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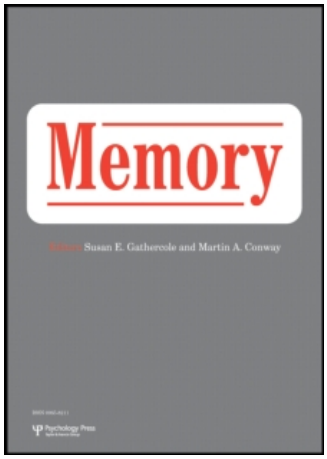

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The effects of local and global processing orientation on eyewitness identification performance

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The effects of local and global processing orientation on eyewitness identification performance

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Recent work has demonstrated that performance on a simultaneous target-present photographic line-up can be enhanced by prior global processing orientation, and hindered by prior local processing orientation induced by processing Navon letter stimuli. A series of studies explore the generality of this processing bias effect using either videotaped scenarios or live interactions. Five experiments demonstrate that these effects are seen across a range of test stimuli, test formats, and test instructions. These data inform the processes engaged in by witnesses when making line-up identifications and indicate that it may be possible to improve the accuracy of witnesses making such judgements.

One of the major contributions of eyewitness research over the past 30 years has been to convincingly demonstrate the error-prone nature of line-up identification evidence. For example, eyewitnesses have been shown to be susceptible to misleading line-up instructions (Malpass & Devine, 1981; Steblay, 1997)—likely to select someone even when the perpetrator is absent from the line-up (Wells, 1993), and particularly likely to pick out an innocent bystander from the line-up (Ross, Ceci, Dunning, & Toglia, 1994). Witnesses have also been shown to be poor at identifying people of another race (Meissner & Brigham, 2001b), or a different age (Wright & Stroud, 2002), and poor at detecting a perpetrator following changes in appearance (e.g., Cutler, Penrod, & Martens, 1987; Read, Vokey, & Hammersley, 1990). A casual reader of such literature might wonder whether psychologists have been engaged on a crusade to undermine the status of identification evidence. Where are the studies attempting to improve eyewitness identification performance? The closest to positive interventions of this nature are those studies that have tried to minimise the errors, investigating improved line-up design (Lindsay & Wells, 1985), appropriate line-up instructions (Malpass & Devine, 1981), and techniques for ensuring the fairness of line-ups (Wells et al., 1998). There appears to be almost no research on improving the identification performance of eyewitnesses. This omission is surprising given the amount of effort devoted to improving verbal recall through the development and testing of the cognitive interview technique (Fisher & Geiselman, 1992; Kohnken, Milne, Memon, & Bull, 1999).

One exception is a recent study by Macrae and Lewis (2002) that succeeded in improving line-up identification accuracy by 23% over baseline by means of a 5-minute cognitive intervention. This remarkable finding, if it generalises to the real word, would potentially offer an enormous advantage to the forensic process. However, since Macrae and Lewis only ran a single target-present simultaneous line-up, further evidence is required before we can consider recommending their

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procedure for use by the police, and more theoretical work is needed before we can safely claim to understand the genesis of the effect.

The context for Macrae and Lewis's (2002) study came from laboratory work on face processing, and the debate over the verbal overshadowing effect. Both these literatures have focused on the distinction between two different modes of processing for faces. One process, common to all visual processing tasks, is featural processing in which the elements of the face are processed independently. The other process, which is thought to be particular to faces or other objects of visual expertise (Diamond & Carey, 1986), is configural processing, in which the processing of each element occurs interactively, such that the recognition of one element is influenced by the configuration of other elements in which it is experienced (Tanaka & Farah, 1993). Numerous laboratory studies have shown that recognition of upright faces involves a configural element that makes face recognition ''special'' (e.g., Diamond & Carey, 1986; McKone, 2004). In these studies, configural processing is demonstrated by showing an effect for upright intact faces that is absent (or much weaker) when processing either an inverted or scrambled face containing the same featural information. For example, Young, Hellawell, and Hay (1987) showed that recognition of half a face is poorer when aligned with an inappropriate other half to make a composite face, compared to presentation of the same two halves misaligned (the composite effect), but this effect occurred only for upright and not inverted faces. Similarly the part–whole effect (better recognition of face parts when embedded within the appropriate whole-face context) occurs only for upright faces (Tanaka & Farah, 1993) and configural changes (shifting the positions of facial features) are much more detectable for upright faces than inverted ones, whereas featural changes (replacing individual features with new ones) are equally detectable whatever the orientation of the face (Leder & Bruce, 1998). The recognition advantage for faces of one's own race over another race is greater for upright than inverted faces (Yin, 1969), which has been attributed to the greater use of configural processing in the recognition of own-race faces.

A number of authors have shown that providing a verbal description of the perpetrator prior to attempting to identify a face from a line-up can impair performance (e.g., Schooler & Engstler-Schooler, 1990; Schooler, Fiore, & Brandiamonte, 1997), an effect known as verbal overshadowing. Schooler and his colleagues (Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Schooler, 2002) have suggested that the verbal overshadowing might be due to a shift towards featural processing following verbalisation. In line with this suggestion, Fallshore and Schooler (1995) showed that the verbal overshadowing effect was observed for faces seen upright at test, but not for those seen inverted at test. They also found that the verbal overshadowing effect was observed only for own-race faces, and was absent for other-race faces, in line with the idea that the own-race advantage is carried through configural processing (Yin, 1969). But if biasing people towards featural processing disrupts face-recognition ability, as Schooler's transfer-inappropriate-processing hypothesis suggests, might it not also be possible to improve face-recognition ability by biasing towards configural processing? This is exactly the question posed by Macrae and Lewis (2002).

In their study, participants saw a videotape of a man robbing a bank (the same video as used by Schooler & Engstler-Schooler, 1990) and then were assigned either to a control group or one of two experimental groups prior to taking the line-up. Those in the experimental groups saw 100 Navon letters (a large letter shape constructed from smaller letters; e.g., an F made from small ds; Navon, 1977) presented individually, and were asked to classify them by the larger letter shape (the holistic processing group) or smaller letter features (the featural processing group). Of the control group, 60% were subsequently able to pick out the perpetrator from an eight-person target-present simultaneous line-up. In comparison, 83% of the holistic processing group succeeded in picking out the perpetrator, but only 30% of the featural processing group did so. Thus featural processing, induced by the experimental task, impaired performance just as imputed for the verbal overshadowing effect. More compelling from a theoretical perspective was the fact that the same Navon stimuli, processed holistically rather than featurally, produced a 23% benefit to line-up performance relative to control instead of a 30% impairment. In their paper, Macrae and Lewis (2002) focused on the theoretical implications of these two effects. However, the applied implications of these effects are no less startling. What these data suggest is that it might be possible to significantly improve the

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accuracy of eyewitnesses by means of a brief intervention prior to a line-up.

There are a number of fundamental questions that need to be addressed before we can claim a full understanding of this effect, and before we can confidently recommend the use of a processing orientation task for use in an applied setting. Perhaps the most basic need is to test the generality of the effect. Macrae and Lewis (2002) used a videotaped crime, and tested recognition of the perpetrator only in a target-present simultaneous line-up. To date, the only replication of Macrae and Lewis (2002) was by Perfect (2003) who used the same study and test materials but manipulated the nature of the Navon task conducted in the retention interval.

These two previously reported studies of the processing orientation effect used a videotaped crime scenario at encoding. While the participants were not told of the any upcoming test at that point, it remains the case that astute participants might have worked out what was likely to follow. Given that they are informed participants in a study, and are being presented with a video clip featuring a single person facing the camera, it might be expected that many participants will work out the purpose of the study. If this is the case, then it is also possible that the participants adopt an encoding strategy that later interacts with the processing orientation task. For instance participants may have chosen to focus on the perpetrator's unusual eyebrows, or the shape of his chin. Thus, what the previous studies might have shown is a bias that influences test performance only following deliberate encoding. Further, given that both Macrae and Lewis (2002) and Perfect (2003) used the same materials, their work may have shown an effect that occurs only for a particular perpetrator under deliberate study conditions.

Furthermore, using deliberate encoding conditions brings the possibility that participants may additionally have engaged in rehearsal strategies during the retention interval. While Perfect's (2003) study attempted to control for the absolute difficulty of the processing orientation tasks by having participants engage in both forms of the Navon task equally, participants were nonetheless aware that they would be tested. Thus, the processing orientation effects in that study, like that of Macrae and Lewis before it, may have emerged because of how participants were attempting to rehearse during the retention interval.

Another shortcoming of the previous work is the absence of a target-absent line-up. In eyewitness identification work it is standard practice to include a condition in which the perpetrator is not included in the line-up, to distinguish between factors that increase accurate responding from those that merely increase choosing (Sporer, 1992). It is conceivable that the processing orientation manipulations used by Macrae and Lewis (2002) and Perfect (2003) simply biased the likelihood that witnesses would choose someone. Just such an account has been proposed to explain the verbal overshadowing effect (Clare & Lewandowsky, 2004). Two experiments in this paper address this question directly.

Consequently the studies reported here use an incidental encoding methodology in which potential witnesses interacted with a stooge, not knowing they were in an experiment at that point and so not preparing for an upcoming memory test. Moreover, because they did not know they would be tested, it also follows that any subsequent effects on face recognition cannot be due to differential rehearsal. Collectively, the present studies test the generality of the effect across different target faces and line-ups, because six different targets were used, each with a different corresponding line-up.

EXPERIMENT 1

The aim of this first experiment was to test the generality of the processing orientation effect using different materials and naturalistic incidental encoding conditions. To date, the only published studies reporting the processing orientation effect used the same video at encoding, and the same photographic line-up. These materials were also used by Schooler and Engstler-Schooler (1990) in the original demonstration of the verbal overshadowing effect. Given that the verbal overshadowing effect has not always been replicated (e.g., see meta-analysis by Meissner & Brigham, 2001a), this suggests that the verbal overshadowing effect may occur only in constrained circumstances, which were serendipitously captured by the materials used by Schooler and Engstler-Schooler. This raises the possibility that the processing orientation effect is likewise sensitive to particular experimental constraints, and that the use of Schooler and Engstler-Schooler's materials has produced conditions that were particularly suitable to finding such an effect.

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Because we wanted to be able to compare our findings with the previous work, our first study replicated the use of target-present line-ups, but used a real-world incidental exposure to a target as the encoding event. In fact, two different targets were used, with corresponding line-ups, to explore the generality of the effect over different materials. The second aim of this study was to investigate whether Navon processing orientation effects are only observed for simultaneous line-ups. Our original intention was to conduct sequential line-ups to contrast with the simultaneous line-ups for the same stooges. However, because of an administrative error, the computer program used in this first experiment did not fully reproduce all the conditions necessary to qualify our methodology as a sequential line-up. Although the line-up members were presented sequentially, the final decision about the identity of the perpetrator was made after all faces had been seen, rather than a decision being made for each individual face as in the sequential line-up proper. Consequently we will refer to our method as a serial line-up, to avoid giving the impression that this was a standard sequential line-up. Nevertheless, the serial presentation methodology used here does provide a test of the processing orientation effects with a different test format. Moreover, the serial presentation of the test stimuli prevents the direct comparison between the faces at test, and so the effects of the processing orientation manipulation remain of theoretical interest.

Our expectations were that we would replicate the previously reported advantages of holistic processing for the simultaneous line-ups, and thereby extend the previous findings. Whether the effect would extend to the serial line-up was less clear-cut, because no previous study has examined the durability of the effect beyond a single trial involving exposure to faces.

Method

Participants. A total of 120 participants[1] were recruited on the university campus to take part in this study. No biographical data were recorded, although it is assumed that the majority were university students or members of staff.

[1] The sample size necessary to give 90% power to detect Macrae and Lewis's (2002) effect size is 66.

Procedure. Individuals were approached by one of two stooges (one 23-year-old male, one 20-year-old female) on the university campus. The stooge asked the individuals for directions to another part of the university campus, under the guise of being a visiting student to the university. Each interaction lasted approximately 30–45 seconds, with the stooge asking for clarification of the directions to prolong the interaction if necessary. Once the directions had been given, the stooge walked off in the direction indicated by the participant.

Once the stooge had disappeared from view, the experimenter approached the person who had given the directions to ask whether they would be willing to take part in a psychological experiment. If the participant agreed, they were taken to a test room in the nearby psychology building. Upon arrival, participants were allocated to one of three experimental conditions. Those in the control condition were given a magazine to read, for a period of 4 minutes. The remaining two conditions were presented with Navon letter stimuli (Navon, 1977) individually on a computer screen at a rate of one every 5 seconds for 4 minutes. The global letter shape covered an area of approximately 150 mm (high) by 130mm (wide), with the smaller letters presented in 12pt font. The method used for inducing processing orientation was the same as reported in Perfect (2003), in that a local–global group were asked to write down the smaller letters for the first 2 minutes, and then swap to reporting the larger letter shapes for the remaining 2 minutes. Those in the global–local group saw the same Navon stimuli, but under instructions to first report the larger shape, then the smaller feature letters. The experimenter gave an auditory mid-list cue to participants to change which attribute of the Navon stimuli they should report.

Once they had completed the experimental manipulations, participants were told that the true purpose of the study was to test their ability to identify the stooge who had asked for directions from an upcoming line-up. Those in the simultaneous line-up condition were then presented with an eight-person target-present simultaneous line-up. Each photograph in the line-up was a head-and-shoulder frontal pose, with the person displaying a neutral expression. The clothing of the targets and all foils in the photographic line-up was different from that worn by the target person during the event. Each photograph was labelled alphabetically and participants made their response by

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indicating which of the photographs they thought corresponded to the target. For all line-ups, the targets were in position 4 (labelled D). Those in the serial line-up saw the same eight faces in a fixed order, one at a time for 5 seconds per face, again with alphabetic labelling. At the end of list participants indicated which of the faces they thought corresponded to the target.

Results

Correct identification rates were collected for two line-up formats, simultaneous and serial, for two different stooges. The use of two different stooges was not theoretically motivated, but rather served to check the generality of any processing orientation effect. Hit rates on the male and female line-ups are shown in Table 1. A logistic regression was carried out to predict hit rate from target gender, line-up format, and condition using deviation coding to enter the categorical predictors.

Overall there was a main effect of target gender, such that the male target was better recognised than the female target, $W(1) = 4.55$, $p < .05$ (odds ratio male/female = 2.65). There was no effect of line up format, $W(1) = 0.87$, *ns*, and no interaction between line-up format and target gender, $W(1) = 1.84$, *ns*. There was a reliable effect of condition $W(2) = 19.72$, $p < .001$ (odds ratios local–global/global–local = 10.51, local–global/control = 8.59, control/global–local = 1.22) which did not interact with target gender $W(2) = 2.37$, *ns*, but did interact with line-up format $W(2) = 7.02$, $p < .05$ (odds ratios for simultaneous line-ups: local–global/global–local 5.74, local–global/control 19.33, global–local/control 3.37; for serial line-ups: local–global/global–local 19.22, local–global/control 3.82, control/global–local 5.03).

Inspection of Table 1 shows that across the two line-up formats performance in the local–global condition was consistent (80% simultaneous, 85% serial) as was performance in global–local (45% simultaneous, 25% serial). However, control rose from 20% in the simultaneous line-up to 60% in the serial line-up. Thus both line-up formats demonstrated the expected effects of processing orientation, and the interaction appears to be due to variation in performance in the control condition, which is not of immediate interest.

Thus the main aim of the experiment, which was to demonstrate the generality of the effect over different faces and test conditions following a real-life encounter, was achieved. With respect to the two processing orientation conditions, the results were similar to those reported previously using video-based materials. Here global processing produced twice the rate of identifications than did local processing. The same was true in the studies by Macrae and Lewis (2002) (83% vs 30%) and Perfect (2003) (80% vs 43%).

The present study used a forced-report procedure (Koriat & Goldsmith, 1996) because participants were required to identify someone in the line-up. While this would constitute a biased line-up instruction in a real case, it does offer the advantage of ruling out an explanation of the effects based on response bias. That is, one potential explanation of the previous findings is that processing orientation alters the willingness of participants to identify someone, and because the line-ups were target present this led to changes in the likelihood of correctly choosing the target. This cannot be the explanation of the present data, since response bias is controlled for in a forced-choice procedure, and yet our data replicated the effects reported previously.

There are a number of shortcomings in the present study that need to be addressed before

TABLE 1
Experiment 1

	Line-up condition				
	Simultaneous		*Serial*		
Group	*Male*	*Female*	*Male*	*Female*	*Overall*
Local then Global	90	70	80	90	83
Global then Local	70	20	40	10	35
Control	30	10	60	60	40

Percentage correct line-up identifications from simultaneous and serial line-ups, for each processing orientation condition in Experiment 1.

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conclusions can be drawn about the likely usefulness of the processing orientation technique in real-world identifications. One important applied issue is the presence or absence of the perpetrator. Experiment 1 followed the procedures of both Macrae and Lewis (2002) and Perfect (2003) in using only target-present line-ups. However, as many researchers have noted, in the real world we do not know whether the line-up contains the perpetrator or just an innocent suspect. If the processing orientation manipulation is having a genuine effect on the ability of witnesses to recognise the target, then it should not only increase hit rates, as in the research conducted to date, but should also reduce false-identification rates in target-absent test conditions. To date, the data do not address the latter point, and so the next two experiments included both target-present and target-absent conditions. Additionally, Experiments 2 and 3 also modified the line-up instructions, so as to move away from a forced choice procedure towards unbiased line-up instructions (Malpass & Devine, 1981), which allow participants to indicate that the perpetrator is not in the line-up.

EXPERIMENTS 2 AND 3

Experiment 1 established that prior processing of Navon stimuli can influence subsequent line-up identification accuracy following a real-world interaction. The two studies that were run subsequently shared the aim of increasing the ecological validity of the testing situation by use of unbiased line-up instructions, which allow the witness to state that the target is not in the line-up, and by inclusion of both target-present and target-absent test conditions. These experiments were designed at the same time, and were run in parallel by two separate experimenters using the same female stooge, and the same photographic line-up members, in target-present and target-absent formats. Experiment 2 employed Navon letters to induce global and local processing orientation, as in previous studies, while Experiment 3 used a face-judgement task to elicit the processing bias.

The use of a face-judgement task to elicit processing orientation was to test whether a processing orientation effect could be elicited by stimuli other than Navon letters. To date, studies exploring the effects of processing orientation on subsequent line-up performance have used Navon letters to induce either the local or global processing orientation. Logically this need not be so, as the theoretical interpretation of the effect is not specific to Navon stimuli; any intervention that induces local or global processing orientations should produce the same effect.

While the principal motivation was to generalise the processing orientation effect to tasks other than the Navon letter task, we were also motivated to use a task that would have ecological appeal. Consequently, we adopted two face-based tasks designed to orient people towards local and global processing in the retention interval. This choice was influenced by both the existing literature on configural and featural processing of faces (Coin & Tiberghien, 1997), and the belief that a face-based orientation task would have more appeal to police involved in identification decisions than a Navon-based intervention. The local task chosen was rating of a single face feature, while the global task was rating the same faces on a personality trait, a manipulation known to affect subsequent recognition when employed at encoding. However, it must be stressed that this manipulation was not used at encoding in the present studies, but as a means of biasing people towards local or global processing in the retention interval, as has previously been achieved with Navon letters.

One potential concern about such an approach is that processing a large number of faces immediately prior to a line-up identification task would produce proactive interference for the female target. In order to counteract any such effect, we only used male faces for the processing orientation task. For purposes of comparison, we retained the control condition used for the Navon-letter-based experiments.

Because in almost all respects the two studies were the same, we report a single method section for both studies, reporting the appropriate differences where necessary.

Method

Participants. Volunteers from the campus of the University of Plymouth were recruited from the outside the university library, and so the majority were university students or members of staff. No biographical data were recorded. No payment was given for participation. Experiment 2 recruited 120 participants, and Experiment 3 recruited 150 participants.

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Procedure. Participants were approached by a 21-year-old female stooge on the campus and asked whether they would be willing to take part in a psychological experiment. On all occasions, the stooge wore a plain black coat, obscuring her other clothing, so that no clothing cues could be used in the subsequent photographic identification task. If they assented, the volunteers were taken by the stooge to a second location, where they were met by one of the experimenters. The stooge then left the scene, leaving the volunteer and experimenter to continue. The exact duration of the interaction between the volunteer and the stooge varied between 20 and 60 seconds, and during this interval the stooge engaged the volunteers in casual conversation as they walked to the test location. Participants were allocated to one of the experiments upon arrival, and thence into one of the experimental conditions (control, local orientation, global orientation).

In the control condition for each experiment participants were asked to generate members of four different semantic categories (Drinks, States of America, Zoo animals, Fruits). Each category was printed individually on a single A4 sheet of paper, and participants were asked to write down as many exemplars as they could within 1 minute. Between each list, responses were collected, and the next category introduced, so that the duration of the entire filler event lasted approximately 5 minutes. These data were not analysed. The experimental conditions in which processing orientation was induced varied across the studies as follows.

In Experiment 2 participants in the local and global processing orientation conditions were shown Navon letters at a rate of one every 5 seconds, with a 1-second interval between each letter, for a 5-minute retention interval. The Navon letters were printed individually on A4 sheets, and the global letter shapes covered an area approximately 80mm wide by 110mm high, with the feature letters made up using font-size 36. Those in the local processing group were instructed to say out loud the smaller letters making up the larger shape. Those in the global processing orientation group saw the same stimuli, but were asked to report the larger letter shape, ignoring the smaller letters. The experimenter wrote down the response given by the participants, but these data were not analysed further.

In Experiment 3 participants in the local and global processing conditions were shown photographs of non-famous male faces at a rate of one every 5 seconds, with a 1-second interval between each face. The photographs (180mm × 150mm) were presented one at a time on single A4 sheets. Those in the local processing orientation condition were asked to rate each face on a 7-point scale as to how distinctive the eyes were for each face, from *1 = very distinctive* to *7 = not at all distinctive*. Those in the global processing orientation condition were shown the same faces, and asked to rate each how honest each face appeared, from *1 = very honest* to *7 = not at all honest*.

Once the experimental manipulation was complete (Navon letter task, or face judgement task), participants were told the true purpose of the study, namely identification of the stooge they had met earlier. They were then asked to give their informed consent to participate in the eyewitness aspect of the study. On assent, participants were given the line-up instructions.

Participants were shown a six-person simultaneous line-up, in either target-present or target-absent format, and told that the stooge might or might not be in the line-up. As in Experiment 1, the line-ups showed head-and-shoulders shots of each line-up member, each displaying a neutral expression, and no clothing matched that worn by the target during the event. Participants responded by ticking a box on a response sheet corresponding to their chosen line-up member, or by ticking the ''Not present'' box. There was no time limit, and the task was self-paced. For the target present line-up the target appeared in position number 4, and for the target-absent line-up this person was replaced with a similar foil.

Results and discussion

Line-up decisions were classified as accurate if the correct person was selected from the target present line-up, or the line-up was rejected in the target-absent condition. All other responses were counted as errors. For each experiment, these accuracy data were analysed using binary logistic regression, with processing orientation condition (global, local, control), target presence (target present vs target absent) and their interaction as categorical predictors of accuracy. The accuracy data for both studies are shown in Table 2.

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TABLE 2
Experiments 2 and 3

	Line-up format				
	Target present		*Target absent*		
Condition	*Expt 2* ($n = 120$)	*Expt 3* ($n = 150$)	*Expt 2* ($n = 120$)	*Expt 3* ($n = 150$)	*Overall*
Global	60	56	45	52	*53*
Local	40	28	25	24	*29*
Control	60	36	40	40	*44*

Percentage correct line-up identifications for target-present (TP) and target-absent (TA) line-ups for each processing orientation condition in Experiments 2 and 3.

Experiment 2. The analysis of the accuracy data failed to replicate the previously observed main effect of condition on line-up accuracy, $W(2) = 3.84$, *ns*, although the performance across the three conditions was in the same rank order as seen in Experiment 1. There was a marginal effect of target presence/absence, $W(1) = 3.42$, $p < .06$, such that accuracy was higher in the target-present line-up, but there was no interaction between the two factors, $W(2) = .05$, *ns*.

Experiment 3.. The analysis of the accuracy data demonstrated a reliable main effect of processing orientation condition, $W(2) = 8.02$, $p < .05$ (odds ratios: global/local 3.35, global/control 1.92, control/local 1.74), in line with the predictions, with global processing leading to higher performance than control, and local processing leading to worse performance than control. The presence/absence of the target had no significant influence on line-up accuracy, $W(1) = .02$, *ns*, and there was no interaction between the two factors, $W(2) = 0.24$, *ns*.

The aim of these two studies was to test the generality of the previously reported processing bias effects in a number of ways. In almost all respects these experiments were successful. We observed processing bias effects with a different stooge than used previously, using unbiased line-up instructions, with target-present and target-absent line-ups, and with a different orienting task to produce the global and local processing orientation.

We will reserve extended discussion of these data until the general discussion, where we review the findings from all the experiments in this series. However, one point is worth stressing at this point: given that we counterbalanced the use of target-present and target-absent line-ups in these two studies, the significance of the main effect of processing orientation in the absence of an interaction with line-up format means that the outcome is not compatible with a response bias account. This is because a response bias account would predict an increased tendency towards a positive (or negative) response across line-up type. This would increase success on one line-up type, but would correspondingly decrease it on the other type, thus negating any overall effect. Thus, the processing orientation effects reported here do not have their effect by increasing the tendency towards one kind of response.

EXPERIMENT 4

Our original intention in Experiment 1 had been to explore whether Navon-induced processing bias influences performance on a sequential line-up. However, because of an administrative error, the sequential line-up was not conducted properly. Consequently in this study we rectified the procedural errors and ran a live-interaction-based study of the impact of processing orientation on a sequential line-up in which participants see the faces one at a time. In this study we followed the standard procedure for the sequential line-ups (Lindsay & Wells, 1985). Participants saw one face at a time, and were required to either identify that face as the perpetrator or reject it. Once they had made a decision it could not been altered, and faces could not be revisited later in the line-up. If the witness identified a face, the line-up terminated at that point. If they rejected a face, the next photograph was presented. Participants did not know how many faces they would see, but if all eight of the faces were rejected the line-up finished, and the participant was informed that he or she had rejected all line-up members.

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To date, the line-up studies of Navon-induced processing bias have used a single trial, in which participants witness all members of a line-up at once and make a judgement. Thus a key question for the present study is whether the previously observed processing bias effects will occur when faces are judged individually. Given that the face-processing literature supporting the distinction between holistic and featural processing has developed largely from tests on which individual faces appear on a trial, there is no a priori reason to believe that the effect will not be present. Indeed, the serial line-up in Experiment 1 showed just such an effect. On the other hand, the eyewitness literature has argued that the processes involved in decision making about sequential and simultaneous line-ups are very different (Lindsay & Wells, 1985; Wells, 1993; Wells et al., 1998), with sequential line-ups argued to involve more absolute judgements of facial identity, while simultaneous line-ups are thought to encourage relative judgements across line-up members. If the previously observed effects of Navon-induced processing bias have their impact on how witnesses make relative judgements, then it is possible that there will be no effect on a sequential line-up.

Another issue that pertains when sequential line-ups are used is the number of identification decisions that a witness has to make. In a standard line-up a single judgement about the entire array of faces is required. However, in a sequential line-up witnesses have to make a series of decisions about each face in turn, the number of which is determined, for successful identifications, by the position of the target in the sequence. In this respect, our serial line-up in Experiment 1 resembled a simultaneous line-up, in that only a single decision was required. To date no studies have explored this issue, but there is related evidence to suggest that the processing bias effect may not survive many face-recognition judgements. Recently Weston and Perfect (2005) explored the effect of Navon-induced processing bias on recognition of composite faces, in a design that required participants to make a series of judgements. They found that Navon-induced processing bias had an effect in the trials that immediately followed the Navon phase, but that the effect wore off after only a few trials. Consequently, in the present study we explore the effects of Navon-induced processing bias for sequential line-ups in which the target face appears either as the first or fourth photograph in the sequence.

Because we intended to manipulate the position of the target face in the sequence, we needed double the number of participants we had used in previous studies. Pragmatic constraints meant that this was not possible, and so we decided to omit the control condition in this study. While this means that we cannot know whether any difference across Navon processing conditions is due to an improvement following global orientation, or an impairment following local orientation, it does enable us to compare the two conditions which are best matched with respect to the retention interval, and thereby determine whether Navon processing influences sequential line-up performance, for each of the two target positions in the sequence.

Method

Participants. A total of 124 volunteers from the campus of the University of Plymouth were recruited as before. No biographical data were recorded.

Method. Participants were approached on campus by a 22-year-old female stooge (a different person from previous studies) asking for directions. The conversation lasted between 30 and 40 seconds before the stooge departed. Once the stooge was out of sight the experimenter approached the witness and obtained their consent to participate in a psychological study. Participants were then allocated to a global-orientation or local-orientation condition, and gave verbal responses to Navon letters presented to them. The Navon letters were printed individually on A4 sheets, and covered an area of 85 mm (high) by 70mm (wide) with the feature letters made up using font-size 36. These were presented manually at a rate of approximately 1 every 2 seconds, for a period of 3 minutes.

Once the Navon processing phase was complete participants were informed of the true purpose of the previous interaction with the stooge, and gave their informed consent to continue with the identification task. At this point, the nature of the sequential line-up was explained to the participants. They then saw a series of photographs of faces individually presented on A4 sheets. Each photograph was 50mm (high) by 67mm (wide) and no clothing cues matched the clothes worn by the stooge during

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the event. Depending on the condition, participants saw a line-up in which the target appeared in the first or fourth position in the sequence. The rate of presentation of the line-up photographs was determined by the participant's response rate.

Results and discussion

The nature of the sequential line-up meant that participants could correctly identify the target face, incorrectly identify a foil, or reject the line-up entirely. Because we only included target-present line-ups, all such line-up rejections are errors. The first analysis examined the influence of Navon processing orientation (global vs local) and target position (1 vs 4) on the frequency of correct identifications. There was a main effect of Navon processing, $W(1) = 8.38$, $p < .01$, odds ratio global/local = 3.04. Overall, 56.5% of participants were accurate following global processing, while only 30.6% of witnesses succeeded in identifying the target following local processing. There was marginal effect of target position, $W(1) = 3.49$, $p < .07$, odds ratio 4th/1st = 2.05, with 35.5% of targets in position 1 identified, against 48.4% of targets in position 4. There was no interaction between the two factors, $W(1) = 0.02$, *ns*. Follow-up tests indicated that the Navon processing bias effect was reliable for position 1, $\chi^2(1) = 4.51$, $p < .05$, and position 4, $\chi^2(1) = 4.13$, $p < .05$.

The next planned analysis was the number of incorrect identifications made by witnesses. Inspection of the data revealed that exactly 5 participants in each combination of conditions (Navon × position) falsely identified a foil. Consequently, because there were no differences between conditions in error rate, there was no evidence for any effects (all Ws = 0). Furthermore, given that there was no variance across conditions for erroneous identifications, it follows that analysis of the miss rates exactly mirrored that seen for correct identifications. We will not labour the point by repeating the statistical analysis reported above, but will simply reiterate that the only reliable effect was that global processing reduced misses relative to local processing.

This study therefore provides evidence that Navon processing reliably influences identification performance in a sequential line-up, in the direction predicted. Although there was no control group, it is worth noting that the performance for the global and local conditions was very close to that seen in the previous two studies, and so it appears that the effect of Navon processing is similar across the two line-up formats. However, without control performance, and use of the same target event, it is not possible to conclusively demonstrate this point.

Another pattern that emerged was that the processing bias effect occurred equally across the two target positions in the sequential line-up. This appears to suggest that Navon-induced processing bias can survive multiple face-recognition decisions: at least up to four trials. While we cannot determine whether or not later positions in the sequence would have shown the effect, the lack of an effect was contrary to our expectations, given that Weston and Perfect (2005) suggested that the effect may be short-lived. Given the many procedural differences between these two studies, and the practical importance of the issue, this is an area that warrants further exploration.

Finally, once again, the data are incompatible with a response-bias account. If the increase in hits following global processing were due to an increased tendency to respond positively, one would expect to see a corresponding increase in the number of false positive errors. This was not the case.

EXPERIMENT 5

In Experiment 5 our intention was to encourage witnesses to take different strategic approaches to the line-up, in particular rapid/automatic or slower/relative judgements (Dunning & Stern, 1994). The rationale for this approach came from Schooler's (2002) transfer-inappropriate processing hypothesis, in which he argued that verbalisation, which is argued to induce featural processing orientation, is associated with greater reliance on slower, controlled processing. This view is consistent with the fact that forcing participants to make rapid decisions overcomes the verbal overshadowing effect (Schooler & Engstler-Schooler, 1990). We were interested in two related questions: Does the speed of line-up judgements impact on any processing bias induced by Navon letters, and if so, does *slowing* a line-up decision negate the benefit of prior global processing?

Participants were given line-up instructions stressing either a rapid response or a careful response, and this was reinforced by means of response deadlines that were fast or slow. Our

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expectation was that a rapid deadline would bias witnesses towards reliance on automatic recognition judgements, while a slow deadline would bias them towards more relative judgements. In the fast line-up condition participants were told that previous research had shown that those who made rapid responses to a line-up were more likely to be accurate, and so they would only have 10 seconds to make a line-up choice. Those in the slow line-up condition were told that previous research had shown that those witnesses who carefully considered their answers were more likely to be accurate, and so they would see the line-up for 30 seconds before being prompted for their answer.

Our interest was whether prior Navon-induced processing orientation led to a processing mode that was more compatible with either automatic or relative line-up judgements. Our expectation was that global processing orientation would lead to a processing mode that was compatible with a rapid line-up decision, and so performance would be enhanced. In contrast, global processing orientation would not be compatible with a slow line-up decision, and so we expected less benefit from the Navon orientation.

Like Experiment 4, this experiment required an experimental manipulation of line-up duration in addition to the different processing orientation conditions. This meant that we ran into the same practical problem of numbers of participants required that had applied previously. However on this occasion we decided to take a different tack from that used previously, and omitted the local processing condition rather than the control condition. Although this is not ideal for the purpose of comparison with the previous studies, it does have the advantage of focusing on the potential benefit of the global Navon condition relative to control, which is the question of most applied interest.

Method

Participants. A total of 72 undergraduate volunteers from the University of Plymouth participated either voluntarily or for partial course credit. No biographical details were recorded.

Procedure. This study used the same live-interaction methodology used previously but with a different female stooge (aged 21 years) and line-up. Following exposure to a stooge, and recruitment by the experimenter, participants were randomly allocated to a Global Navon condition for 5 minutes, or generated category exemplars for the same period of time. Participants in the Global Navon condition saw 50 Navon stimuli printed individually on sheets of A4, within an area of 40mm (wide) $\times$ 50mm (high), at a rate of approximately one every 5 seconds, and made their response verbally. Participants were then further allocated to either a slow-line-up condition or a fast-line-up condition.

Participants in the slow-line-up condition were told that previous research had indicated that the longer witnesses took looking at a line-up, the more likely it was they would make an accurate judgement. They were then asked to look at the line-up for 30 seconds before being asked for their response. Participants in the fast-line-up condition were told that previous research had indicated that witnesses who make automatic, fast judgements tend to be more accurate than those taking a long time. They were then told that they would have to make their line-up response within 10 seconds.

Both groups then saw a six-person target-present line-up, with the target in position 5. As in previous studies, the photographs showed frontal head-and-shoulders shots with individuals displaying a neutral expression, and no clothing matched that worn by the target during the event. Participants were given unbiased instructions, and gave their response verbally after either 10 s or 30 s.

Results and discussion

Performance on the line-up was subjected to a binary logistic regression as before, with factors of condition (Navon vs Control) and line-up instruction (Fast vs Slow) and their interaction as predictors of accuracy. There was a reliable effect of condition, $W(1) = 10.37$, $p < .001$, odds ratio global/control 9.23 but no effect of line-up instruction, $W(1) = 0.79$, *ns*, and no interaction, $W(1) = 0.79$, *ns.* Both fast and slow control groups were accurate on 50% of occasions, and this contrasted with 94% correct for the fast line-up following global Navon, and 83% for the slow line-up following global Navon.

Thus, once again the data indicate a positive impact of global Navon processing orientation, this time in relation only to control performance. Contrary to our expectations, effect was not influenced by the timing of the line-up choice. Because the lack of an interaction between

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processing orientation and line-up instruction constitutes a null effect, it is hard to make strong claims about this. This study does demonstrate that Navon-induced processing orientation can influence both rapid and slow line-up choices: however, what is less certain is whether the same would remain true for line-up choices that are made spontaneously. One possibility is that our manipulation of response time did not alter the spontaneous strategy used by participants. Those in the slow condition may have made a rapid decision, and simply delayed their response. Nevertheless, this final experiment does succeed in again demonstrating a positive effect of Navon-induced processing bias for a live interaction, with a different set of materials than used previously.

GENERAL DISCUSSION

At the outset of these studies, only two published studies had reported the biasing effects of Navon stimuli on subsequent line-up performance and both had used identical test materials. This series of studies has demonstrated that the effects can be observed across a wide range of settings. We have shown the same biasing effects of Navon processing with different target faces (and different associated foils), in target-present and target-absent line-ups, with biased and unbiased instructions, in simultaneous and sequential line-ups, and with instructions to respond rapidly or slowly. All these studies have used an incidental study methodology that prevents the use of deliberate encoding strategies or rehearsal-based explanations of the effect.

Collectively the studies reported here, together with those previously reported, demonstrate that these effects not only generalise across conditions but are also sizeable enough to warrant applied interest. Table 3 summarises the data from the five studies here, together with the two previously published studies by Macrae and Lewis (2002) and Perfect (2003). Across a total sample size of 766, there is a weighted average advantage of 19.8% for global processing orientation compared to control, and an impairment of 16.5% following a local processing orientation task. Put another way, for the two groups who were subject to the same visual filler task (global and local Navon letter orientation), local processing leads to an average of around 33% correct, while global processing leads to around 69% correct, more than doubling the hit rate.

Thus, across the studies reported here, it is hard to escape the conclusion that processing orientation effects can have substantive impacts on the ability of witnesses to make accurate line-up decisions for a person that they have recently encountered. The 20% increase in performance following global orientation is in line with the 23% improvement reported by Macrae and Lewis (2002). It might be argued that these data therefore offer little in the way of new findings. But this is to misunderstand what these data have shown. Because these data were collected following incidental exposure to real people, they show that the processing orientation benefit is not limited to the particular target individual or test conditions used formerly, is not due to deliberate encoding strategies, and is not due to differential rehearsal. We have also shown that the effect does not occur only in target-present simultaneous line-ups, and is not restricted to the use of Navon stimuli to elicit the effect. In conditions that are considerably closer to the real world than the laboratory-based testing used in the previously published studies, these studies have still shown 20% improvement in line-up performance. What is perhaps even more remarkable is that such increases in performance follow a simple intervention lasting no more than 5 minutes; no special training is required and no expensive equipment necessary. On value for money grounds alone, the application of the processing orientation technique to real-world cases deserves close attention.

Inspection of Table 3 reveals the consistency of the pattern with respect to global and local processing orientation. However, it also reveals the inconsistency of performance with respect to control performance, which ranged from 70% (Perfect, 2003), when it was close to performance following the global orientation condition, to 36% (Experiment 3) where it was closer to performance following local orientation. Given the wide variability in methodologies across studies, it is hard to know what to make of this variability. One obvious explanation is that the identification tasks were differentially difficult for whatever reason, be it the initial encoding, the line-up, or the distinctiveness of the interaction with the stooge. However, another possibility that warrants consideration is the filler task employed. Our choice of filler tasks was not as controlled as it might have been. Initially, we replicated the reading task used by Macrae and Lewis (2002). However, in later studies in which we tested in

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TABLE 3
Results in all studies reported to date

	Orientation condition					
	Global		*Control*		*Local*	
Study	*N*	*% correct*	*N*	*% correct*	*N*	*% correct*
Macrae & Lewis (2002)	30	83	30	60	30	30
Perfect (2003)	30	80	30	70	30	43
Experiment 1 [a]	40	83	40	40	40	35
Experiment 2 [b]	40	53	40	50	40	33
Experiment 3 [b]	50	56	50	36	50	28
Experiment 4 [c]	62	57	–	–	62	31
Experiment 5 [d]	36	88	36	50	–	–
Weighted mean accuracy	68.9		49.1		32.6	
Sample size	288		226		252	

Number of participants and percentage correct on a line-up identification task following each processing orientation condition in all studies reported to date using local and global orienting tasks prior to the line-up.

For each experiment cells report overall means, collapsed across experimental factors:

(a) Averaged across stooge, and line-up format.

(b) Averaged across target presence/absence.

(c) Averaged across target position in the line-up.

(d) Averaged across fast/slow conditions.

the field, we wanted a task in which it was easy to engage passers-by, and so we adopted a category generation task. It is possible that these tasks lead to a more featural or global processing style, with consequential impact on line-up performance. It is even possible that variation within tasks—such as reading different kinds of text—have differential effect. However, until there is an independent measure of processing orientation it will be hard to establish this.

The effect observed for the face-processing task in Experiment 3 provides evidence that a processing orientation effect can be induced with a task other than categorising Navon stimuli. Processing faces in a global manner, by means of an honesty-rating task, induced higher levels of subsequent performance than rating the distinctiveness of the eyes. Thus, in this respect, there is nothing special about the status of Navon stimuli in producing the effect, and so any explanation of the origin of the effect must be able to account for what is shared by the tasks that produce such processing bias effects.

One explanation that cannot account for the effects observed in the present set of experiments is a response bias account. We think this for four reasons. First, there is no a priori reason to believe that orienting to the global shape of a letter will influence people's willingness to respond on a face-identification task, since the two tasks are logically unrelated (which is not the case when identifying a face one has attempted to describe). Second, we found positive effects of global orientation on a forced-choice line-up, where the response bias was fixed. Third, we found positive effects of global orientation on target-absent line-ups, where the correct response was to reject all options. Fourth, there is already a published study in which local rather than global orientation improves subsequent face-identification performance. Weston and Perfect (2005) used local and global Navon orientation prior to speeded decisions about composite faces (Young et al., 1987). Given the whole face leads to misleading configural processing, it was predicted that local orientation rather than global orientation would improve performance, and this is what was found with a response latency measure. Thus, local orientation does not always lead to worse performance, and global orientation does not always improve performance.

Although we do not believe our data are compatible with a response-bias account, we are not certain that they necessarily imply a simple configural–featural distinction either. Global and local orientations to Navon stimuli have a number of properties that may underpin the observed effects. Perhaps the most obvious is that the information needed to solve the global orientation tasks requires attention to be spread over a broader area than that required by the local orientation task. It may be that it is distributing

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attention in this manner, rather than detecting a configuration, that is beneficial to subsequent face identification. We call this the attention distribution hypothesis. Some preliminary data from our own laboratory are consistent with this idea. Orienting participants to size-matched large features (of even larger global configurations) and small global configurations (made up of even smaller features) had the same effect on subsequent line-up performance (Perfect, 2005). Thus size may be a crucial mediating factor. However, we are also aware of recent data that are incompatible with this idea, in that processing-orientation effects on face recognition have been demonstrated with orientation tasks that do not involve a spatial component at all, such as crossword solutions (Lewis, 2006), or thinking of the near or distant future (Hunt & Carroll, in press). We have also recently found that spacing out the features of Navon letters, so that they no longer have local precedence, can reverse the effects reported here. That is, global orientation to spaced Navon letters impairs subsequent line-up performance, while local orientation improves it (Perfect, Weston, Dennis, & Snell, 2007). Thus, in this particular study, distribution of attention over a broader area impairs face recognition, contrary to the attention distribution hypothesis.

A related but conceptually distinct account is that local orientation requires participants to distinguish the small details that discriminate letters in small print, and hence requires focus on information carried at high spatial frequencies. Conversely, judging the global configural shape requires participants to focus on information carried at lower spatial frequencies. Thus it is possible that it is the spatial frequency of information being attended to that is crucial, rather than the configural nature of the information per se. Given that prior research has shown the importance of information carried at different spatial frequencies for face recognition (Boutet, Collin, & Faubert, 2003), and that it is known that attention to Navon stimuli can alter the sensitivity to gratings of different spatial frequencies (Robertson, Egly, Lamb, & Kerth, 1993), this spatial frequency hypothesis may be worthy of closer attention. However, this account also struggles to explain data from non-spatial processing orientation tasks such as crossword solutions (Lewis, 2006), temporal construal (Hunt & Carroll, 2007), or spaced Navon stimuli (Perfect et al., 2007).

Given these new findings, we believe that the current findings need to be set in a theoretical context that is broader than the global/local (or holistic/featural) distinction that has been discussed hitherto. We believe that the apparent similarity between the importance of configural information in face recognition, and the configuration of features in Navon letters, has been a red herring. What may be more important is the general thinking style invoked by the intervening task, along the dimension of controlled versus automatic processing, as argued by Schooler (2002). While the current findings are compatible with this general form of Schooler's (2002) transfer-inappropriate processing hypothesis, it remains uncertain as to exactly what is transferred, and how this subsequently impacts on face processing. However, extended theoretical discussion of this point is beyond the scope of the present paper, since we do not have the data to adjudicate between competing theoretical accounts.

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