had all been piloted to determine that the nationality of the celebrity could be identified by at least eight out of eleven participants. The names used are listed in Appendix B.

3.1.3. Design and procedure

The design and procedure of Experiment 3 was identical to that in the Experiment 2, except that the two *alternating* conditions were not included.

3.2. Results

3.2.1. Memory performance

Fig. 6 shows the profiles of performance over serial position for all four experimental groups, with unadjusted 95% CIs calculated according to Loftus and Masson (1994).

There was evidence of a significant release effect on trial six in the *cued*, but not the *uncued* condition; mean performance of participants on trial six was outside the 95% CI for trial five. This was not the case in the *uncued* condition. The mean improvement in accuracy from trial five from trial six in the *cued* condition was 0.56 items (9 participants scored higher on trial six than trial five, 7 scored the same and 2 scored worse), whilst in the *uncued* condition, there was a decrease in performance of

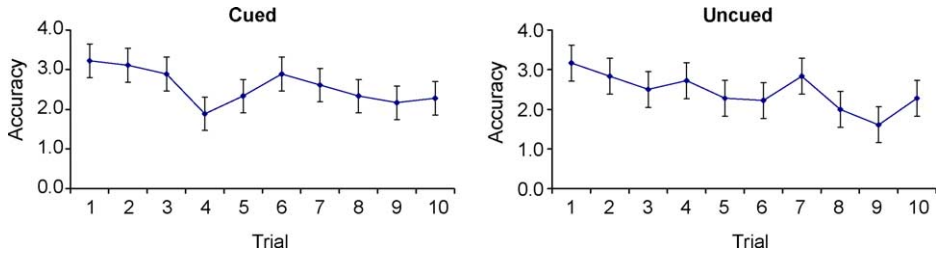

Fig. 6. Profiles of memory accuracy (/4) against serial position for cued and uncued groups in Experiment 3. Confidence intervals are 95%.

0.06 items (6 scored higher after the shift, 6 scored the same and 6 scored more poorly). Performance on trial six in the *cued* condition, the first trial of the second category, was of a comparable level to that on trial one. In the *uncued* condition there appeared to be an increase in performance on trial seven, which had not been predicted.

A 2×(10) ANOVA was run on the data from these groups, with cueing condition as a between participants factor and serial position as a within participants factor. Cueing condition was not a source of a significant main effect ($F(1,34)<1$, $MSE=1.469$) and neither was the two-way interaction, although it approached significance ($F(9.306)=1.895$, $MSE=1.679$ $p<0.1$). The main effect of serial position was highly significant ($F(9,306)=6.338$, $MSE=5.618$, $p<0.01$). Predicted comparisons indicated that performance on trial five was significantly worse than that on trial six ($t(17)=2.149$, $p<0.05$) in the *cued* condition but not in the *uncued* condition ($t(17)=0.187$). Unplanned multiple *t*-tests between performance levels in the two cueing conditions at each trial indicated that performance was higher in the *uncued* condition than the *cued* condition on trial four, but this difference was not significant when the *t*-tests were corrected for multiple comparisons. In conjunction with the performance profiles (see Fig. 6), it is possible that the interaction resulted from stronger PI in the *cued* condition on trial four. In a separate, post-hoc, paired samples analysis, the unpredicted increase in performance on trial seven compared to trial six was found to be not significant when adjusted for multiple comparisons ($t(17)=2.170$, p (Bonferroni adjusted)$=1.000$.

Comparison of the graphs in Figs. 4 and 6 suggests that the build up of PI over trials one to five may have been stronger in the *cued* condition in Experiment 3 than in the *blocked-cued* condition in Experiment 2. The data from trials one to five in these groups were entered into a mixed design ANOVA with experiment and cue type as between participant factors and serial position as a within participants factor. Experiment ($F(1,68)=10.801$, $MSE=28.336$, $p<0.005$) and serial position ($F(4,272)=10.128$, $MSE=8.183$ $p<0.001$) were significant main effects. However, of interest here was the only other significant effect, the three way interaction of experiment, cue type and serial position ($F(4,272)=2.661$, $MSE=2.150$ $p<0.05$). Inspection of Figs. 3 and 5 suggests that the interaction reflects a stronger build up of PI in the *cued* condition in Experiment 3.

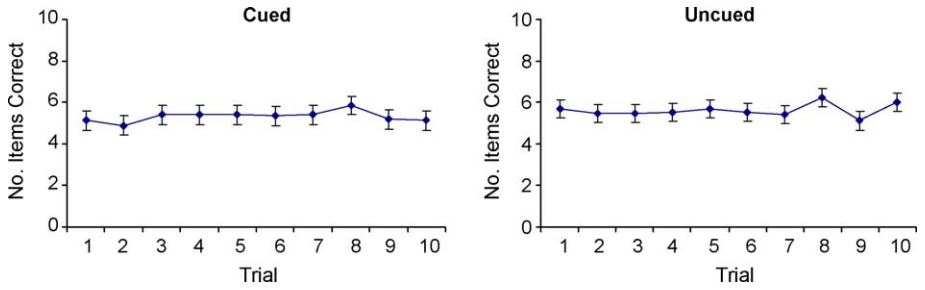

Fig. 7. Profiles of counting performance (no. items correctly produced) against serial position for cued and uncued groups in Experiment 3. Confidence intervals are 95%.

3.2.2. Item accuracy

Overall, 65.69% of UK items were correctly answered and 59.72% of US items were correctly answered. There was no significant difference between the number of correctly answered US items and UK items ($t(38) = 1.471$ $p > 0.1$).

3.2.3. Arithmetic performance

As in previous experiments there was no evidence of any trade off between counting performance and memory performance having occurred at the critical trial (Fig. 7). One unexpected pattern was observed; performance of the *uncued* group fluctuated markedly over the final three trials.

3.3. Discussion

The results of Experiment 3 replicate those of Experiment 2. When a property (nationality) was used as the stimulus organising principle, a statistically reliable release from PI was observed on the critical trial when the property was *cued*, but was absent when the property was not *cued*. In Experiment 3, the list of to be remembered items did not contain items which differed at the category level (occupation) Hence, the absence of a release from PI in the *uncued* condition of Experiment 2 cannot be attributed to the influence of a distinction amongst the stimuli that is more salient than the organising criterion for stimulus blocking. It must be acknowledged that although variations in occupation may have been removed in Experiment 3, it remains possible that other potentially more salient dimensions *may* have persisted in the stimulus materials. One possible candidate is musical genre; however, all of the musicians used in the experiment were modern (famous post 1960) and perform in the pop idiom, so this seems unlikely. Salience of the stimulus dimensions in these experiments is nonetheless an important issue, and we return to it in the General Discussion.

Comparison of the build up of PI between Experiments 2 and 3 suggest that PI built up more quickly in Experiment 3 in the *cued* condition that in the corresponding condition of Experiment 2. This pattern is of interest because, one prediction derived

from the IAC model is that greater semantic overlap, and hence the more shared SIUs between the to-be-remembered items will produce a stronger effect of PI. In Experiment 3, the items in the lists presented shared nationality and occupation, whilst in Experiment 2, list members were selected only to share the same nationality. Hence the suggestion that PI built up more strongly in Experiment 3 is consistent with the IAC model. This point remains somewhat speculative and further research explicitly designed to test the hypothesis that PI is stronger as a function of semantic overlap is required.

4. Experiment 4

The observation that cueing differentially affects RPI raises the question of how cueing interacts with the underlying organisation of identity-specific semantic memory for people. Two alternative and competing explanations are possible. One of these is similar to the explanation presented by Gardiner et al. (1972) and Marques (2000), who suggest that cueing can be used to switch the currently relevant categorisation in semantic memory. Applied to the data from Experiments 1 and 2, this approach would argue that occupation was a higher level categorisation than nationality, and that RPI related to nationality would only be observed if the relevance of that property level categorisation was made explicit.

It is also possible that the data reported could have resulted from flexible on-line categorisation of the names during the memory task. Rather than reflecting the underlying structure of semantic memory, RPI could be the result of the operation of flexible selective processes. Barsalou (1983, 1985) showed that novel *ad hoc* or goal-derived categories showed a typicality gradient previously believed to be characteristic of categorical structure of semantic memory. Examples of Barsalou's for general semantic memory include, things that might fall on your head, plunder taken by conquerors and things that can float.

Cueing may draw attention to any organising dimension that can be used to differentiate between a list of one category and another. Under this view it would be immaterial whether the relevant dimension is stored in semantic memory. The effect of RPI would occur because the cognitive system is capable of organising items in a novel way according to task demands. Therefore it could be argued that the effects of switching nationality seen in Experiments 2 and 3 might not reflect the categorical structure of semantic memory. If this account is correct RPI would be observed under *cued* but not under *uncued* conditions for any novel, *ad hoc* categorisation. Alternatively, if the effect of RPI reflects stored category structure in semantic memory, no RPI should be observed even when a category shift is cued in a novel, *ad hoc* category. Therefore in Experiment 4 we used an *ad hoc* stimulus organisation principle for famous people that is broadly analogous to Barsalou's *ad hoc* goal-derived categories.

The organising principle selected in Experiment 4 was between people who do the job for which they are known standing or sitting. This is a useful *ad hoc* category because a set of names can be drawn up for which there is a substantial degree of

agreement of category membership, but it is not a categorisation that is likely to be used in daily life.

4.1. Method

The same paradigm as used in Experiments 1–3 was used in Experiment 4.

4.1.1. Participants and apparatus

There were 36 participants in Experiment 4, five were male and 31 were female. Their mean age was 23 years 5 months (SD = 6 years 7 months), all were students at Goldsmiths' College. The experiment took place in a laboratory; the same apparatus was used as that described for Experiments 1–3.

4.1.2. Materials

The stimuli were the names of 20 celebrities who primarily sat down to do the job that they were known for, and the names of 20 celebrities who stood up. The celebrities selected were from a variety of backgrounds such as sports, music and broadcasting, and the lists were compiled as much as possible so that occupational categories were represented in both sitting and standing groups, to attempt to avoid confounds. The items were all piloted with a different group of participants and only those items that were correctly identified and correctly categorised into the sitting and standing groups by at least eight out of 11 participants were included in the experimental lists. The names used are detailed in Appendix C.

4.1.3. Design and procedure

The design and procedure of Experiment 4 was similar to that of Experiment 3, but instead utilised the stimuli described above. In the *cued* condition the cues used were 'Sitting Down' and 'Standing Up'. To prevent confusion, participants in the *cued* condition only had the meaning of the categorisation cues explained to them during the instructions prior to the practice trials. This was necessary because the cues were somewhat opaque without this explanation.

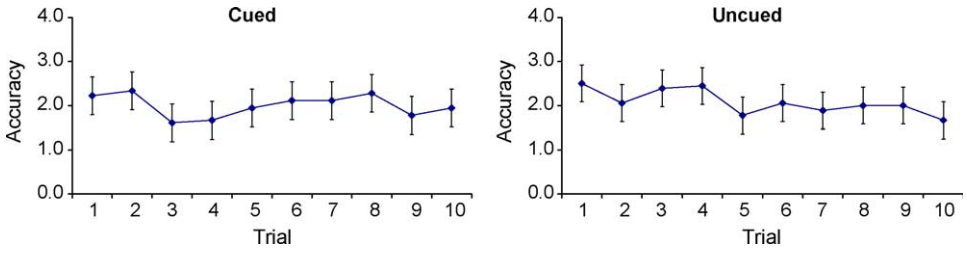

Fig. 8. Profiles of memory performance accuracy (/4) against serial position for cued and uncued groups in Experiment 4. Confidence intervals are 95%.

4.2. Results

4.2.1. Memory performance

Fig. 8 shows the profiles of performance over serial position for all four experimental groups, with unadjusted 95% CIs calculated according to Loftus and Masson (1994).

It is apparent from Fig. 8 that there was no evidence in either condition for category shift related RPI effects between trials five and six, the point at which the category changed. In both *cued* and *uncued* conditions the difference between the mean number of items correct on trials five and six was well within the 95% confidence interval; mean improvement in accuracy from trial five from trial six was 0.17 items in the *cued* group (7 participants scored more highly on trial six than trial five, 6 scored the same and 5 scored more poorly) and 0.28 items in the *uncued* group (7 scored higher, 7 scored the same and 4 scored more poorly).

A $2\times(10)$ ANOVA was run on these data, with cueing condition as a between-participants factor and serial position as a within-participants factor. Cueing condition was not a source of a significant main effect ($F(1,34)<1$, $MSE=0.544$) and neither was the main effect of serial position ($F(9,306)=1.228$, $MSE=1.007$, $p>0.05$). The two-way interaction between cueing and serial position was significant ($F(9,306)=1.935$, $MSE=1.588$, $p<0.05$). Planned comparisons indicated that performance on trial five was not significantly better than that on trial six in either condition (*cued*, $t(17)=-0.546$; *uncued*, $t(17)=-0.893$). Unplanned multiple *t*-tests between performance levels in the two cueing conditions at each trial indicated that performance was higher in the *uncued* condition than the *cued* condition on trial four, but this difference was not significant when the *t*-tests were corrected for multiple comparisons. In conjunction with the performance profiles (see Fig. 8), it appears that the interaction indicated that PI was a little slower to establish in the *uncued* than in the *cued* condition.

4.2.2. Item accuracy

It was found that overall, 46.53% of 'sitting' items were correctly answered and 55.42% of 'standing' items were correctly answered. The difference between the number of correctly answered 'sitting' items and 'standing' items approached significance ($t(38)=1.932$, $p<0.1$).

4.2.3. Arithmetic performance

The serial position profiles (Fig. 9) of arithmetic performance indicate fairly constant arithmetic performance and there was no suggestion that the predicted RPI effects were masked by a trade off with counting performance.

4.3. Discussion

The profile of performance over serial position of participants in this experiment demonstrated some evidence for a build up of PI over the early serial positions. Build up of PI was not in phase over serial position between the two conditions. There was a slight increase in performance over later trials, most probably a consequence of practise effects. In these respects, the profiles of both the groups in

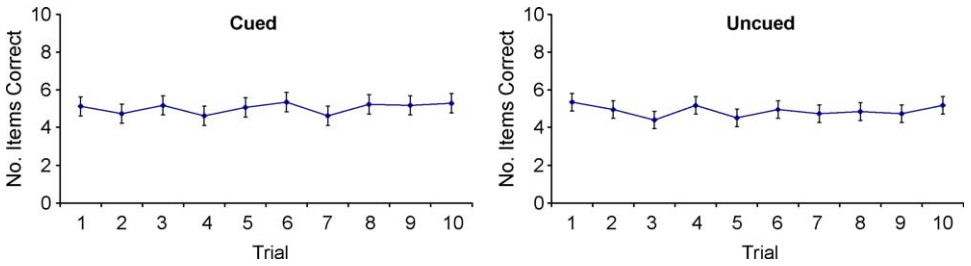

Fig. 9. Profiles of counting performance (no. items correctly produced) against serial position for cued and uncued groups in Experiment 4. Confidence intervals are 95%.

Experiment 4 are similar to those of participants in the *alternating* conditions of Experiments 1 and 2.

It was the found participants recalled a marginally significantly greater number of 'standing' items than 'sitting' items. However, given that the order of presentation of the categories was fully counterbalanced, this could not have affected the overall conclusions. The analysis of the counting task data did not suggest that potential RPI effects had been masked by trade offs with counting task performance.

The most noteworthy feature of the results was that there was no evidence of any set shift related RPI in the *cued* condition. This suggests that organising sets of stimuli using an *ad hoc* principle was not sufficient to produce release from proactive interference. There was no evidence to suggest that participants in the *cued* condition had categorised the stimuli at encoding into sitting or a standing groups, and used that information to assist at recall. Hence, the results of Experiment 3 gives support to the view that that the effects of RPI observed in the earlier experiments arose from the use of the underlying categorical structures encoded in semantic memory rather than from the application of on-line processing.

5. General discussion

Experiment 1, using occupation as a stimulus organising principle, demonstrated a category shift related release from proactive interference, which occurred irrespective of cueing. Experiment 2, which used nationality as the organising principle for stimuli, demonstrated a similar shift related RPI effect, but only when participants were *cued* to the category structure in the stimulus sets. Experiment 3 replicated the results of Experiment 2 using a stimulus set that did not include a category distinction that was potentially more salient than the criterion use to organise the stimulus lists. Experiment 4 showed that no category related RPI was observed when the novel categorisation of sitting/standing was used to arrange the stimuli.

These results clearly support the claims of Gardiner et al. (1972), Loess (1968) and Marques (2000) that the RPI technique is capable of revealing information about the underlying structure of semantic memory. The current research extends this into

the domain of identity-specific semantic memory for famous people. The results demonstrate that RPI can serve as a useful marker within the domain of semantic memory for people's names. The RPI method is a powerful technique for shedding light on how memories are organised. One of its most important benefits is that it is a covert technique; participants generally reported that they were unaware of the specific purpose of the experiment until debriefing.

The experiments reported support three conclusions. First, it has been shown that a switch in the occupation of individuals referred to by stimulus items produced release from PI whether or not the category shift was *cued*. These data provide support, from a very different paradigm to reaction time studies of semantic (associative) priming and face–name interference, that occupation plays an important role in the category structure of memory for celebrities. Occupation is not necessarily the highest level descriptor for knowledge about people, but the data from Experiment 1 do support the contention that it is associated with automatic, implicit effects. Recently it has been suggested that the failure to observe priming in a single face or name familiarity decision between celebrities who share a semantic but not an associative relationship provides evidence that semantic memory for people may not have a category structure (Barry et al., 1998). The present data provide evidence against this view.

Second, it has been shown that changing stimuli from one nationality to another is only associated with release from PI if participants are *cued* to nationality. This result is consistent with the view that nationality is stored in memory but is not spontaneously used as an organising principle. The differences we observed between RPI from occupation and nationality categories are consistent with Johnston and Bruce's (1990) distinction between occupation as a category and nationality as property. Our data suggest that the structure of identity-specific semantic memory is sufficiently flexible for a property to be used as a categorising principle when it becomes salient to the task.

Third, Experiment 4 shows that is not the case that simply any organising principle will produce release from PI when it is *cued*. Participants were unable to use a novel *ad hoc* category (celebrities who work standing versus those who work sitting) to gain release from PI even when they were *cued* to the category shift. These data add weight to the interpretation that release from PI genuinely reflects the category structure of identity-specific semantic memory. These conclusions are similar those of Gardiner et al. (1972) in relation to general semantic memory. They identified a subordinate level of the semantic hierarchy in the object domain that yielded release from PI only when the category shift was *cued*.

Barry et al. (1998) and Young et al. (1994) failed to identify categorical non-associative effects in priming of famous people, in the Barry et al. case using a technique identical to that used successfully to elicit categorical priming with objects. Where categorical priming has been observed, the effects have been weaker than in associative priming studies (Brennen and Bruce, 1991; Carson and Burton, 2001). The experiments in this paper provide evidence from an alternative source to priming studies which points towards categorical effects within memory for famous people. It is not possible to compare the strength of the effects in these experiments with those from priming studies. However, it is likely that the RPI technique, which uses a very large number of exemplars of each category compared to priming studies, has a high sensitivity to the underlying structure of

semantic memory. The most likely explanation for the fact that these experiments support the categorical organisation of semantic memory, while the studies by Barry et al. (1998) and Young et al. (1994) do not, is simply that categorical effects are weaker than associative effects, and that the RPI technique is more sensitive than single item priming.

Barry et al. (1998) proposed a social networks hypothesis, suggesting that category boundaries in identity-specific semantics are less clear and representations will be more idiosyncratic than is the case for semantic representations of objects. Crucially, Barry et al.'s argument rests on the absence of categorical priming in the presence of associative priming. The fact that there is now growing evidence of categorical effects in semantic memory for people must be accounted for by any theoretical approach.

It should be noted that we are not making the claim that occupation is the basic or fundamental category within semantic memory for people, simply that amongst our stimuli, it is important, it is associated with implicit effects, and it is processed in a qualitatively different way to lower level descriptors. Additionally, we accept that our classification of nationality as a property may not apply to all classes of famous people: for example within international footballers or statespersons, nationality is likely to be a more salient piece of information, and for these groups it could be a higher level descriptor than for other famous people. Furthermore, the important descriptors relating to celebrities of whom we have little personal knowledge may not be the same as those used with familiar individuals. However, on the basis of these results, we do predict that qualitatively different category level and property level descriptors of some sort should be observable within identity-specific semantics for all known individuals, and that these would manifest themselves in a similar manner to those seen in these experiments. Future research would be required to clarify what other dimensions may represent categorical and property level descriptors, especially amongst familiar but not famous people.

It could be argued that, instead of being related to qualitatively different storage in semantic memory, the results of the experiments in this paper merely reflect differences in the salience of the various dichotomies in the stimuli used; in other words that the manifestations of differing patterns of RPI are a consequence of the fact that occupation, for example, is a more salient dimension than nationality. However, there are a number of reasons to suppose that this is unlikely. Firstly, our definition of categories and properties was made a priori on the basis of Johnston and Bruce's (1990) work which also demonstrated qualitative distinctions between categories and properties. Secondly, there was no evidence in Experiments 2 or 3 at all of an RPI effect in the *uncued* condition, or in Experiment 4 in either condition, but there was strong evidence in the *cued* condition. Had relative salience per se been the cause of the RPI effects, then one would have expected at least some evidence of RPI in these conditions (as, under this view, the stimuli would differ only in relative intensity). Furthermore, one would perhaps have expected stronger RPI effects in the *cued* condition of Experiment 1 than in the *uncued* condition. We do acknowledge that these arguments cannot completely refute the possibility that salience alone underlies the patterns we have observed, not least because of the difficulty of interpreting null results. However, we would argue that our interpretation that the differences are based on the category/property distinction is a more satisfactory explanation of these results.

In fact, the issue of salience is not one that is problematic only in terms of the current experiments. If one views semantic memory as an information processing system that develops (as opposed to being hard wired) in such a way as to manifest distinct categories and properties, then it would be highly likely that the most salient groupings would be categorical, whilst less salient attributes would be manifest as properties. Thus the relationship between salience and category/property distinctions is also problematic to Johnston and Bruce's distinction, and even to Collins and Quillian's (1969) proposal in respect of knowledge about objects, as it would predict longer response times to properties than to categories, assuming that categories were more salient than properties. This issue would be a worthy candidate for future investigation. However, the difficulty of holding salience levels constant for a category comparison and a property comparison should not be underestimated.

To date, attempts to identify categorical priming between non-associated peoples' names have focused principally on occupation. However, in the light of the presence of categorical effects at the property level, nationality, in this paper, we would predict that priming effects based on nationality should also be present. The discovery of such a pattern would further reduce the appeal of the salience explanation, as one would predict that reduced salience should lead to reduced priming.

The IAC models of Brédart et al. (1995) and Burton, Bruce, and Johnston (1990) explicitly predict that categorical priming will occur for people. As the links from the PIN to the various SIUs are assumed to be bi-directional, the models explicitly predict that any two PINs that share connectivity via a single SIU should benefit from some form of priming, and hence that identity-specific semantic memory for people is categorically organised. This prediction is not just limited to associates. The data presented in this paper, along with the data of Brennen and Bruce (1991) and Carson and Burton (2001) therefore are consistent with the IAC account. However, it is necessary to explain the fact that associative priming effects are stronger than categorical ones. Carson and Burton (2001) argue that the explanation lies with the fact that highly associated individuals share a greater number of SIUs than do categorically related individuals. Thus effects based on association are viewed as being the result of the same general processes underlying effects based on categorisation. A similar explanation might be applied to the distinction between category level and property level descriptors. More specifically the semantic representations of celebrities who share an occupation (e.g. singer) may overlap more (i.e. have more SIUs in common) than celebrities who share a nationality. In the case of a property, such as nationality, it might therefore be necessary to explicitly activate the relevant property SIU by cueing in order to observe categorical effects in a memory experiment. Further research is required to test the predictions that we have derived from the IAC architecture in simulations that apply the framework specially to modelling the RPI paradigm.

Evidence consistent with the prediction of priming based on nationality has been reported in the literature on 'provoked overt recognition'. Some prospagnosic patients can achieve overt recognition of famous faces that could they not recognise individually when several famous faces from the same occupation category (e.g. actors) are presented simultaneously (Sergent and Poncet, 1990). In terms of the IAC model it is assumed that residual sub-threshold activation from several (unrecognised) faces can summate at the SIU representing the shared occupation and

help the PINs of the individual celebrities to rise above threshold, achieving overt recognition. It is interesting to note that Diamond, Valentine, Mayes, and Sandel (1994) demonstrated provoked overt recognition in a densely prosopognosic American patient when the shared category was their British nationality.

The experiments reported have demonstrated that the phenomenon of RPI can be used effectively to investigate the structure of semantic memory for familiar individuals. Investigations exploiting RPI have the potential to illuminate other issues in identity-specific memory, such as issues of pooled semantics, or perhaps even the relationship between the retrieval of names and of personal properties. One of the chief advantages is the fact that the experimental rationale of the RPI technique (especially in the *uncued* versions) is opaque to the participant; therefore responses are unlikely to be affected by influences beyond the realm of semantic memory, such as social categorisation or experimenter effects. The results reported here recommend that the investigation of RPI may be a technique that could usefully used more widely.

In conclusion, these experiments have used proactive interference to demonstrate that effects of categorical structure in semantic memory for people can be observed. Two levels of effects were identified which were consistent with the distinction between a category and a property put forward by Johnston and Bruce (1990).

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Appendix A

Names used in Experiments 1 and 2

	Actors		Musicians	
UK	Barbara Windsor	Sean Connery	Cliff Richard	David Bowie
	Ross Kemp	Michael Caine	John Lennon	Robbie Williams
	Catherine Zeta Jones	Alec Guinness	Geri Halliwell	Jarvis Cocker
	Hugh Grant	Ewan McGregor	Bob Geldof	Freddie Mercury
	Anthony Hopkins	Kate Winslet	Noel Gallagher	Paul McCartney
US	Burt Lancaster	John Wayne	Whitney Houston	Shania Twain
	Michelle Pfeiffer	Jack Nicholson	Tina Turner	Britney Spears
	Al Pacino	Michael J Fox	Frank Sinatra	Madonna
	Tom Cruise	Marilyn Monroe	Elvis Presley	Kurt Cobain
	Gillian Anderson	Robert de Niro	Diana Ross	Mariah Carey

Appendix B

Names used in Experiment 3

UK	US
David Bowie	Diana Ross
Geri Halliwell	Mariah Carey
Paul McCartney	Whitney Houston
Jarvis Cocker	Elvis Presley
Cliff Richard	Kurt Cobain
Robbie Williams	Tina Turner
John Lennon	Frank Sinatra
Noel Gallagher	Britney Spears
Freddie Mercury	Shania Twain
Boy George	Bruce Springsteen
Darius Danesh	Bob Dylan
Emma Bunton	Lionel Ritchie
Ms Dynamite	Busta Rhymes
Paul Weller	Eminem
Phil Collins	Ja Rule
Richard Ashcroft	Lauryn Hill
Craig David	Mary J. Blige
Gareth Gates	Missy Elliot
Lulu	Sheryl Crow
Will Young	Madonna

Appendix C

Names used in Experiment 4

Sitting		Standing	
Chris Moyles	David Coulthard	Carol Smillie	Michael Jackson
Jeremy Paxman	Melvyn Bragg	Billy Connolly	Madonna
Trevor McDonald	Agatha Christie	Cliff Richard	Tiger Woods
Jonathan Ross	Stephen King	Boris Becker	Paul Gascoigne
Graham Norton	Moira Stuart	Alan Titchmarsh	David Beckham
David Frost	Michael Parkinson	Andre Agassi	Les Dennis
Richard Whiteley	Michael Schumacher	Mick Jagger	Tim Henman
Terry Wogan	Elton John	Jamie Oliver	Eminem
Ayrton Senna	Chris Tarrant	Delia Smith	Geri Halliwell
Simon Mayo	Stirling Moss	Carol Vorderman	Ian Botham

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