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SHIFT IN VISUAL LATERALITY WITHIN BLOCKS OF TRIALS *

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Single random polygons were briefly presented for subsequent recognition in either the left or the right visual half-field, randomized within each of three blocks of 40 trials. No overall perceptual asymmetry was found, but the distribution of correct recognitions within a block showed a shift in favor of the right visual field for later as compared to early trials (experiment 1). The shift was due to a systematic improvement of right visual field performance within blocks, left visual field performance remaining unchanged. This effect was replicated in experiment 2 and in the control condition of experiment 3. It was not caused by increasing familiarity of the stimulus material (experiment 2). When an unrelated auditory verbal task was given before each visual trial, an overall right half-field superiority was found, evenly distributed across trials (experiment 3). Thus extraexperimental subverbalization could have primed the left hemisphere in terminal subblocks in the earlier experiments. However, neither of two manipulations designed to preclude subverbalization yielded an overall left half-field superiority (experiment 4). Indeed, precluding subverbalization seemed to improve left hemisphere performance in the present task, in which verbal coding is not useful. Difficulty in demonstrating reliable left visual field superiority for relatively nonverbal stimuli thus does not necessarily reflect weak or unstable specialized processing by the right hemisphere. The same outcome can result from gradual gains in left hemisphere performance within a block of trials. In the present task, for which there is relative right hemisphere specialization, the left hemisphere has the potential to match right hemisphere performance.

Introduction

Many investigators have observed lateral asymmetries in the recognition of briefly exposed visual stimuli. When words or letter groups are

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presented either to the right or the left visual half-field in randomized sequence, right-handed subjects recognize more of these verbal stimuli in the right half-field, and to a lesser extent this holds also for single letters. Stimuli that are not explicitly verbal show no such asymmetry (White 1969). The right half-field advantage has been attributed to the left cerebral lateralization of language processes (Kimura 1966). Correspondingly, one would predict a left visual half-field advantage for recognition involving processes for which there is known right (minor) hemisphere dominance (Kimura 1969). Yet it has proved remarkably difficult to find instances of left half-field superiority that reliably replicate (White 1971; Bryden 1982). In the course of one failed attempt to demonstrate left visual half-field superiority for recognition of relatively nonverbal stimuli, we made an observation which might help explain why left visual half-field superiorities can be hard to demonstrate. In the experiment in question an individual solid black multi-angled polygon was briefly exposed in one visual half-field at each trial of a forced choice recognition paradigm. These 'nonsense shapes' were chosen because they are not economically recodable into verbal form, and it was expected that subjects would use a nonverbal strategy in processing them. For such a strategy, the right (minor) hemisphere should be controlling (Fontenot 1973; Patterson and Bradshaw 1975), so that a left visual field advantage might be expected.

Experiment 1

Method

Subjects

Twenty-four undergraduate students (11 males, 13 females) participated in partial fulfillment of an introductory psychology course requirement. All were right handed, as judged by their responses on a 14-item questionnaire (Crovitz and Zener 1962). They ranged in age from 17 to 22 years.

Apparatus

Three sets of 40 white stimulus cards were prepared. Each 12.7×9.2 cm card contained one black stimulus figure located to the left or to the right of the fixation point. The figures were 4-, 6-, 8- and 12-sided polygons taken from Vanderplas and Garvin (1959). The three sets of 40 cards differed in association value, ranging respectively from 20 to 30, 36 to 40, and 46 to 62. (The higher this value is, the more readily does the form elicit verbalizations.) Each set of 40 cards contained 20 different polygons and each polygon appeared once on the left and once on the right. The polygons were presented in a constant order, which was randomly selected with the constraint that 10 left sided stimuli and 10 right sided stimuli should appear in the first 20 and the same for the second 20 within each block of 40 cards. In addition, test cards were prepared, each with five more polygons, taken from Vanderplas and Garvin (1959), arranged along its central vertical axis. Four distractor figures appeared with each stimulus figure on a test card. All had the same number of sides as the stimulus figure and were about the same size. A separate set of stimulus cards and accompanying test cards was prepared for use on practice trials.

The figures were presented on a Model GB Scientific Prototype two-channel tachistoscope with the background field and central fixation point in one channel and the stimulus card in the other. The cards were viewed from a distance of 84 centimeters and the angle subtended by the distance between the fixation point and the center of each polygon was 1 45′. The mean visual angle subtended by the longest diameter of the polygon was 50′. The stimulus cards reflected 103 cd/m^2 as determined by a MacBeth illuminometer.

Procedure

Each subject viewed the three blocks of stimulus cards within a one-hour period. There was a five-minute intermission between blocks during which the subjects conversed with the experimenter. The subjects were instructed to fixate the centrally located fixation point. They were told that a figure would appear either to the left or to the right of this fixation point. The order of presentation had been randomly selected and they should not try to anticipate on which side of the card the figure would appear. The subjects initiated their own presentation after a ready signal from the experimenter. Immediately after each presentation, the subject viewed a test card and was asked to pick out the figure that he had just seen from the four distractors. If the subject was uncertain, he had to guess.

The order of presentation of the three blocks of stimulus cards was counterbalanced. This resulted in six orders in which the three blocks could be presented. Of the four subjects in each order, two went through each block of cards in one direction and two in the reverse direction.

Each subject was given 10 practice trials during which the exposure duration was adjusted to a level at which the subject would make approximately 50% errors. Piloting had revealed that an initial error rate at this level would become less across experimental trials, but not so low that there would be a ceiling effect for accuracy. The exposure durations thus arrived at ranged from 5 to 11 msec.

Results

There was no overall asymmetry in the efficiency with which the polygons were recognized ($F < 1$), nor was there any effect of association value ($F < 1$) or stimulus 'complexity', as defined by Vanderplas and Garvin (1959) ($F < 1$), on recognition accuracy. However, a relationship appeared between the direction of asymmetry and the timing of the trials within blocks.

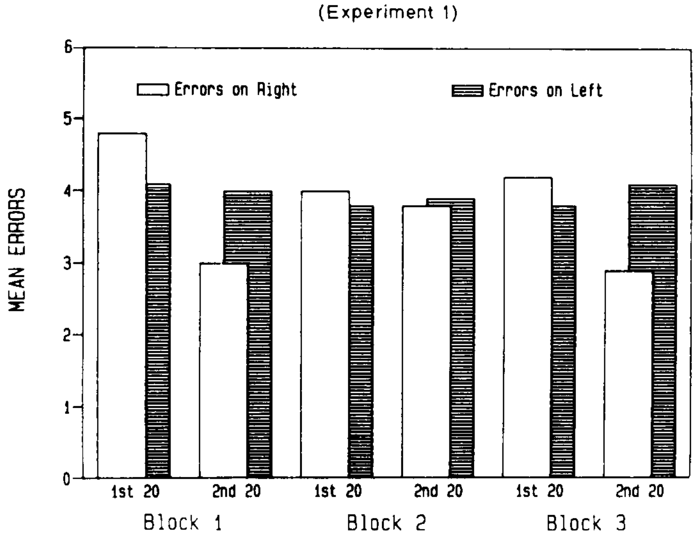

Fig. 1. Distribution of figure discrimination errors in the left and right visual field in the first and last half of three consecutive blocks of experiment 1.

The distribution of errors within the three blocks in the order in which they were presented was investigated by comparing the pattern of errors on the first 20 cards with the pattern of errors on the second 20 cards for each block. Within each block of cards, the balance of errors shifted toward the left visual field as the subject proceeded through the block (fig. 1).

An analysis of variance showed a significant interaction between subblocks of 20 trials and the percentage distribution of errors across fields ($F = 5.54$, $p < 0.0005$). Within the summed initial subblocks, there was no laterality effect ($F < 1$). Within the summed terminal subblocks, there was significantly better recognition for stimuli exposed in the right half-field ($F = 6.41$, $p < 0.05$). The interaction between blocks of 40 trials and the lateral distribution of errors was not significant. The mean number of errors for the three blocks of 40, 16.2, 15.1 and 14.4 respectively, did not differ significantly ($F < 2$). Examination of the data for each visual field separately showed no significant shift in performance between individual pairs or summed initial and terminal subblocks for the left visual field. In the right visual field, performance improved significantly from initial to terminal subblock within the first and third block ($t = 4.89$, $p < 0.001$; $t = 2.89$, $p < 0.01$) and between summed initial and terminal blocks ($t = 4.48$, $p < 0.001$). Also, there was no evidence of reciprocal change in recognition efficiency between initial and terminal subblocks in the two visual fields. A significantly negative correlation would have indicated trade-off between hemi-fields. Instead, there were isolated changes in right visual field performance.

Discussion

No overall left visual half-field superiority was found (as in many 'failed' attempts to demonstrate a left superiority for relatively 'nonverbal' recognition tasks including nonsense shapes (Dee and Fontenot 1973; Birkett 1978; Duda and Adams 1987a)). Given such an outcome, it is customary to question whether the recognition task was 'truly' nonverbal. But the nonverbal character of stimuli is always open to challenge, there being no generally accepted metric of verbal codality to validate such a characterization. So even if the right hemisphere were specifically implicated in the representational coding of the stimuli, a sufficiently substantial tendency toward verbal encoding could have neutralized any potential overall swing of performance toward left visual field superiority. However, this argument could be applied in post hoc fashion to any stimulus arrangement. Scrutiny of the data suggested an alternative approach.

When each of the three blocks of forty trials was divided into initial and terminal subsets of twenty, analysis revealed a significant left-to-right shift in relative recognition accuracy between summed initial and terminal subsets. This shift was contributed by improved terminal subset performance in the right visual field without significant change in left visual field performance. Some factor capable of enhancing recognition efficiency on the right seems to gain influence in the course of each block of trials and to dissipate during the subsequent rest period. Had the study consisted of one block only, it would have been tempting to align the result with other instances of 'priming by practice' (Cohen 1982) in which laterality relationships shift across trials (Kallman and Corballis 1975; Gordon and Carmon 1976). But no such unidirectional change can be assumed in this case.

Could differential novelty explain the findings? Goldberg and Costa (1981) have suggested that the right hemisphere is maximally involved when stimuli are novel. In our study, each terminal subblock reintroduced stimuli presented for the first time in the preceding initial subblocks. Differential novelty could therefore account for the interaction between visual fields and subblocks of trials, but not the trend toward improved right visual field scores across blocks. Also, the changing laterality relationships were due to changes in left, not right, hemisphere performance.

Do subjects increasingly adopt a verbal strategy of stimulus coding (Dee and Hannay 1973; Dimond and Beaumont 1974a) during each block and relinquish it after each rest period? Evidence for a verbal encoding strategy is lacking in that stimulus association value and complexity were not determinants of recognition accuracy. The increasing role of the left hemisphere in shape identification indicated by its relatively better performance in terminal subblocks was apparently not attended by a strategic shift toward a more verbal 'left hemisphere' encoding style, as suggested by Moscovitch (1979). Nevertheless, the possibility of verbal encoding cannot be completely dismissed, for the following reasons. Familiarity has been reported to induce right field advantage for nonsense shape recognition (Hannay et al. 1981; Morais and Ben-Drow 1985). Within each block of trials, each form appeared twice, once on each side. Perhaps at the second appearance, the stimulus was somewhat familiar, and elicited more verbal coding than was used when the stimulus was completely novel. If so, any such verbal coding conferred no overall performance advantage. Correct responses were not significantly more frequent in the terminal than the initial subset of each block. But because left hemisphere scores did rise significantly in terminal subsets, a direct test of this possibility was carried out. In the next experiment, each target stimulus appeared once only. If the within-block laterality shift uncovered in the first experiment occurred because each stimulus shape was presented twice, then presenting a new shape on each trial should abolish this effect.

Experiment 2

Method

Subjects

Twenty-four new right-handed subjects (13 males and 11 females) were drawn from the same subject pool as in the previous experiment. The subjects ranged in age from 17 to 20 years.

Apparatus

Two blocks of stimulus cards were prepared. Each block of cards contained 40 figures (20 left, 20 right), and within a block each figure appeared only once. Block 2 was identical to block 1, except that if a figure appeared on the left in block 1, it was on the right in block 2 and vice versa. The 40 stimulus figures were selected from the 60 figures used in experiment 1 by eliminating the 10 figures that were missed the most and the 10 that were missed the least. The 40 figures were matched for difficulty on the basis of the errors made in experiment 1. One member of a matched pair was assigned to the right and the other member to the left in block 1. (In block 2, this was reversed.)

Forty test cards were prepared in the same manner as in the previous experiment. Each card contained one stimulus and four distractor figures. The distractors were chosen without replacement from a set of 160 figures so that a subject never saw the same figure more than once.

Procedure

The general procedure was the same as in experiment 1, except that each subject viewed only one block of stimulus cards. Twelve subjects viewed block 1 and twelve block 2. Half of the subjects within each group went through the block in one order, and half in the reverse order.

Results

The results were pooled for all of the subjects, and the pattern of errors for the first 20 figures viewed was compared with the pattern for the second 20 (fig. 2). For the first 20, the mean percentage of the errors that were on the right was 54.2%; for the second 20, it was 47.2%. This difference was again significant ($t = 2.22$, $p < 0.05$). Across subblocks mean errors declined from 6.29 to 5.02 in the right half field ($t = 1.59$, NS) and rose from 4.51 to 5.00 in the left half field ($t = 0.71$, NS).

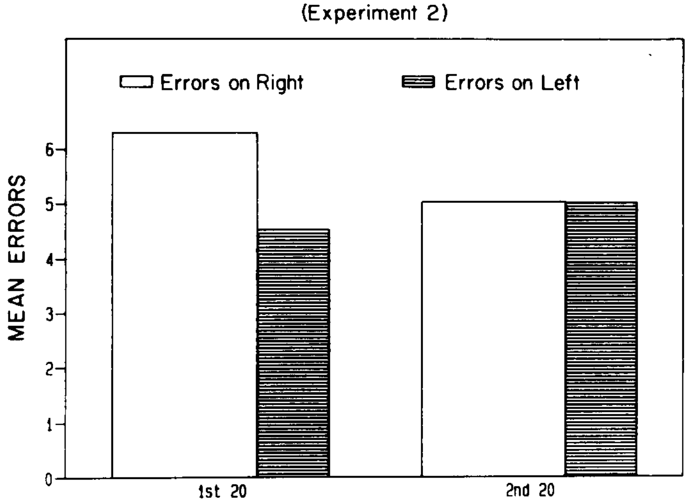

Fig. 2. Distribution of figure discrimination errors in the left and right visual field in the first and last half of the presentations, in which each of the figures occurred only once.

Discussion

A significant effect of order (initial versus terminal) of the subblocks of trials on the left–right distribution of errors was found again, although novelty of stimulus materials was held constant across trials, and any conceivable utility of applying a verbal code pending reappearance of test stimuli was eliminated by the experimental design. The trend toward improvement in right visual field performance across subblocks this time fell short of significance. One cannot explain the changing laterality findings by supposing that subjects intermittently adopt a verbal strategy for shape recognition. Nor can it be supposed that across trials subjects develop a 'description' by use of which the left hemisphere progressively gains control of task performance (Goldberg and Costa 1981). If so, it would not be expected that the 'descriptive system' becomes unavailable after a brief intermission, only to have to be generated anew. Turkewitz and Ross (1983) found laterality shifts across trials in a face recognition paradigm, and argue that these index the development by subjects of a 'general processing strategy' for this material. But their subjects showed a steady gain in performance across four blocks of trials. In our study, no gain in efficiency across blocks was observed. Nor did the performance of either hemisphere decline over trials. This rules out an explanation in terms of selective hemisphere fatigue (Dimond and Beaumont 1972).

An alternative mechanism derives from Kinsbourne's (1970) selective hemisphere activation model. Priming the left hemisphere by imposing a prior verbal load is capable of enhancing right visual field identification of non-verbal stimuli (Kinsbourne 1970, 1973; Brune 1973; Hellige and Cox 1976; Kinsbourne and Byrd 1985). The verbal activity thus need not be related to the primary perceptual task to have an effect on it. Comparable verbal activity between perceptual trials could conceivably also arise for extraexperimental reasons. Subjects no doubt think their own largely verbal thoughts sporadically during most experiments. Could the monotony of the present task have elicited spontaneous, unrelated covert verbalizations increasing over trials that fortuitously served as verbal primes, but were temporarily dispelled by conversion with the experimenter during rest periods (just as in vigilance paradigms unrelated cognitive activity is thought to intrude increasingly across trials within a block (Davies and Parasuraman 1982)). Milberg et al. (1981) have shown that inhibiting subvocalization can abolish (and even reverse) a rightward-biased perceptual asymmetry for a verbal task (dichotic listening to consonant–vowel combinations). This implies that subvocalization can be instrumental in setting up a right-sided laterality effect (though this has not, at any rate in an explicitly verbal task, yet been demonstrated for the visual modality). The next experiment attempts to simulate such an effect by determining whether a performance advantage on the right can be induced in initial trials by interpolating an unrelated verbal task before each presentation of a figure.

Experiment 3

Method

Subjects

Twenty-four right-handed subjects (14 males and 10 females) were drawn from the same subject pool as in experiments 1 and 2. The subjects ranged in age from 17 to 29 years.

Apparatus

The materials were as in experiment 1 except that only high and low association value stimuli cards were employed and two rather than three blocks of 40 cards were presented. In addition, two lists of one-syllable words were prepared. Each list contained 40 sets of six words each.

Procedure

The subjects were divided into two groups of 12. The general procedure for both groups was the same as in experiment 1 except that the subjects in one group had six words read to them before each presentation and were instructed to recite the words from memory after they had viewed the stimulus and made their choice from the test card. Since the associated verbal task to additional time, only two blocks of cards were presented to each of the two groups, limiting the duration of the experimental session to 1 hour. The order of presentation of the two blocks was counterbalanced, with half of the subjects in each condition going through the cards in one direction and half going through in the reverse direction.

Results

The control group (without the associated verbal task) made more shape identification errors on the right (mean 18.25) than on the left (mean 16.25). This trend toward

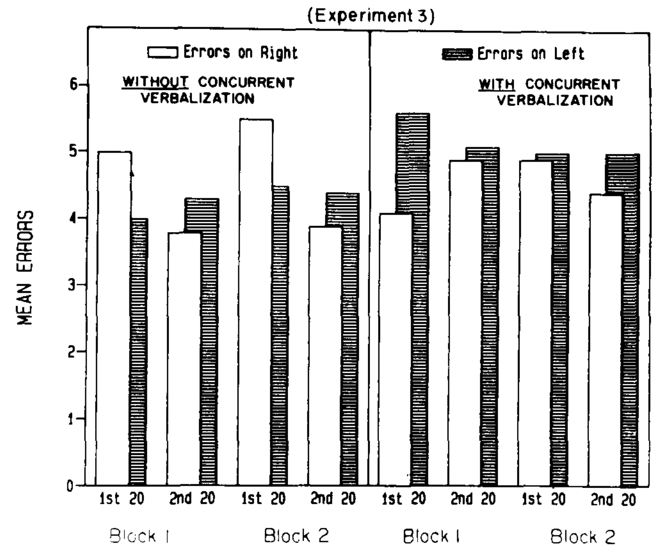

Fig. 3. Distribution of figure discrimination errors in the left and right visual field in the first and last half of two consecutive blocks, with or without an associated verbalization task.

left visual field superiority fell short of significance ($F = 3.44$, $0.05 < p < 0.1$). The group with the associated verbal task made more shape identification errors on the left (mean 19.83) than right (mean 17.33), as predicted. This right-sided advantage for recognition in the context of an unrelated verbal task was significant ($F = 4.83$, $p < 0.05$). The difference in the pattern of errors between the two groups was significant ($F = 3.48$, $p < 0.05$).

The incidence of errors by visual half-field for each subblocks of 20 trials was separately examined for the two groups (fig. 3). For the control group, the results were similar to those in experiments 1 and 2. Again, there was a significant interaction between subblocks of 20 trials and the lateral distribution of errors, ($F = 3.10$, $p < 0.05$), shown in fig. 2. This time it was the initial subblocks that generated a laterality effect, in favor of the left half-field ($F = 6.72$, $p < 0.05$). The terminal subblocks showed no field effect ($F < 1$). The interaction between blocks of 40 trials and the distribution of errors was not significant ($F < 1$). There was no significant difference in the number of total errors between the two blocks ($F < 1$) or within the blocks ($F < 2$).

Examination of the data for each visual field separately showed no significant shift between individual pairs or summed subblocks in the left visual field. In the right visual field, performance improved significantly from initial to terminal subblock within the first block ($t = 2.65$, $p < 0.025$) and across summed subblocks ($t = 2.54$, $p < 0.03$). Again, there was no effect of association value of polygons and recognition performance ($F = 2.05$, $p > 0.15$, NS).

Discussion

A rightward shift of laterality was again found in the control condition of this experiment, replicating shifts observed in experiments 1 and 2. But in contrast to the first two experiments the shift here consisted of an initial leftsided advantage, abolished in terminal trials (like that found for dichotic listening to tones by Spellacy (1970)). A within-block performance increment in the right visual field again accounted for the effect. Thus we are witnessing neither an attentional shift from left to right visual field (Kinsbourne 1970, 1973) nor a control shift from right to left hemisphere (Dimond and Beaumont 1974b), but a change over trials within each block within the left hemisphere–right visual field system. Interpolating a verbal task between tachistoscopic trials abolished the within-block laterality difference without impairing overall performance. There was an overall laterality effect favoring the right visual half-field in this condition.

Hardyck et al. (1978) hypothesized that substantial repetition of a limited set of stimuli is a necessary condition for obtaining visual laterality effects. Sullivan and McKeever (1985) qualified this generalization by restricting it to the left hemisphere (right visual field). The present results conflict with this generalization. In the absence of more than one (experiments 1 and 3 central) or any repetition of all (experiment 2), laterality effects demonstrably occurred.

The laterality shift effect cannot be explained within the framework of the 'direct access' hypothesis, Kimura's (1966) early attempt to account for the laterality phenomenon. The independent variation of right and left hemisphere efficiency in the shape recognition task calls for an account in terms of relative hemisphere dominance. Both hemispheres can and do accomplish the act of recognition, though with unequal efficiency (Geffen et al. 1971). The right field superiority that in the absence of explicit verbal priming was limited to the terminal subblock was extended by priming to implicate the entire block of trials. Thus priming by the verbal task was not additive with the shifting laterality pattern found in the present control condition and in experiments 1 and 2. Typically, verbal priming generates right field advantage where none existed, but does not enhance a right field advantage that exists already (Bruce 1973; Cohen 1975; Hellige and Cox 1976: experiment 2; Hellige 1978). Similar effects were inadvertently obtained by Bryden and Rainey (1963). They observed a right field advantage for familiar forms in a design which interspersed forms with alphabetic material. A priming effect across blocks was obtained by Paivio and Ernest (1971), when blocks of letters preceded blocks of pictures.

Was left hemisphere performance, and presumably activation, enhanced across subblocks by subvocalization? In the next experiment, this possibility was examined by introducing two manipulations, both intended to counteract the hypothesized subvocalization. The predicted outcome was elimination of the shift between subblocks, a left visual field superiority being maintained across blocks.

One maneuver was to instruct subjects to hold their mouth wide open, and tongue apposed to the floor of the mouth. This inhibits subvocalization (Bond and Tinker 1959). The other was to instruct subjects to refrain from verbal thinking during the blocks of trials.

Experiment 4

Method

Subjects

Twenty-four right-handed subjects (12 males and 12 females) were drawn from the same subject pool as in previous experiments. The subjects ranged in age from 17 to 22 years.

Apparatus

Materials were identical with those of experiment 1 except that only two blocks of stimulus cards were used.

Procedure

The subjects were divided into two groups of 12. The procedure was as in experiment 1, except that subjects in one group (A) were instructed to maintain their mouth fully open and tongue pressed down during the two blocks of trials, whereas subjects in the other group (B) were instructed to refrain from thinking in words during the blocks of trials.

Results

Groups A and B made almost the identical number of left and right field errors (mean left 16.25 versus right 16.33 and left 17.25 versus right 16.92 respectively, fig. 4). There was not even a trend toward a laterality shift across subblocks in either group. There was no significant difference in number of errors between the two blocks or within blocks.

Discussion

Both manipulations did have the predicted effect of abolishing the laterality shift across subblocks. But this did not occur in the predicted manner, as the expected right visual field superiority did not materialize. Thus instead of left hemisphere performance improving across trials within each block, as in previous experiments, it maintained a steady level, on a par with right hemisphere performance.

The explanation for these findings is not readily apparent, but they do weaken the view that the laterality shift across subblocks is due to the waxing and waning of silent verbal activity by the subject. Whereas explicitly incorporating verbalization into the task enhanced left hemisphere performance (experiment 3), inhibiting verbalization in the present study did not impair it. Yet the manipulations were not simply ineffective, as they both had one of the predicted effects. We do confirm our previous conclusion that it is the left hemisphere that contributes the effect under scrutiny, because two manipulations of left hemisphere activity modified the effect. Given that suppressing subvocalization eliminated the right visual field inferiority that obtained on early trials, one is bound to wonder whether it was subvocalization (non-contributory to the

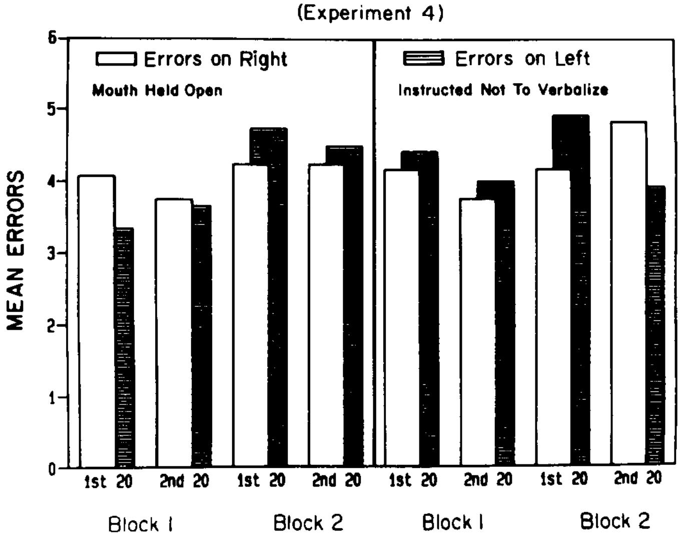

Fig. 4. Distribution of figure discrimination errors in the left and right visual field in the first and last half of two consecutive blocks with suppressed vocalization or verbalization.

recognition task) that, by hint of intrahemispheric interference (Kinsbourne and Cook 1971; Kinsbourne and Hiscock 1983) impaired the left hemisphere's contribution to the recognition task.

General discussion

Shifting perceptual asymmetries presented without further analysis (e.g., Stillman et al. 1984) are uninterpretable not in terms of hemisphere function after separate analysis of left and right hemisphere performance, laterality shifts can be classified relative to whether (a) they represent reciprocal change in relative hemisphere efficiency, overall performance remaining constant (e.g., Kinsbourne 1973) or unequal change in hemisphere efficiency over trials (e.g., present study); (b) the change is monotonic across trial blocks and sessions (most studies) or confined to an uninterrupted block of trials (this study). Experiment 1 demonstrated a shift in visual asymmetry within a session. The shift was contributed by improved right visual field performance in terminal subblocks. Experiment 2 provided evidence against attributing this shift to a verbal or other descriptive strategy for coding recurring stimuli, as the effect persisted although no stimulus shape was presented more than once. Experiment 3 in its control condition again replicated the laterality shift found in experiment 1 and again showed it to be contributed by a right visual field effect. But unrelated verbal activity (left hemisphere activation) abolished the attentional shift within subblocks by consolidating a right visual field advantage across all subsets of the test session. In each experiment it was the left hemisphere–right visual field that accounted for the effect. This aligns the effect with that found in other studies that incorporated a verbal priming manipulation into a non-verbal laterality paradigm (Kinsbourne 1970, 1973; Hellige and Cox 1976: experiment 1; Kershner et al. 1977; Carter and Kinsbourne 1979; Kinsbourne and Byrd 1985). Right hemisphere–left visual field performance did not change significantly across subblocks.

These three experiments leave open several alternative possible causes of the improvement in left hemisphere–right visual field performance across a block of trials. Perhaps the finding taps a characteristic reaction of the left hemisphere to any situation which initially elicits a right hemispheric mental set. As task demands become familiar, the left hemisphere improves its performance. (When left hemisphere activation predominates, no comparable changes over time in right hemisphere activity are observed (Geffen and Traub 1980; experiment 3 of present study).) Or perhaps left hemisphere priming, by increasing covert verbalization within a block of trials, could be the cause. That such priming could generate a shift toward left hemisphere–right visual field superiority was explicitly demonstrated in experiment 3, but a prediction of the priming hypothesis was not confirmed in experiment 4. The latter data are more suggestive of an interference hypothesis. According to this, subvocalizing during early trials within a block interferes with the primary task processing when the same hemisphere engages in both. This would align that experiment with many studies demonstrating interference between two tasks programmed in the same hemispheres (reviewed by Kinsbourne and Hiscock 1983). The subvocalization in this study differs from that in the work of Milberg et al. (1981), in that our task was non-verbal, whereas they used an (auditory) verbal task. Thus inhibiting covert verbal activity might be conducive to better performance in our paradigm, but detrimental in theirs.

The change does seem to represent a shift from right hemisphere superiority toward left hemisphere superiority for task which both hemispheres can accomplish. Accordingly, one might expect such an outcome during any task for which hemisphere specialization is 'relative' rather than 'exclusive' (Zaidel 1983).

Whatever its cause, the laterality shift within blocks has implications for the interpretation of laterality findings. Studies of lateral asymmetries are not typically designed to investigate variation over time. Yet outcomes may be complicated by laterality shifts within an experimental session. In the present work, there was no overall laterality shift across blocks, so the effect must depend on an unbroken succession of trials. The length of an experiment as well as the placement of rest periods must therefore now be included among the relevant variables in the study of lateral asymmetries. Short blocks of trials could elicit a right hemisphere advantage while longer blocks within the same paradigm may not. For instance, Heron (1957) found no laterality effect for nonsense shapes; he presented eighty-eight trials without a break. It is premature to conclude from the difficulty in demonstrating or replicating a left visual field superiority for non-verbal stimuli that right hemisphere function must be unstable or right hemisphere specialization be weak (Benton 1979). In the present series of studies any instability pertained to the left, not the right, hemisphere. Even left hemisphere advantages in certain non-verbal reaction time (Simon 1977) and simultaneity matching (Efron 1963) paradigms could conceivably reflect improving left hemisphere function across a long unbroken series of trials, within a session. So might the findings of Hardyck et al. (1978). They found no asymmetry of latency in a bilingual semantic matching task in three experiments using 60 or 64 lateralized trials. In their fourth study, using 200 trials, the expected right visual field superiority emerged. The lengthier block of presentation could have enabled a late-emerging left hemisphere superiority to develop. Failures to confirm previously reported (Witelson 1974, 1976; Gardner and Ward 1979) left hand dominance in cross-model (visual–tactile) shape matching (Duda and Adams 1987a; Adams and Duda 1987) could be scrutinized from the same viewpoint. More generally, our findings caution against too readily accepting the absence of an overall perceptual asymmetry as proving that the hemispheres participate equally in the task involved (Hardyck et al. 1978). In our series of experiments overall asymmetries were not found, yet we have demonstrated that lateralized effects did occur, but shifted across trials so as to preclude the emergence of a significant main effect for visual half-field.

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