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Navon processing and verbalisation: A holistic/featural distinction

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Three experiments compared face recognition performance following global and local Navon processing and verbalisation, and explored the extent to which the effects of these tasks were influenced by encoding processes. Experiment 1 used the Navon letter task at encoding, whereas Experiments 2 and 3 used personality and physical feature judgements to induce holistic and featural encoding. Accuracy and response latencies were measured for stimuli of own- and other-race faces. Results showed that both the Navon and verbal overshadowing effects were not influenced by the Navon encoding task; however, the judgement task used in Experiments 2 and 3 eliminated all impairment caused by local processing but not by providing a verbal description. These results are discussed with regards to the holistic and featural explanations of Navon processing and verbalisation effects.

There is agreement amongst researchers that optimal face recognition is achieved through holistic processing where the information about specific features (featural information) is combined with information about the spatial relationships between features (configural information) (Bartlett & Searcy, 1993; Tanaka & Farah, 1993; Thompson, 1980; Yin, 1969). This claim has been supported by research using a variety of different tasks, for example, the recognition of facial composites (Young, Hellawell, & Hay, 1987), comparing the recognition of whole faces and face parts (Tanaka &

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Farah, 1993) and the recognition of inverted faces (Bartlett & Searcy, 1993; Thompson, 1980; Yin, 1969).

Research has shown that any task or process that disrupts or reduces the amount of holistic information used in face recognition substantially reduces recognition accuracy. The transfer appropriate processing theory provides one explanation of why this occurs. Transfer appropriate processing theory (TAP; Morris, Brandsford, & Franks, 1977; Roediger, 1990) claims that optimal memory performance is achieved when encoding processes match retrieval processes. With regard to face recognition, this theory suggests that optimal face recognition is achieved when holistic processing is used at both encoding and retrieval stages. Any task that disrupts the use of holistic information, at either stage, reduces face recognition accuracy.

THE ROLE OF ENCODING STRATEGIES

The TAP theory of memory highlights the importance of encoding and retrieval strategies for optimal performance. Therefore, it is surprising that only a few studies have investigated the influence of different encoding strategies on face recognition performance (Coin & Tiberghien, 1997; Hanley, Pearson, & Howard, 1990; Wells & Hryciw, 1984). Despite the small number of studies conducted, the results support the claim that performance is optimal when encoding processes match retrieval processes. For example, Wells and Hryciw (1984) induced holistic and featural encoding strategies by asking participants to make judgements about faces based on either abstract traits (holistic) or physical features (featural). The retrieval tasks were either to identify someone from a lineup or to create a photofit. They found that lineup identification was more accurate following trait judgements, whereas photofit creations were more accurate following judgements about physical features. They concluded that accurate lineup identifications were based on holistic retrieval strategies and thus benefited from holistic encoding. Furthermore, optimal photofit creations were based on a more featural strategy and thus benefited from featural encoding processes. In line with TAP these results highlight the importance of similar encoding and retrieval strategies for optimal performance.

THE CROSS-RACE EFFECT

Holistic face processing requires access to, and the use of, both featural and configural information. The contribution of both featural and configural information has been demonstrated using a number of techniques. One notable advance in the face memory literature has involved work on the face inversion effect; the finding that inverted faces are identified with less accuracy than upright faces (Bartlett & Searcy, 1993; Thompson, 1980; Yin, 1969). The consensus within the literature points towards a reduction in the access to configural information when faces are inverted. Diamond and Carey (1986) hypothesised that this effect was the result of a lack of expertise with the inverted stimulus. This, they claimed, stemmed from experienced participants' reliance on configural information, which was not present in novice participants. Research investigating the role of expertise in face recognition has concluded that expert processing relies on access to configural information (e.g., Diamond & Carey, 1986; Rhodes, Brake, Taylor, & Tan, 1989).

A line of research linking reliance on configural information to that of expertise comes from research comparing own-race and other-race face recognition. Studies examining cross-race identifications have shown that individuals are better at recognising faces of their own race than faces of another race (Brigham & Malpass, 1985; Ellis & Deregowski, 1981; Rhodes et al., 1989). One common explanation for this advantage is that individuals have more expertise with own-race face recognition (Ellis, Deregowski, & Shepherd, 1975; Rhodes et al., 1989), and thus greater access to configural properties. Rhodes et al. (1989) explored the lack of configural information used in other-race face recognition using inversion techniques. They found that reduced performance following inversion of own-race faces was not present with other-race faces and concluded that their results provide evidence for the importance of configural information in expert face recognition. This lack of configural information in identifying other-race faces points towards a greater reliance on featural properties.

THE VERBAL OVERSHADOWING EFFECT

Tasks such as the recognition of inverted faces and recognition of other-race faces have demonstrated that a lack of configural information reduces face recognition accuracy. In addition to these face recognition tasks, it has been shown that other tasks such as providing a verbal description of a face can also reduce the amount of configural information used in the recognition process.

Research has shown that under some circumstances providing a verbal description of a face prior to a face recognition task significantly reduces face recognition accuracy (Brown & Lloyd-Jones, 2002, 2003; Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Schooler & Engstler-Schooler, 1990). This effect, known as verbal overshadowing, has a number of possible explanations with the most recent rendering it as a change in processing style (Fallshore & Schooler, 1995; Schooler, 2002). This suggests that the act of verbalisation causes the transfer of inappropriate processing (TIP) to the final test. The TIP account claims that faces are encoded using a holistic strategy and that providing a verbal description changes the processing style from holistic, used at encoding, to a more featural-based strategy brought on by the verbal description process. Therefore, when presented with a recognition task, the featural processing strategy used to provide the verbal description is transferred to the retrieval process, reducing face recognition accuracy.

This processing account of verbal overshadowing has been supported in the literature by a number of studies. For example, research has shown that verbally describing a face that is not the target stimulus also reduces face recognition accuracy (Brown & Lloyd-Jones, 2002; Dodson et al., 1997), and even describing a car can have a negative impact on face recognition accuracy (Westerman & Larsen, 1997). This finding provides support for a generalised processing shift and cannot be explained by interference from the verbalised account (Schooler & Engstler-Schooler, 1990). The verbal overshadowing effect has been tested using multiple trials, with mixed results (e.g., Brown & Lloyd-Jones, 2002, 2003; Fallshore & Schooler, 1995; Lloyd-Jones, Brown, & Clarke, 2006; Melcher & Schooler, 1996; Ryan & Schooler, 1998). A small number of studies demonstrated a detrimental effect of verbal description over a series of trials (Brown & Lloyd-Jones, 2002, 2003; Lloyd-Jones et al., 2006) with the remainder only finding a verbal overshadowing effect for the first trial following a verbal description (Fallshore & Schooler, 1995; Melcher & Schooler, 1996; Ryan & Schooler, 1998). Furthermore, other studies have used different stimuli to highlight the generality of the effect of verbalisation. For example, negative effects of verbalisation have also been demonstrated using colours (Schooler & Engstler-Schooler, 1990), taste (Melcher & Schooler, 1996), voices (Perfect, Hunt, & Harris, 2002), and shapes (Brandimonte, Schooler, & Gabbino, 1997).

PROCESSING BIAS THEORY

The processing bias account of the verbal overshadowing effect states that providing a verbal description reduces the amount of configural information attended to at retrieval, which is the result of a shift in processing style from holistic to a more feature-based style. A study conducted by Macrae and Lewis (2002) attempted to investigate the processing style account of verbal overshadowing, using the global and local responses to the Navon letter task (Navon, 1977) to induce holistic and featural processing styles. Their study used a lineup task as a test of recognition and they asked participants to either engage in global processing of Navon stimuli, local processing of Navon stimuli, or a control task prior to the recognition test. They found that engaging in global processing significantly improved recognition accuracy (83%) compared with control (60%) and local processing significantly decreased accuracy (30%). The aim of their experiment was to investigate whether engaging in local processing would impair recognition accuracy the same as providing a verbal description. They concluded that local processing, like verbalisation, caused a transfer inappropriate processing shift to a more featural based strategy and thus reduced performance. Furthermore, they claimed that the global Navon task encouraged a more appropriate holistic strategy which led to better performance. Although a possible explanation for the results, this claim that the effects of verbalisation and local Navon processing are caused by the same processing deficit is, as yet, unsupported. A number of studies have found evidence for the effects of Navon processing on face recognition performance (Perfect, 2003; Weston & Perfect, 2005); however, to date these effects have not been directly compared to the effects of verbalisation.

THE LINK BETWEEN VERBALISATION AND PROCESSING BIAS

There are some consistencies in the literature between the effects of verbalisation and local Navon processing. For example, research has shown that the effects of verbalisation are limited to a short number of recognition judgements following the verbalisation process (Fallshore & Schooler, 1995). In line with these results, similar findings of a trial effect have been demonstrated using the Navon processing task (Weston & Perfect, 2005). However, despite these similarities, no study to date has investigated the similarities between the effects of verbalisation and Navon processing. The present studies aim to bridge this gap.

The present work aimed to bring together the findings of Macrae and Lewis (2002) and Fallshore and Schooler (1995) by investigating the effects of Navon processing and verbalisation across multiple trials. In order to compare the processing styles used in both the Navon letter task and verbalisation, face recognition performance was tested following both holistic and featural encoding strategies and for own- and other-race faces. All experiments presented in this paper used a four-stage procedure. In Stage 1, participants engaged in either the holistic or featural encoding task. In Experiment 1 holistic and featural encoding was encouraged with the Navon letter task whereas in Experiments 2 and 3 participants were asked to focus on either personality traits or facial features. In Stage 2, participants were asked to remember eight images of faces presented on the screen (Caucasian or Asian). Multiple images were presented at encoding because a multiple encoding paradigm has been used in previous research to demonstrate the effects of Navon processing (e.g., Weston & Perfect, 2005). Stage 3 was a between-subjects interval task where they completed either the global or local version of the Navon letter task, provided a verbal description or read aloud from a book. In Stage 4 they were presented with two face images at a time and asked to decide which face had been presented before (Caucasian or Asian). Given that only two alternatives were presented at retrieval in this paradigm there is a possibility that the strategies used at test when presented with only two alternatives differ to the strategies used when presented with an array of 6–8 faces. Although a two-alternative paradigm differs from previous paradigms used to investigate the verbal overshadowing effect, a two-alternative paradigm has reliably demonstrated effects of Navon processing (e.g., Weston & Perfect, 2005). The four stages were repeated four times to make four blocks so that each participant completed all combinations of the encoding and race factors. A number of predictions follow from the literature.

Predictions

Encoding processes. The TAP account states that optimal face recognition accuracy is achieved through the use of holistic processing at encoding and retrieval. Therefore, based on the assumption that global Navon processing induces a holistic strategy, three predictions regarding the encoding manipulation were made. First, holistic encoding would lead to better face recognition accuracy compared with faces encoded featurally. Predictions were also made regarding the interaction between the encoding task and interval task effects. Following holistically encoded stimuli, it was predicted that both the local Navon processing and verbalisation conditions would produce performance below that of the control condition. Furthermore, it was predicted that the global Navon interval task would produce performance rates equal to controls, given that stimuli had been encoded using a holistic strategy. Following featurally encoded stimuli, it was predicted that both the local Navon processing and verbalisation conditions would produce performance equal to that of the control condition. Furthermore, it was predicted that the global Navon interval task would improve performance compared to control.

Cross-race effects. In order to investigate the link between global and local Navon processing and holistic and featural processing styles both own- and other-race faces were used as stimuli. Research has shown that own- and other-race faces are processed differently using holistic and featural strategies, respectively. Given this distinction the following predictions were made. First, own-race faces would be recognised more accurately than other-race faces, thus confirming the race effect found in the literature. Second, the recognition of own-race faces would benefit from holistic encoding strategies whereas the recognition of other-race faces would benefit from more featural encoding strategies.

Furthermore, research which has investigated the effect of verbalisation on own- and other-race faces has provided support for the claim that verbalisation results in a processing shift (Fallshore & Schooler, 1995). They found that reliance on featural information in other-race faces reduced the impact of verbalisation compared with own-race faces. Therefore, based on this finding this experiment makes the final prediction that the processing shifts due to Navon processing and deficits following verbalisation would only be evident for own-race and not other-race faces.

EXPERIMENT 1

The aim of Experiment 1 was to compare the effects of verbalisation and Navon processing for both own-race and other-race faces following both holistic and featural encoding. Results found by Macrae and Lewis (2002) suggest that the impact of global and local versions of the Navon processing task was the result of encouraging holistic and featural processing styles. Based on this claim we decided to use the Navon letter task to encourage the use of holistic and featural processing at the encoding stage.

Method

Participants. Eighty participants (from the University of British Columbia, Vancouver and the University of Plymouth, UK took part in this experiment for course credit. Fourteen were male and sixty-six were female (age range 17–45 years). Half of the participants were of Asian origin and half were of Caucasian origin.

Stimuli and design. The experiment used a 2 (encoding: global, local) × 2 (race of stimuli: own race, other race) × 4 (interval task condition: control, global, local, verbal) mixed-design with two within-subjects factors, encoding strategy and race of stimuli, and one between-subjects factor, interval task condition. The task used a repeated measures design with multiple stimuli where participants were asked to make a series of judgements based on faces previously encountered.

The face stimuli were digital colour photographs taken of female students from the University of British Columbia. Both full-face and three-quarter pose images were used. All images were of the head only and the background of each image was neutral. The stimulus set comprised of 64 images, 32 three-quarter pose images used at the encoding stage and 32 full-face images used at the test stage. Half of the people in the images were Asian and half were Caucasian.

A multiple trial design was used in this experiment where face recognition accuracy was tested over four blocks. Each block contained an encoding manipulation (global or local), eight faces for encoding (own race or other race), an interval task which was either global or local Navon processing, a control task or verbal description task, and four two-alternative forced choice test trials. In each block, and for each participant, one combination of encoding and race of stimuli was tested, for example global encoding with own-race faces, global encoding with other-race faces, local encoding with own-race faces and local encoding with other-race faces. The order of the encoding/race of stimuli combination was counterbalanced across participants.

The experiment was programmed in E-Prime and run on a PC. The face stimuli at encoding and test were presented in a surface area of 5 cm wide × 7 cm high. The experiment took 45 min to complete.

Procedure. All participants were briefed as to the nature of the experiment and asked to provide their informed consent. Participants were told that there were four stages to the experiment. In Stage 1, they were asked to complete a version of the Navon letter task. In Stage 2, they were asked to remember eight images of faces presented on the screen. Stage 3 was the between subjects interval task where they completed either the global or local version of the Navon letter task, provided a verbal description or read aloud from a book. In Stage 4 they were presented with two face images and asked to decide which face had been presented before. These four stages were repeated four times to make four blocks so that each participant completed all combinations of the encoding and race factors.

During Stage 1 all participants were asked to complete either the global or local version of the Navon letter task (Navon, 1977), for 3 min. For both global and local processing, participants were presented with 90 Navon letters each for 2 s. During the 2 s that the letter was on the screen participants were asked to say aloud either the large letter (global processing) or the small letter (local processing). Following this they were shown eight three-quarter pose faces presented simultaneously on the screen for 12 s and asked to remember these faces. These faces were either eight Caucasian faces or eight Asian faces.

Before the experiment began participants were randomly assigned to one of four interval task conditions; in Stage 3 they engaged in one of these four tasks. Participants in the global processing condition engaged in the global version of the Navon letter task. Participants in the local condition engaged in the local version of the Navon letter task. Participants in the verbal description condition were shown another face (not one of the eight presented at encoding) and asked to provide a verbal description of this face. To encourage a more featural analysis of the face participants were asked to write down everything they could about the shape, size, and the appearance of different features such as the eyes, nose, mouth, etc., for the full 3 min. Participants in the control condition were asked to read aloud from a book. All participants engaged in one of these tasks for 3 min.

In Stage 4 participants were presented with four two-alternative forced choice test trials. Each trial presented two faces simultaneously. Both were full-face images where one face had been presented at encoding and the other a new face. The "new" image presented on each trial was determined by the degree of similarity to the old image. This similarity was determined by asking a sample of 20 independent reviewers to choose which image, out of a collection of 10 possible images was most similar to a target image. The image which was selected most often was deemed most similar to the target was selected as a pairing at test. A high degree of similarity between old and new images at test was important to avoid ceiling effects in the data. In Stage 4 the participants' task was to indicate using the keys "c" and "m" on the keyboard which face they had seen before. On two trials the old face appeared on the left and on two trials the old face appeared on the right; the presentation order was randomised.

These four stages were repeated four times to create four blocks. Four blocks were used to ensure a completely counterbalanced design with different stimuli in each block. All participants completed all four blocks. The four blocks consisted of: global processing at encoding and own-race faces, global processing at encoding and other-race faces, local processing at encoding and own-race faces, and local processing at encoding and other-race faces.

Results and discussion

Both accuracy and latency data were used in the analysis as both have been used in previous research to demonstrate the effects of verbalisation and Navon processing (e.g., Brown & Lloyd-Jones, 2002, 2003; Macrae & Lewis, 2002; Schooler & Engstler-Schooler, 1990; Weston & Perfect, 2005). Although both measures are reported here, for the purpose of this paper, the accuracy measure was used as the main dependent variable. This measure was chosen for two reasons: (1) The majority of research in this area uses accuracy as a measure of performance; and (2) given the nature of the paradigm, the below ceiling accuracy rates reduced the reliability of the latencies as the most accurate measure of performance.

Results based on the multiple trial analysis revealed that the effects were strongest in the first trial following the interval task manipulation. A mean comparison of all trials did not show any differences in performance between interval task conditions (global, $M = 0.71$; control, $M = 0.71$; local,

$M = 0.68$; verbal, $M = 0.66$). However, means from the first trial only revealed a different pattern (global, $M = 0.80$; control, $M = 0.73$; local, $M = 0.60$; verbal, $M = 0.61$). Based on this finding and results of previous studies (Fallshore & Schooler, 1995; Melcher & Schooler, 1996; Ryan & Schooler, 1998; Weston & Perfect, 2005), showing that the effects of verbalisation and Navon processing were limited to a short number of trials, we report the results from the first trial only.

Two separate analyses were carried out. The first was to investigate how effective the Navon encoding task was in encouraging holistic and featural processing styles. To test this we compared the effects of both encoding tasks on the ability to recognise own- and other-race faces, in the control condition only. Only the control condition was used in this analysis because it was predicted that the Navon and verbalisation manipulations would interfere with processing at test. Given that own- and other-race stimuli have been shown to use holistic and featural processes respectively, this enabled us to measure the effectiveness of the holistic and featural encoding tasks. Second, we examined the influence of the interval tasks on recognition performance.

Cross-race effects in the control condition

A 2 (encoding: global, local) × 2 (race of stimuli: own, other) factor ANOVA, carried out on the accuracy scores in the control condition, did not find any significant main effects of race, $F < 1$, or encoding, $F < 1$, nor a significant interaction between race of face and encoding, $F < 1$.

A 2 (encoding: global, local) × 2 (race of stimuli: own, other) factor ANOVA, carried out on the latency scores in the control condition did not find any significant main effects of race, $F < 1$, or encoding, $F(1, 19) = 2.17$, $MSE = 3{,}254{,}227$, nor a significant interaction between race of face and encoding, $F < 1$.

Interval task effects

A 2 (encoding: global, local) × 2 (race of stimuli: own, other) × 4 (interval task: control, global, local, verbal) factor ANOVA carried out on the accuracy scores found a significant main effect of interval task, $F(3, 76) = 3.53$, $MSE = 0.728$, $p < .05$ (control, $M = 0.73$; global processing, $M = 0.80$; local processing, $M = 0.60$; verbalisation, $M = 0.61$). Bonferroni pairwise comparisons revealed that accuracy scores following local processing, $p = .04$, and verbalisation, $p = .06$, were significantly lower than accuracy following global processing. No significant differences were found between the Navon or verbalisation condition compared with control. The main effects of race, $F < 1$, and encoding, $F < 1$, did not reach significance. The interactions between interval task and encoding, $F(3, 76) = 1.02$, $MSE = 0.253$, $p > .10$, race and interval task, $F(3, 76) = 1.57$, $MSE = 0.303$, $p > .10$, race and encoding, $F(1, 76) = 1.24$, $MSE = 0.253$, $p > .10$, and race, encoding, and interval task, $F < 1$, did not reach significance.

Although the interaction between race, encoding, and interval task did not reach significance, the pattern of means were in the direction predicted. Figure 1 shows the mean accuracy scores for each condition following global and local encoding for both own- (Figure 1a) and other-race (Figure 1b) faces. Figure 1a shows an advantage of global processing across both encoding manipulations. Moreover, the graph shows a differential effect of verbalisation and local Navon processing following global and local encoding. For globally encoded faces both verbalisation and local processing

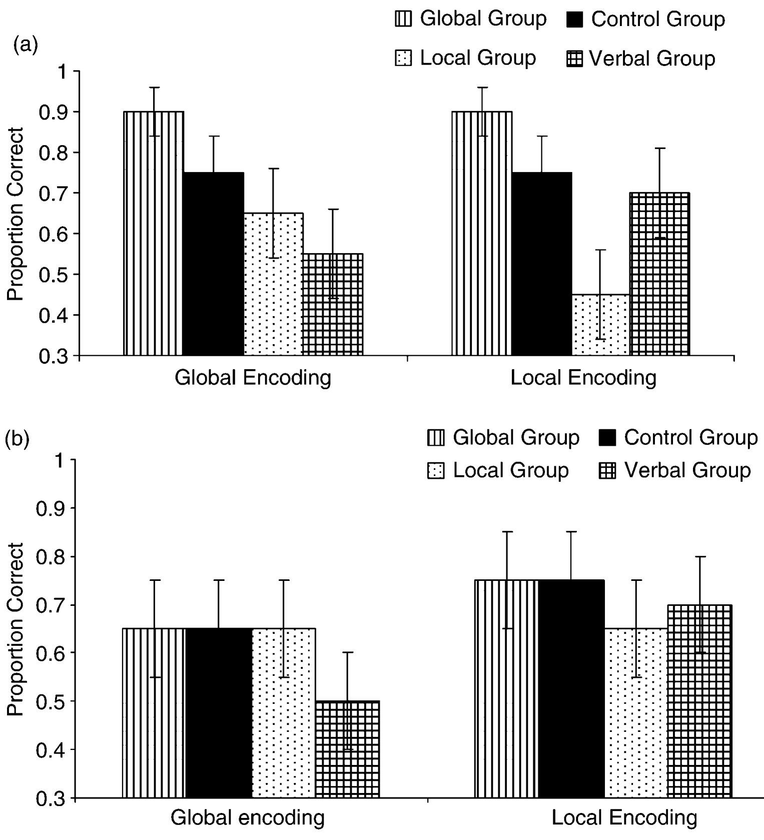

Figure 1. Mean accuracy scores and standard errors for (a) own-race faces and (b) other-race faces, across all conditions following holistic and featural encoding in Experiment 1.

reduced accuracy; however, for locally encoded faces accuracy was reduced far more following local Navon processing compared with verbalisation. Furthermore, as shown by Figure 1b, the advantage of global processing and detriment of local Navon processing and verbalisation were not apparent for other-race faces.

Analysis of the mean latency scores (in ms) revealed a significant main effect of race, $F(1, 76) = 4.61$, $MSE = 11{,}824{,}913$, $p < .05$, with faster reaction times for own-race faces (own race, $M = 3407$, other race, $M = 3791$) and a significant main effect of interval task, $F(3, 76) = 6.50$, $MSE = 56{,}169{,}371$, $p < .01$ (control, $M = 2745$; global processing, $M = 3096$; local processing, $M = 3961$; verbalisation, $M = 4595$). Bonferroni pairwise comparisons revealed that reaction times following local processing, $p = .06$, and verbalisation, $p = .001$, were significantly slower compared with control. Also reaction times following verbalisation, $p = .011$, were significantly slower than those following global processing. The main effect of encoding did not reach significance, $F < 1$. The interactions between interval task and encoding, $F < 1$, race and interval task, $F(3, 76) = 1.19$, $MSE = 3{,}038{,}681$, $p > .10$, race and encoding, $F < 1$, and race, encoding, and interval task, $F(3, 76) = 1.40$, $MSE = 5{,}299{,}669$, $p > .10$, did not reach significance.

The accuracy data from Experiment 1 showed that although local processing and verbalisation tasks appeared to impair performance, the only significant impairment was observed when compared with the global processing condition. Furthermore, global Navon processing improved performance; however, again the difference in means between global processing and control conditions did not reach significance. Results from the latency data were consistent with the accuracy data. Individuals were significantly slower to respond at test following local processing and verbal description. Marginal differences were found between interval tasks; however, no significant interactions were found in performance between interval task, race, and encoding, as predicted. This result was surprising given that previous research has found that the effects of verbal description were eliminated when recognising faces of another race (Fallshore & Schooler, 1995).

Analysis of the cross-race data from the control condition and the lack of an interaction between race of stimuli and encoding task indicate that the global and local Navon task used at encoding might not have successfully induced the holistic and featural styles used in own- and other-race face recognition. This could explain why the encoding task did not significantly interact in the predicted way with own- and other-race stimuli. Furthermore, if holistic and featural strategies were not induced at encoding the predictions regarding the effects of verbalisation and Navon processing would not be upheld. To test this we conducted a second experiment where we changed the encoding task to a task in which participants were asked to think about either personality traits or physical features of face images.

EXPERIMENT 2

Method

Participants. Eighty participants from the University of Plymouth, UK took part in this experiment for course credit. Twenty-three were male and fifty-seven were female (age range 18–38 years). Half of the participants were of Asian origin and half were of Caucasian origin.

Stimuli and design. The stimuli used and the design of Experiment 2 were the same as that used in Experiment 1.

Procedure. The only change made to the procedure was during encoding. For the holistic encoding manipulation participants were told "past research has shown that focusing on personality traits of faces can help you remember them, therefore whilst the eight faces are on the screen I would like you to think about which face you think is the most honest". For the featural encoding manipulation participants were told "past research has shown that focusing on a person's eyes can help you remember them, therefore whilst the eight faces are on the screen I would like you to focus your attention on the eyes of each face". All other procedures were the same as in Experiment 1.

Results and discussion

In line with the results of Experiment 1, the data from Experiment 2 were analysed using the first trial only following the interval task as this is where the effects were strongest.

Cross-race effects in the control condition. A 2 (encoding: holistic, featural) $\times$ 2 (race of stimuli: own, other) factor ANOVA carried out on the accuracy scores in the control condition did not reveal a significant main effect of race, $F < 1$, or a significant main effect of encoding, $F < 1$. However, results showed a significant interaction between race of face and the encoding manipulation, $F(1, 19) = 8.88$, $MSE = 1.51$, $p < .01$. A paired samples t-test found that following holistic encoding, own-race faces were recognised with more accuracy than other-race faces, $t(19) = 2.52$, $p = .021$. This pattern was reversed following featural encoding; other-race faces were recognised more accurately than own-race faces, $t(19) = -0.204$, $p = .05$. This significant interaction is displayed in Figure 2.

A 2 (encoding: holistic, featural) × 2 (race of stimuli: own, other) factor ANOVA, carried out on the latency scores in the control condition found no significant main effects of race, $F < 1$, or encoding, $F(1, 19) = 1.70$, $MSE =$ 3,551,137, $p > .10$, or any significant interaction between the two factors, $F < 1$.

Interval task effects. A 2 (encoding: holistic, featural) × 2 (race of stimuli: own, other) × 4 (interval task: control, global, local, verbal) factor ANOVA carried out on the accuracy scores found a significant main effect of interval task, $F(3, 76) = 6.60$, $MSE = 1.37$, $p < .01$ (control, $M = 0.54$; global processing, $M = 0.79$, local processing, $M = 0.78$; verbalisation, $M =$ 0.83). Bonferroni pairwise comparisons revealed that accuracy scores following the control task were significantly lower than accuracy scores following global processing, $p = .005$, local processing, $p = .009$, and verbalisation, $p = .001$. The main effect of race was approaching significance, $F(1, 76) = 2.82$, $MSE = 0.450$, $p < .10$, where own-race faces ($M = 0.77$) were recognised with more accuracy than other-race faces ($M = 0.69$). There was no main effect of encoding, $F(1, 76) = 2.29$, $MSE = 0.312$, $p > .10$. Results revealed a significant race by interval task interaction, $F(3, 76) = 2.98$, $MSE = 0.475$, $p < .05$, and a significant encoding by interval task interaction, $F(3, 76) = 3.21$, $MSE = 0.437$, $p < .05$. This two-way interaction between encoding and interval task was further investigated by examining the interval task effects following holistic and featural encoding trials separately using one-way ANOVAs. Bonferroni pairwise comparisons showed that for stimuli encoded holistically, global processing, $p < .001$,

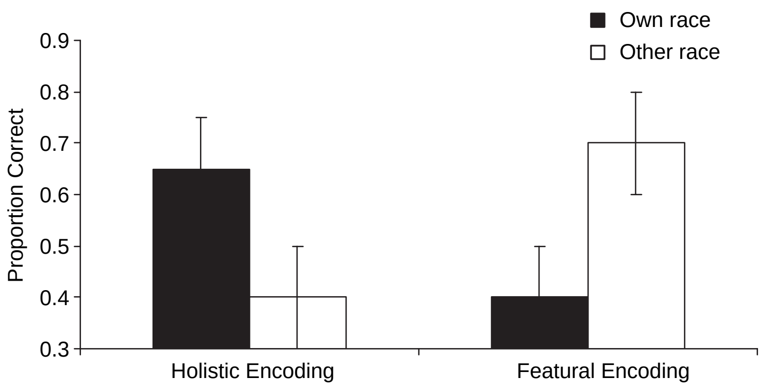

Figure 2. Mean accuracy scores and standard errors for own-race faces and other-race faces, following holistic and featural encoding for the control condition in Experiment 2.

and verbalisation, $p = .005$, both improved performance compared with control. For stimuli that had been encoded featurally, both local processing, $p = .048$, and verbalisation, $p = .048$, improved performance compared with control. The interaction between race and encoding did not reach significance, $F < 1$. However, analysis did reveal a significant three-way interaction between race, encoding, and interval task, $F(3, 76) = 3.06$, $MSE = 0.608$, $p < .05$. This three-way interaction is displayed in Figure 3. This interaction was analysed further by splitting the data by race of stimuli.

For own-race faces there was a significant main effect of interval task condition, $F(3, 76) = 8.88$, $MSE = 0.136$, $p < .001$. There was no interaction between encoding and interval task, $F(3, 76) = 1.06$, $MSE = 0.179$, $p > .10$. Figure 3a shows that accuracy scores improved, compared with control,

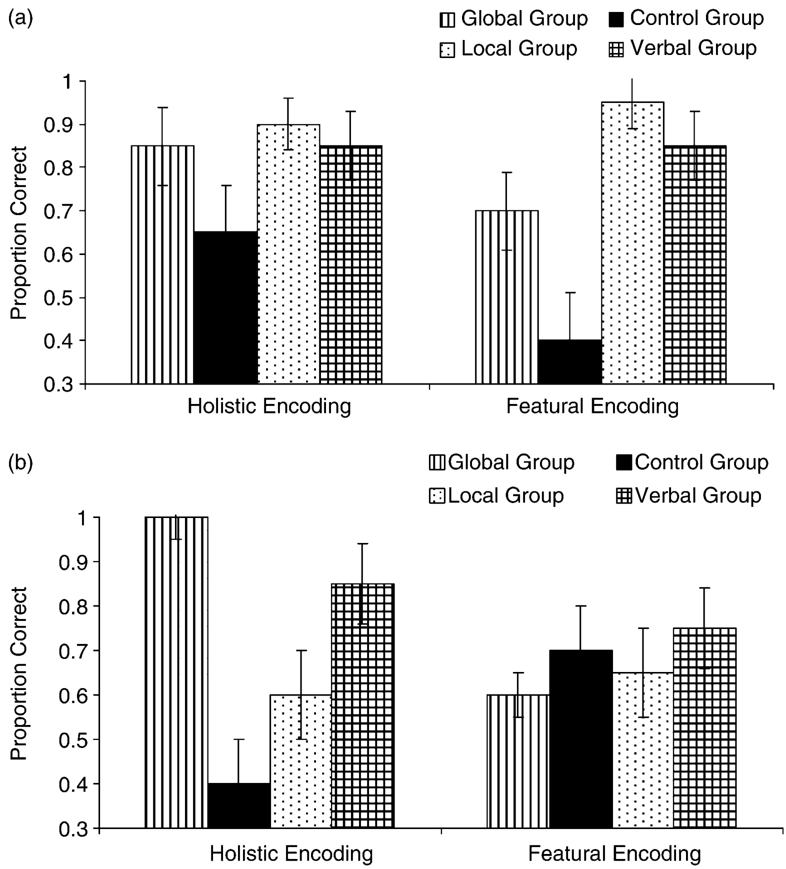

Figure 3. Mean accuracy scores and standard errors for (a) own-race faces and (b) other-race faces, across all conditions following holistic and featural encoding in Experiment 2.

following all interval task conditions for both holistic and featural encoding tasks. For other-race faces there was a significant main effect of interval task, $F(3, 76) = 2.77$, $MSE = 0.231$, $p < .05$, and a significant interaction between encoding and interval task, $F(3, 76) = 5.48$, $MSE = 0.156$, $p < .01$. One-way ANOVAs showed that there were significant differences between interval task conditions following holistic encoding, $F(3, 76) = 8.84$, $p < .01$. Bonferroni pairwise comparisons revealed that global processing, $p < .001$, and verbalisation, $p = .004$, improved performance compared with control. No significant differences were found between interval tasks following featural encoding, $F < 1$. This interaction is displayed in Figure 3b.

Analysis of the mean latency scores revealed a significant main effect of encoding, $F(1, 76) = 5.41$, $MSE = 34{,}974{,}174$, $p < .05$ (holistic encoding, $M = 4386$; featural encoding, $M = 3724$) and a significant main effect of interval task, $F(3, 76) = 3.77$, $MSE = 84{,}347{,}724$, $p < .05$ (control, $M = 3718$; global processing, $M = 3753$, local processing, $M = 3201$; verbalisation, $M = 5548$). Bonferroni pairwise comparisons revealed that reaction times following verbalisation were significantly slower compared with reaction times following local processing, $p = .015$. The main effect of race did not reach significance, $F < 1$. None of the interactions reached significance; race by interval task, $F < 1$; encoding by interval task, $F(3, 76) = 2.54$, $MSE = 16{,}396{,}983$, $p > .05$; race by encoding, $F < 1$; race by encoding by interval task, $F(3, 76) = 1.32$, $MSE = 9{,}689{,}135$, $p > .10$.

The only difference between the design of Experiment 2 and that of Experiment 1 was the nature of the encoding task used to induce holistic and featural strategies. Instead of the global and local versions of the Navon letter task used in Experiment 1, Experiment 2 used holistic and featural tasks which asked participants to focus on either personality traits (holistic) or physical features (featural) prior to the initial face presentation.

The results from the control condition were consistent with the claim that own-face faces and other-race faces are recognised by different processing styles. Analysis showed that holistic encoding benefited the recognition of own-race faces, whereas featural encoding benefited the recognition of other-race faces. This manipulation not only provided a test of the reliability of the encoding task but also provided a measure of the holistic and featural processes used in the recognition of own- and other-race faces.

The interval task analysis on the accuracy data showed that all three manipulations—global processing, local processing, and verbalisation—improved performance compared with control. The significant interaction between encoding and interval task showed that following holistic encoding both global processing and verbalisation improved performance. However, following featural encoding, local processing and verbalisation improved performance. It was predicted that local processing and verbalisation would both have a negative effect on performance due to the transfer of an inappropriate processing style and that this effect would greater following holistic encoding. Consequently, the improvement in accuracy following local processing and verbalisation was surprising given the results found in the Navon and verbal overshadowing literature. However, the latency data were somewhat inconsistent with the accuracy data. Whilst reaction times following local processing did not differ from control, verbalisation significantly increased the time taken to respond at test. However, the high accuracy and slow reaction times found in this experiment could be explained by a speed–accuracy tradeoff in that participants were compromising speed for high accuracy in the verbalisation condition.

Given previous findings in the literature which have shown a clear advantage of global processing and disadvantage of local processing, the results following the Navon task in Experiment 2 were unexpected and not in line with predictions. A third experiment was conducted to test the results found in Experiment 2. Experiment 3 used the same holistic and featural encoding task as Experiment 2; however, in order to increase power in the data the race factor was removed from the design. Furthermore, due to the limited research conducted on the Navon processing task it was decided to remove the verbalisation interval task condition from the design and focus on the effects of Navon processing. In order to add to the reliability and generality of the results different face stimuli were used in Experiment 3 to those used in Experiments 1 and 2.

EXPERIMENT 3

Method

Participants. Sixty participants from the University of Plymouth, UK took part in this experiment for course credit. Twenty-one were male and fifty-nine were female (age range 19–35 years).

Stimuli and design. The face stimuli were digital colour photographs of male faces. Both full-face and three-quarter pose images were used. All images were of the head only and the background of each image was neutral. The stimulus set comprised of 64 images, 32 three-quarter pose images used at the encoding stage and 32 full-face images used at the test stage.

The experiment used a 2 (encoding: holistic, featural) × 3 (interval task: control, global, local) mixed-design with one within-subjects factor, encoding strategy, and one between-subjects factor, interval task.

Procedure. The experiment procedure was the same as in Experiments 1 and 2; however, with the race factor removed the four experimental blocks consisted of two holistic encoding blocks and two featural encoding blocks with own-race face stimuli.

Results and discussion

Interval task effects. A 2 (encoding: holistic, featural) × 3 (interval task: control, global, local) factor ANOVA carried out on the accuracy scores found a significant main effect of interval task, $F(2, 57) = 8.86$, $MSE = 0.752$, $p < .001$ (control, $M = 0.54$; global, $M = 0.80$; local, $M = 0.74$) where performance improved following both global Navon processing, $p < .001$, and local Navon processing, $p < .01$, compared with control. Figure 4 shows the means for each interval task condition following both holistic and featural encoding. There was no significant main effect of encoding, $F(1, 57) = .2.52$, $MSE = 0.300$, $p > .10$, or encoding by interval task interaction, $F < 1$.

The two-factor ANOVA carried out on the latency scores did not reveal any significant main effects of encoding, $F(1, 45) = 2.02$, $MSE = 2{,}277{,}284$, $p > .10$, or interval task, $F < 1$. The two-way interaction between encoding and interval task did not reach significance, $F < 1$.

This experiment aimed to investigate the effect of holistic and featural encoding strategies and the influence encoding strategy has on the Navon effect. As in Experiment 2, Experiment 3 manipulated holistic and featural encoding strategies by asking participants to focus on either personality traits or featural aspects of a face. In line with the results of Experiment 2, both global and local Navon processing increased accuracy scores compared with control. Furthermore, this beneficial effect following both global and local Navon processing was sustained for both holistic encoding trials and featural encoding trials. The results of Experiment 3 support the global

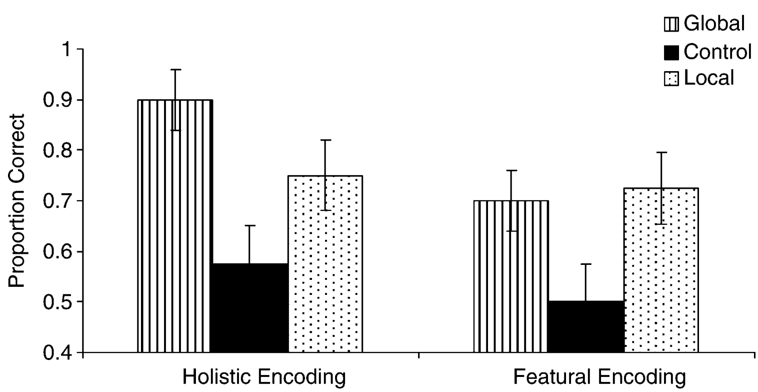

Figure 4. Mean accuracy scores and standard errors across all conditions following holistic and featural encoding in Experiment 3.

processing advantage found in Experiment 2 and in previous literature. However, the increased accuracy following local Navon processing found in both Experiments 2 and 3 raises questions about the reliability of the effects of local processing and the relationship between the Navon letter task and holistic and featural processing styles. This point is discussed further in the General Discussion.

GENERAL DISCUSSION

The aim of this paper was to investigate the effects of Navon processing and verbalisation on face recognition performance following both holistic and featural encoding. The results, from three experiments, although unexpected, have questioned the claim that the effects of Navon processing and verbalisation can both be explained using a holistic and featural processing framework.

Encoding and race effects

The TAP account of face recognition, which states that optimal performance is achieved through similarity between encoding and retrieval strategies, gained some support from the results of these studies. In Experiments 1 and 3 the effects of the Navon task were the same regardless of the type of processing engaged in at encoding. However in Experiment 2, the positive effects of global processing, local processing, and verbalisation differed depending on the encoding task participants engaged in. For example, effects were found for global processing and verbalisation following holistic encoding, whereas the effects of local processing and verbalisation were found following featural encoding. One explanation for these results relates to the potential differences between the processes evoked by the encoding task and the processes evoked by the Navon processing task. The reliability of the encoding task was tested by comparing performance for both own- and other-race faces following holistic and featural encoding. Given that own- and other-race faces have been shown to elicit different processing styles, this comparison enabled a test of the encoding task in evoking holistic and featural processes. Experiment 1, which used the global and local Navon task at encoding, did not find any significant differences in performance due to the type of encoding process in either the control condition analysis or the interval task analysis. However, when the personality and physical judgement task was used at encoding in Experiment 2, the control condition results showed a clear interaction between encoding process and race of stimuli. This interaction demonstrated that holistic encoding was beneficial for own-race faces (65%) compared with other-race faces (40%), whereas featural encoding was beneficial for other-race faces (70%) compared with own-race faces (40%). The only difference between Experiments 1 and 2 was the type of encoding task used. Therefore, the differential findings of Navon processing and verbalisation across Experiments 1 and 2 suggests that the Navon encoding task and the holistic/featural encoding task did not encourage the same processing style.

If one assumes that the own-race effect found in the literature is the result of a holistic and featural processing distinction then the results of Experiment 2 indicate that the holistic and featural encoding task used in this experiment successfully induced the holistic and featural processing styles used in face recognition. To date, evidence for the holistic account of the cross-race effect has come from tasks such as inversion which assume that poor performance equates to a lack of configural information. The results of Experiment 2 have provided a measure of the type of holistic and featural information used in the recognition of own- and other-race faces by manipulating processing style at encoding. One explanation therefore for the lack of any encoding effects in Experiment 1 is that the global and local encoding task did not evoke the necessary holistic and featural processing styles used in face recognition.

Past research has posed a strong link between global and local Navon processing and holistic and featural face processing strategies (Macrae & Lewis, 2002). However, the results of Experiment 1 do not support this strong claim as the Navon processing task, when presented at encoding did not affect performance on the face recognition task. However, the lack of any encoding effects in Experiment 1 does not rule out an explanation based on holistic and featural processing. It is possible that any effects of global and local processing only occur prior to test and not at encoding. We consider this explanation in the next section.

Navon processing as an interval task

It appears that the influence of Navon processing on face recognition performance is not as clear as first thought. Results from a number of studies have provided support for a global processing advantage and local processing disadvantage on face recognition performance (Macrae & Lewis, 2002; Perfect, 2003). However, the inconsistent results found across Experiments 1 and 2 in this paper cast doubt on the generality of the effect. Some possible explanations for the different results found across experiments are described next.

The consistent increase following global processing and decrease following local processing in past research has led researchers to posit a possible link between holistic and featural face processing and the global and local

Navon letter task. But the link between Navon processing and face processing strategies has not yet been extensively tested in the literature. It seems that the Navon letter task, when presented at encoding does not influence performance (Experiment 1). When presented as an interval task between encoding and retrieval global and local Navon processing produced means in line with predictions. Although not significantly different from control, the means observed in Experiment 1 were consistent with past research. Therefore, one explanation for the results found in Experiment 1 is that Navon processing does influence holistic and featural processing styles; however, these effects are most influential postencoding just prior to retrieval.

However, the results of Experiment 2, which used a facial judgement task at encoding provides evidence for the differences between global and local Navon processing and holistic and featural face processing. Contrary to predictions all interval task conditions improved performance compared with control. Improvements in performance were consistent across both holistically encoded and featurally encoded stimuli. This unexpected improvement following local processing was replicated in Experiment 3 where again accuracy scores improved following both the global and local processing interval task regardless of the encoding strategy used.

If one assumes that the holistic and featural encoding task used in Experiments 2 and 3 successfully induced holistic and featural encoding strategies, then the positive effects of global and local processing when presented prior to retrieval are difficult to explain in terms of a holistic and featural processing bias. For example, based on a combination of TAP and processing bias theory, local processing when presented prior to retrieval should impair performance due to the featural nature of the task. However the results of Experiments 2 and 3 showed a strong advantage following local processing. As mentioned earlier, it is possible that the effects caused by engaging in the global and local versions of the Navon letter task were not the result of a shift towards holistic and featural processing strategies. This leaves the Navon effect open to alternative explanations, which are discussed later in this section.

Verbalisation as an interval task

In addition to the effects of Navon processing, another aim of this paper was to explore the similarities between the effect of verbalisation and the effect of local Navon processing. Despite the limited number of studies carried out that directly test the relationship between verbal overshadowing and local processing, similarities between the two tasks have been reported, such as the longevity of both effects (Fallshore & Schooler, 1995; Weston & Perfect, 2005).

The processing bias account of verbalisation suggests a change in processing from a holistic to a more feature-based style. Based on this account larger effects of verbalisation were predicted following holistic encoding. Although the pattern of means in Experiment 1 supported this prediction, the interaction between encoding and interval task did not reach significance. As mentioned earlier, this interaction may have been due to the discrepancy between Navon encoding and holistic and featural processing styles. The results of Experiment 2 showed that, in line with the effects of the local processing interval task, verbalisation improved accuracy following both holistic and featural encoding. The latency data, however, showed the opposite results.

Whilst reaction times to make a response following local processing did not differ from control, reaction times following verbalisation increased significantly. The different effects found between local processing and verbalisation in terms of latencies highlights possible differences between the two effects. However, it could be argued that the lengthy latencies shown in the verbalisation condition can be attributed to a speed–accuracy tradeoff in that participants were sacrificing speed of responding for high accuracy. Therefore, the high accuracy found in the verbalisation group may not have been an accurate measure of performance given the length of time it took participants to respond, compared with participants in the other conditions. However, the data did not support this prediction. In order to investigate this explanation we removed the participants whose response times were more than two standard deviations from the mean. Whilst the mean response latencies dropped to around 3500 ms, the accuracy only dropped to 80%, which was still better than control.

One further explanation for the increase reaction time found following verbalisation in Experiment 2 relates to potential interference of the verbalised face. Participants in the verbalisation condition were exposed to a "ninth" face which they were asked to verbalise; this stimuli was not shown to participants in all other conditions. Therefore, it could be argued that this caused proactive interference with the time it took participants to make a decision. However, whilst this theory explains the effects found in Experiment 2, the results of Experiment 1 are not consistent with this explanation as no significant differences were found between the effects of verbalisation and the other three conditions.

Whilst it is clear that Navon processing and verbalisation influence face recognition performance, we still have a lot to learn regarding the processes involved in each task. This paper investigated the holistic and featural explanation of the Navon processing task and verbal overshadowing effect and has demonstrated a potential discrepancy between these two processes.

Whilst we need to investigate the processes involved in the Navon letter task in more depth, this paper has provided evidence for a possible distinction between Navon processing and verbalisation.

Navon processing: A holistic/featural explanation

One explanation for these findings relates to the cognitive processes involved in the Navon letter task and the processes involved in face recognition. Engaging in both a holistic processing style and a global Navon processing task has been shown to improve face recognition accuracy. However, there is no direct evidence to suggest that they actually elicit the same cognitive processes. There are many cognitive operations involved in face recognition and many tasks have been shown to influence face recognition accuracy. The personality and physical judgements used to induce holistic and featural processing styles at encoding have shown beneficial for different face recognition tasks such as lineup recognition and photofit creations (Wells & Hryciw, 1984). The benefits observed from using both personality and physical attributes at encoding highlights the importance both types of information have in recognition. However, the Navon letter task has not been tested with the same scrutiny. The main body of evidence for the influence of Navon processing has come from the perception literature, which explores the perceptual nature of the task in terms of the precedence and hierarchy of information (Navon, 1977). Therefore, the claim that global and local Navon processing influences the holistic and featural processing styles necessary for face recognition remains to be tested.

A final consideration—why did local processing increase accuracy?

Why did local processing increase accuracy in Experiments 2 and 3 and not in Experiment 1? The answer to this question warrants further investigation; however, we provide some possible explanations.

First, a featural recognition strategy may have been beneficial to the type of recognition task used. Past research (e.g., Macrae & Lewis, 2002; Perfect, 2003) has measured face recognition accuracy using an eight person array or lineup, where holistic processing has been shown to be the optimal strategy (Dunning & Stern, 1994). Other experiments which have used two-alternative forced choice tasks required participants to recognise composite face halves—a less holistic approach (e.g., Weston & Perfect, 2005). The experiments conducted in this paper used a two-alternative forced choice task whereby individuals had to make a decision based on only two alternatives in which the optimal strategy was holistic. It is possible that given only two alternatives, individuals were able to use a more featural-based comparative strategy as this was not so cognitively demanding. Given that both holistic and featural processing could be used, it follows that either global or local processing would improve performance on this task. However, we acknowledge the circularity of this argument.

The differences found between Experiment 1 and Experiments 2 and 3 can also be explained by the differential processes involved in the Navon letter task and holistic and featural processing tasks. For example, local processing only improved performance when the personality and physical judgement task was used at encoding and not when the Navon task was used at encoding. It is possible that the specificity of the holistic and featural task used in Experiments 2 and 3 allowed participants to encode particular facial characteristics which could be used in the later recognition task. This suggests that the improvement following global processing and impairment following local processing, observed in the literature, only occurs when no specific holistic or featural information has been encoded.

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