

Socialization and Attentional Deficits Under Focusing and Divided Attention Conditions

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We conducted two studies to test and refine the hypothesis that, when undersocialized individuals focus on events of immediate interest, they allocate too large a proportion of their processing resources to those events and have little attention available for processing other important events. College students who completed the Socialization (So) scale (Gough, 1960) performed visual and auditory tasks simultaneously under conditions favoring the visual task, an equal division of processing resources between the tasks, or both. In both studies, low-So Ss performed relatively poorly on the auditory task under focusing conditions but displayed no primary task advantage and no significant performance deficits under divided attention conditions. These data support the utility of theories relating antisocial behavior to individual differences in allocation of attention. Low-So Ss' unresponsiveness to secondary events is not a simple function of the reallocation of resources to the primary task or a speed-accuracy trade-off. Moreover, under certain conditions, this deficit may disappear, given substantial practice.

Socialization has often been defined as the process through which children internalize the role expectations of a society (Mead, 1934). According to Gough (1948), unsocialized individuals, including psychopaths, tend to behave without regard for social norms, because they have difficulty perceiving and evaluating their behavior from the perspective of others. Among several instruments developed for the study of socialization (see Raine, Roger, & Venables, 1982), the Socialization (So) scale (Gough, 1960) has probably been the most widely used (e.g., see Megargee, 1972; Schalling, 1978). In a variety of populations and in several different countries, So scores have been correlated with criminal behavior. Even among delinquents, low So scores have been associated with greater recidivism and offense frequencies (Megargee, 1972). Finally, low-So college students have reported engaging in more theft, vandalism, and use of controlled substances than high-So students (Newman, Widom, & Nathan, 1980).

These behaviors of low-So individuals resemble those of psychopaths sufficiently to raise the possibility of common underlying mechanisms. Low-So college students have also been shown to behave as do psychopaths in some laboratory situations,

showing passive-avoidance deficits (Nathan, 1980) and perseveration of a dominant response (Waid & Orne, 1982). Moreover, low-So individuals have displayed electrodermal hyporesponsiveness to a variety of stimuli (Raine & Venables, 1984; Waid, 1976; Waid & Orne, 1982), a psychophysiological abnormality that may also be characteristic of psychopaths (see also Fowles, 1980; Hare, 1978; Schalling, 1978). Finally, several investigators have reported moderately strong and significant correlations between So scores and ratings of psychopathy (e.g., Hare, 1985; Kosson & Newman, 1988).

It may well be that psychopathic personality is a prototype around which other antisocial personalities are organized (e.g., see Yochelson & Samenow, 1977). At the very least, it appears that several groups of antisocial individuals share enough behaviors to warrant testing hypotheses for common mechanisms (see Gorenstein & Newman, 1980; Tarter, 1978).

Several investigators have proposed that attentional differences underlie the antisocial behavior of psychopaths. Jutai and Hare (1983) attributed psychopaths' advantage at screening out irrelevant tones to a greater allocation of attention to things of immediate interest. Newman, Widom, and Nathan (1985) explained psychopaths' passive-avoidance learning deficit as a function of attention to reward contingencies at the expense of attention to punishment contingencies. In fact, a detailed hypothesis regarding attentional dysfunction in psychopaths can be found in Shapiro's (1965) discussion of emotional and information processing in impulsive individuals. Among other things, Shapiro (1965) described psychopaths as vulnerable to a short-circuiting of attention by objects of "immediate, concrete, personal relevance" (p. 167).

Kosson and Newman (1986) translated these ideas into the

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overfocusing hypothesis. They first defined focusing as a systematic shift in the distribution of diverse processing resources from one or more tasks (or objects) to one immediate, concrete task. Overfocusing was then defined as a qualitatively similar but more extreme redistribution of processing resources. In terms of capacity theories of attention, the overfocusing hypothesis posits stable individual differences in the ways different people distribute their attention among multiple inputs (see Kahneman, 1973). Thus, overfocusing on a task should produce a trade-off: both superior performance on this task and poorer performance on any concurrent tasks. Kosson and Newman (1986) further proposed that whenever antisocial individuals focus on a task that is engaging, they overfocus.¹ That is, in assuming that antisocial individuals overfocus in response to the same situational parameters that focus others, they predicted overfocusing in any situation that produces a differential focus on one of several objects or tasks.

The suggestion that antisocial individuals allocate too little attention to peripheral events provides a straightforward account of many clinical features of antisocial personalities, from lack of empathy (i.e., failure to consider the needs of others) to impulsivity (i.e., failure to reflect on the long-range consequences of one's actions). This hypothesis also accounts for much of the empirical evidence on psychopathic and antisocial behavior. For example, overfocusing provides a straightforward mechanism for perseveration of a dominant response (Newman, Patterson, & Kosson, 1987; Waid & Orne, 1982), failure to delay gratification (Blanchard, Bassett, & Koshland, 1977), and failure to integrate information over time (Gullick, Sutker, & Adams, 1976; Painting, 1961). Finally, attentional overfocusing provides a parsimonious explanation for the psychophysiological abnormality noted previously. Electrodermal activity is often correlated with shifts of attention (e.g., Spinks, Blowers, & Shek, 1985; cf. Dawson & Schell, 1982). Thus, electrodermal unresponsiveness may reflect fewer shifts of attention to neutral, conflictual, or feedback stimuli.

The initial test of the overfocusing hypothesis suggested that psychopaths are characterized by attentional abnormalities. However, the evidence was not directly supportive of overfocusing per se. Kosson and Newman (1986) asked male prisoners to work simultaneously at a visual search and auditory probe-reaction time task under instructions either to do their best on both tasks or to treat the visual task as a primary task. A subset of psychopaths achieved marginally superior visual search performance under focusing instructions but, contrary to predictions, performed no worse on the auditory task. Moreover, psychopaths displayed performance deficits on both tasks under divided attention instructions, deficits not predicted by the overfocusing hypothesis. Psychopaths also displayed performance deficits on both tasks when tested by a female experimenter, a finding that appeared to reflect their allocation of too much attention to the experimenter at the expense of the experiment (Kosson, 1985).

Because nonpsychopathic prisoners failed to perform better at the visual search under focusing than under divided attention instructions, it could be argued that the instructional manipulation employed by Kosson and Newman (1986) was not strong enough to produce differential distributions of processing resources. Certainly, the two experimental conditions used identi-

cal response requirements and reinforcement contingencies and nearly identical stimuli. On the other hand, the instructional manipulation did produce better visual task performance and worse auditory task performance in psychopaths. Nevertheless, the effectiveness of the instructional manipulation remains open to question.

The two studies to be reported here were designed to provide more powerful tests of the overfocusing hypothesis. Rather than only telling our subjects to focus or divide their attention, we presented them with distinctly different situations designed to produce different distributions of processing resources. Because the overfocusing hypothesis predicts a pattern of individual differences in performance under the same conditions that promote focusing generally, any manipulation of a multiple-task situation that truly focuses our subjects should be sufficient to produce overfocusing. In the first study, monetary incentives were used to focus subjects on the visual over the auditory task. In the second, the frequencies of visual and auditory targets were manipulated to encourage different allocations of attentional resources. In these studies we also attempted to extend the overfocusing hypothesis to undersocialized individuals. If psychopathy and undersocialization reflect common mechanisms, similar patterns of deficits may be expected in the two populations.

Study 1

Substantial evidence indicates that incentives improve performance on information-processing tasks and that differential incentives produce inferior performance on those tasks without payoffs (e.g., see Eysenck, 1982). Thus, differential incentives focus human information processors preferentially on one of two or more concurrent tasks.

The empirical literature on psychopaths also provides a context for predicting greater responsiveness to tangible incentives among undersocialized individuals. As emphasized by Gorenstein and Newman (1980), overreactivity to reward appears as tenable as insensitivity to punishment in explaining the behavior of psychopaths (see also Newman & Kosson, 1986). Newman and Howland (1987) have further demonstrated performance deficits in psychopaths as a specific function of conditions that maximize behavioral activation or engagement. Thus, given incentives applied to one of two concurrently performed tasks, the overfocusing hypothesis predicts that undersocialized individuals will display relatively superior performance on the task emphasized and inferior performance on the other task.

Method

Subjects

Subjects were 60 male college students who scored in the upper or lower third of a sample of 90 undergraduates at the University of Wisconsin who completed both the So scale and the information-processing tasks to be described. Subjects volunteered for this experiment to obtain credit points toward their grades in introductory psychology courses.

¹ By *engagement*, we mean a motivational state that usually includes preparation for information processing and action, as well as responsiveness to the incentive value of the task situation.

Mean So scores for the low-So and high-So groups were 30.70 and 40.33, respectively.

Apparatus and Tasks

The information-processing tasks, a visual search and a go-no-go auditory-probe reaction time (RT) task, were essentially the same as those used by Kosson and Newman (1986). These tasks were chosen because previous evidence suggested that they demand effortful (i.e., controlled) processing resources; these tasks also allowed us to assess processing interference without producing competition at the level of sensory masking or response execution. The presentation and pacing of both tasks were controlled by an Apple II Plus computer.

Visual search. The visual search required subjects to look for occurrences of any of three target letters and maintain a running count of the total number of targets seen. Each trial consisted of the presentation of a new set of target letters for 3 s followed by eight successive test displays of 1,800 ms' duration, with each test display containing one letter in each of the four corners of an Apple II Plus monitor. At the end of each trial, subjects pressed one of four buttons on a response panel to indicate whether they had seen one, two, three, or four targets. Though subjects reported only the total number of targets presented, task demands were increased by employing the same letters that served as targets in one trial as distractors in other trials. Each target and distractor subtended approximately 10.8 min of visual angle.

Each subject was administered the same randomly determined sequence of target sets and test displays. These were presented in blocks of 12 trials, and the single-task block and the first dual-task block were each preceded by 2 practice trials. Search performance was estimated by both the percentage of search trials performed correctly and by a weighted sum of search errors, in which the absolute differences between the actual and reported number of targets were summed across trials.

Go-no-go probe RT task. The auditory-probe RT task required subjects to press a button as quickly as possible whenever they heard a low-pitched tone through headphones they were wearing. Corresponding to each visual search block of 12 trials, 18 low- and 20 or 21 high-pitched tones were presented. The tones were presented by the Apple II Plus computer at approximately 143 Hz and 476 Hz for a duration of 172 ms as measured by a Tectronix 475A oscilloscope. The intensities of the tones were approximately 62 dB (low) and 72 dB (high) as measured by a General Radio 1551-C sound level meter and 1560-P81 headphone coupler.

Each subject received the same randomly determined sequence of tones within the constraints that tones occurred equally often, 0, 450, and 900 ms into the visual search test displays (of 1,800 ms' duration), and that no two tones occurred within a 1-s interval. Subjects sat with the index finger of their dominant hand on a response button and were allowed 900 ms to respond to auditory probes. Median reaction times were calculated to assess each subject's performance. Responses shorter than 50 ms were considered anticipatory responses and excluded from analyses. When no response had occurred within 900 ms, reaction times of 900 were recorded and used in computing subjects' medians.

Focusing manipulation. Incentives were applied to visual search performance during the second block of dual-task performance in one of two ways. Subjects either were given a chip worth 20¢ whenever they correctly identified the total number of visual search targets presented or were given a stack of chips worth \$2.50, from which a chip (worth 20¢) was removed for every incorrect search trial. Thus, the incentive occurred either within a context of reward or a context of punishment. Further, feedback about money won or lost was provided after each trial. No predictions were made with respect to these two incentive contexts.

Single-task baselines. Assuming that dual-task performance is largely determined by the amount of processing capacity that subjects

apply to the situation, we estimated this capacity from subjects' performance on each task completed by itself. The baseline visual search was equivalent to the dual-task visual search. The baseline auditory task was identical to the dual-task probe RT task with the following exceptions: The beginning of each trial was indicated by the visual display **BE READY** rather than by the presentation of a new target set, and, within a trial, no visual signals differentiated the eight intervals of 1,800 ms.

Procedure

This study was completed over two semesters under slightly different conditions. First-semester subjects completed the So scale just prior to being tested by a female experimenter, whereas second-semester subjects completed the scale as part of an earlier group testing and were administered the information-processing tasks by a male experimenter. In both cases, subjects were informed that they would be paid depending on their performance only when they arrived for behavioral testing and were not informed of the specific monetary contingency until they had completed the first dual-task block.

Following a description of the study (and the completion of the So scale for first-semester subjects), all subjects completed the behavioral tasks in the following order: visual task baseline, auditory task baseline, both tasks under divided attention instructions, and both tasks with incentives applied to visual task performance. Instructions for the first dual-task block stressed the importance of performing as well as possible on both tasks. To avoid contradicting these divided attention instructions, when incentives were applied, subjects were told,

The tasks are exactly the same [as before] except that, from now on, you will have the opportunity to earn money for good performance on the visual search. . . . As before, try to notice every occurrence of every target letter, and press Button #1 as fast as you can whenever you hear a low tone.

Subjects received accurate feedback regarding their performance on both tasks every four trials. As noted earlier, in the incentive condition, subjects received additional visual task performance feedback after each trial.

Results

To assess the effects of differences between the first and second semesters of the study, time of testing was retained as a between-subjects variable during data analysis. The specific incentive context (reward vs. punishment) assigned was also retained as a between-subjects variable. Because the two measures of search performance yielded similar results, only the analyses of trials performed correctly (percentage correct) are reported here.

Baseline Measures

Analyses of performance under single-task conditions were based on a $2 \times 2 \times 2$ (Group \times Context \times Time of Testing) analysis of variance (ANOVA). These analyses revealed no group differences in baseline performance on either task. Low-So subjects performed correctly on 57.3% of search trials and responded to auditory probes with an average latency of 177.4 ms. For high-So subjects, the corresponding performance means were 63.5% correct and 204.2 ms. The analysis of subjects' probe RT baselines also reveals a significant Group \times Context \times Time of Testing interaction, $F(1, 52) = 4.27, p < .05$, in which high-So subjects who participated in the study during the first semester and later received the incentives in a punish-

ment context responded slower than other subjects on the auditory task baseline. Because incentive contexts had not yet been introduced, this effect is not considered meaningful.

Dual-Task Measures

Dual-task data were analyzed by analysis of covariance (ANCOVA) procedures in which the single-task version of each task was used as a covariate in analyzing performance on that task.² Because performance on each task appears to vary inversely with the concurrent processing load imposed by the other (Kosson & Newman, 1986), dual-task data were also blocked in accord with the simultaneous demands of the other task. Two levels of visual task load were distinguished on the basis of whether visual targets or only visual distractors were present during probe presentation. Three levels of auditory task load were distinguished according to whether no tones, high tones, or low tones (i.e., probes) were presented during visual test displays containing targets. In addition, auditory task data were blocked according to the position of auditory probes within visual search test displays (i.e., 0, 450, or 900 ms), because previous research had revealed an interaction between probe position and concurrent load effects (Kosson & Newman, 1986).

Probe reaction time performance. Median probe RTs were evaluated through a $2 \times 2 \times 2 \times 2 \times 2 \times 3$ (Group \times Context \times Time of Testing \times Incentive \times Visual Search Load \times Position of Probe) mixed-model ANCOVA. The hypothesis of poorer auditory task performance for low-So subjects under incentive conditions was tested by the Group \times Incentives interaction and by planned comparisons. The Group \times Incentives interaction was significant, $F(1, 52) = 4.05, p < .05$. Comparisons revealed that, as predicted, low-So subjects' probe RTs were not significantly slower than those of high-So subjects under divided-attention conditions (344.1 ms vs. 319.5 ms). However, when incentives were applied to search performance, low-So subjects responded significantly slower to auditory probes (509.7 ms) than did high-So subjects (420.8 ms; see Figure 1).

The omnibus analysis also yielded significant main effects for group, $F(1, 51) = 4.13, p < .05$; for incentives, $F(1, 52) = 69.90, p < .001$; and for concurrent load, $F(1, 52) = 32.08, p < .001$, indicating slower responses to auditory probes for low-So subjects, when incentives were applied to search performance and when search targets were present during probe presentation. As noted above, the Group \times Incentives interaction shows that the main effect for So depends upon the application of incentives to visual search performance. That the covariate was not significant ($p < .12$) indicates that, in contrast to our earlier study, performance on the auditory baseline was not particularly related to dual-task auditory performance.³

This analysis also revealed two noteworthy higher order interactions involving concurrent load. A Group \times Context \times Load effect, $F(1, 52) = 4.45, p < .05$, indicates that concurrent load effects were appreciable for most subjects but not for high-So subjects assigned to the reward context condition. This effect was as prominent before the introduction of incentives as after and is probably not meaningful. Finally, the analysis also yielded a Load \times Position of Probe interaction, $F(2, 104) = 13.78, p < .001$, indicating that the effect of concurrent visual

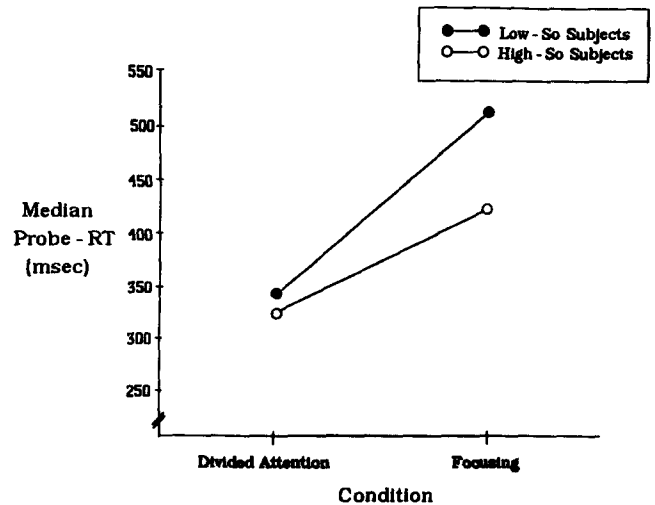


Figure 1. Auditory probe-reaction time under dual-task conditions. (So = Socialization scale, Gough, 1960; RT = reaction time; MSEC = milliseconds.)

task load depends on the temporal position of auditory probes within the 1,800 ms test display. In particular, the presence of a visual search target slowed probe RT for probes presented 450 or 900 ms into the test display but not for probes presented at the same instant as the test displays (i.e., 0 ms). Responses to such probes were already (nonsignificantly) slower than responses to probes occurring later in the test displays, presumably because subjects had not yet determined whether the visual display contained any targets.⁴

Visual search performance. A $2 \times 2 \times 2 \times 2 \times 3$ (Group \times Context \times Time of Testing \times Incentive \times Probe RT Load) mixed-model ANCOVA was conducted to examine visual search performance. Once again, the hypothesis was tested by the Group \times Incentive term as well as by planned comparisons. In this case, the Group \times Incentive interaction was nonsignificant, $F(1, 52) < 1$. Planned comparisons yielded no evidence of low-So superiority when incentives were tied to search performance. Low-So subjects performed slightly (and nonsignificantly) better than high-So subjects both before (54.7% vs. 53.1% correct) and after (60.3% vs. 58.7%) the introduction of incentives. There was also a significant Group \times Incentive \times

² Separate regressions for each baseline measure revealed no violations of the ANCOVA assumption of parallel regression surfaces.

³ A reanalysis of dual-task auditory performance, using percentage of search baseline trials performed correctly as a covariate, yielded results very similar to those reported here, with a significant effect for the covariate. That visual search baseline performance was more reliably related to dual-task auditory performance than was auditory baseline performance indicates that choice of the best covariate may depend more importantly on factors such as task difficulty, reliability, or both than on surface parameters (e.g., sensory modality and task requirements).

⁴ A supplementary parallel analysis of the number of probes missed revealed a main effect for incentives, $F(1, 52) = 26.78, p < .001$, but no significant group effects although, on average, low-So subjects missed slightly more (2.43) probes than high-So subjects (1.95), $p > .15$.

Load effect, $F(2, 104) = 3.51, p < .05$. However, it only qualifies the Incentive \times Load interaction also observed: The latter was statistically significant only for high-So subjects. Specifically, high-So subjects actually performed significantly worse on the search under incentive than under divided attention conditions in the absence of any concurrent load. In sum, there was no evidence for group differences in visual search performance as a function of the presence of incentives, concurrent auditory load, or both.

The omnibus analysis also indicated significant main effects for the presence of incentives, $F(1, 52) = 5.47, p < .025$; for concurrent load, $F(2, 104) = 23.89, p < .001$; and for the covariate, $F(1, 51) = 5.80, p < .025$. The main effect for incentives indicates that subjects performed better when incentives were tied to performance (59.3% correct) than in the absence of incentives (53.4% correct). The load effect reflects subjects' better performance when no tones (65.7% correct) or high tones (58.2% correct) were broadcast during the display of targets than when auditory probes competed for subjects' attention (45.2% correct). The significant covariate indicates that, as in our previous study, single-task and dual-task search performance are related.

Finally, as noted earlier, there was also a significant Incentive \times Load interaction, $F(2, 104) = 6.06, p < .005$, suggesting that incentives improved search performance when either auditory probes or distractors were broadcast during presentation of search targets; incentives had no appreciable impact in the absence of a concurrent load. Interpretation of this effect is qualified by the three-way interaction involving incentive, load, and group (described earlier).

Discussion

The results of this study provide evidence that undersocialized individuals' attentional allocations are especially sensitive to at least one manipulation of dual-task situations that produces focusing. In this case, the introduction of incentives produced a small but reliable improvement in visual task performance and a dramatic slowing of response to auditory probes for all subjects, and the deterioration in responses to probes was much greater for low-So than for high-So subjects. Low-So subjects responded 88.9 ms slower than high-So subjects under incentive conditions, compared with a difference of 24.6 ms under no-incentive conditions. Thus, these data are consistent with the proposal that focusing on events of immediate significance leaves undersocialized individuals with less residual attentional capacity for processing other events than their more socialized counterparts.

That low-So subjects performed no worse than high-So subjects on the visual search (and under divided attention conditions) indicates that undersocialization is not associated with a general inability to perform under dual-task or focusing conditions. On the other hand, that low-So subjects' poorer responsiveness to auditory probes was unaccompanied by relative superiority in search performance is also inconsistent with the overfocusing hypothesis as originally stated. The main effects obtained for incentives and for concurrent load demonstrate that allocating additional processing resources to one task interfered with performance on the other. If low-So subjects had

withdrawn more resources than high-So subjects from their secondary task because they had allocated more resources to their primary task, some relative advantage in visual search performance should have been evident.⁵ Low-Sos' relative performance deficit in the absence of any relative performance advantage represents a clear lack of trade-off between resources withdrawn from one task and applied to the other and, therefore, a second instance of evidence arguing against the postulated association between primary task superiority and secondary task inferiority. We will return to this issue in the discussion following Study 2.

These data also appear at odds with the results of our previous study (Kosson, 1985), in which incarcerated psychopaths had displayed marginally superior primary task performance and no secondary task inferiority under focusing attention conditions. Moreover, in the present study, low-So subjects showed no performance deficit under divided attention conditions, whereas psychopaths had performed relatively poorly on both tasks under divided attention conditions. Although the divided attention conditions in the two experiments were virtually identical, the subject groups differed substantially in educational attainment and probably differed in average intelligence as well. Direct comparisons between the two studies are therefore inappropriate. The divergent results may reflect differences in the focusing manipulations used and in the difficulty of the dual-task situations, as well as real differences between the two populations.

One unexpected finding from this study appears to corroborate an unexpected result from our previous study. As noted earlier, high-So subjects in this study actually performed worse on the visual search under incentive than under no-incentive conditions in the absence of any concurrent load. Although this anomalous finding disappeared given a secondary task load, it suggests that, for high-So subjects, the dual-task situation itself was more difficult after than before the introduction of incentives. This finding bears resemblance to the lack of improvement in visual search performance for nonpsychopaths given instructions to focus on the visual search. Thus, the present data add credence to the possibility that, for many people, dividing attention equally between two meaningful inputs may be easier than attending preferentially to one of them.

Because discrepancies in the results of the two studies also raised the possibility that the specific individual differences observed under focusing and divided attention conditions were not robust, we conducted a second dual-task study with low-So and high-So college students. We sought to replicate the results of this study using a different set of information-processing tasks and a different means of producing focusing. In addition, we designed these tasks to be more comparable in their infor-

⁵ It can always be argued that the resources withdrawn from a secondary task are not usefully applied to the primary task, either because resources are not complementary (Navon & Gopher, 1979) or because performance is no longer resource limited (Norman & Bobrow, 1975). However, these possibilities appear inconsistent with the demonstrated condition and concurrent load effects. At the same time, it must be acknowledged that the critical parameters that control focusing are not entirely established, and it is possible that some alternative combinations of situational parameters could reveal primary task superiority.

mation-processing requirements, while allowing us to assess new dimensions of performance.

Study 2

In developing a new dual-task paradigm, we sought information-processing tasks that not only demanded limited-capacity processing resources and drew on common resource pools but also were somewhat comparable in difficulty, complexity, and underlying information-processing requirements. For these reasons, we selected visual and auditory perceptual classification tasks, to be described shortly.

The new tasks were also designed to permit analyses of two new aspects of dual-task performance. First, tasks were selected that would permit rapid presentation of many trials, so that we could assess the stability of individual differences in processing performance with time on task. A pilot study using these tasks (Kosson & Newman, 1987) had revealed secondary task deficits for low-So subjects only during the early stages of a dual-task focusing condition. Consequently, we expected undersocialized individuals to be unresponsive to secondary task demands only during the initial stages of our focusing situation. Second, we selected tasks for which both accuracy and response latency could be used to assess performance. In this way, we could examine whether the individual differences we observed reflected true differences in perceptual sensitivity to auditory (or visual) stimuli or simply differences in the response criteria subjects used (e.g., fast and inaccurate vs. slow and accurate; see Dickman & Meyer, 1988). On the basis of our pilot data, we predicted that the auditory task performance data would resemble not a simple speed-accuracy trade-off but rather a clear performance decrement.

To induce subjects to focus on one of the tasks or to divide their attention equally between them, we manipulated the frequency of targets (i.e., stimuli requiring processing) presented by the two tasks. In our focusing condition, the visual task contained a higher percentage of targets than the auditory task. In our divided attention condition, the two tasks presented an equal number of targets. A variety of evidence indicates that humans allocate attention in order to process targets (see Duncan, 1980). Thus, we predicted that presenting more visual than auditory targets would lead all subjects to focus on their visual task and, therefore, that low-So subjects would perform especially poorly on the auditory task.

If secondary task deficits reflect the reallocation of a general attentional resource from a less salient to a more salient task, then individuals who overfocus should display a relative performance advantage in responding to primary task events. However, on the basis of the results of Study 1, we expected no differences in performance on the visual task itself under these conditions. The replication of no differences in primary task performance would strengthen our confidence in the data of Study 1, whereas the observation of such differences would suggest the need to search for critical differences between the methods of the two studies.

We also used this study to reexamine the performance of undersocialized individuals under divided attention conditions. As noted earlier, under these conditions, we have observed performance deficits in psychopaths but not in low-So college stu-

dents. However, as noted earlier, the only individual differences prediction we made was with regard to auditory task accuracy under focusing conditions. We expected that low-So subjects would correctly classify a smaller percentage of auditory targets than would high-So subjects and that our simultaneous recording of auditory response latency would not force reinterpretation of any performance difference as secondary to a speed-accuracy trade-off.

Method

Subjects

Subjects were 61 right-handed male college students who scored in the upper or lower third of a sample of 673 students who completed the So scale. The mean So scores for the low-So and high-So groups were 28.67 and 42.25. As in Study 1, subjects volunteered for this experiment to obtain credit points toward their grades in introductory psychology courses.

Apparatus and Tasks

The information-processing tasks were visual and auditory perceptual classification tasks. Both tasks required subjects to classify stimuli into one of three categories. The presentation and pacing of both tasks were controlled by an Apple II Plus computer.

Visual stimuli were strings of consonants, numbers, or combinations of consonants and numbers. Each string contained eight symbols and was displayed in the center of an Apple II Plus monitor for 350 ms. Each symbol in a string subtended 10.8 min of visual angle.

Auditory stimuli were four-note tone sequences of ascending pitch, constant pitch, or some combination of ascending and constant segments. Each tone of an auditory sequence was presented through headphones for roughly 60 ms, with 25 ms between tones. Within a given sequence, all increments in pitch were either 55 or 74 Hz (as measured by a frequency counter). The tones were generated by a voltage-controlled oscillator designed for this experiment.

Both tasks required subjects to classify only a subset of the stimuli presented. In the case of visual stimuli, symbol strings were surrounded by a rectangular frame. This frame was either horizontal or vertical in orientation, subtending $13.2^\circ \times 3.6^\circ$ or $7.3^\circ \times 10.7^\circ$ of visual angle, respectively. Only those stimuli surrounded by horizontal frames were designated targets; subjects were instructed to ignore strings surrounded by vertical frames. In the case of auditory stimuli, the overall pitch of a tone sequence was either relatively low (roughly 320 to 1075 Hz) or relatively high (roughly 1100 to 1450 Hz), and subjects were asked to classify only those auditory sequences composed of high-pitched tones. In both cases, targets were distinguished from distractors on the basis of a gross physical cue, so that discriminating targets from distractors would take relatively little attentional capacity. There is evidence that both gross visual orientation and gross pitch discriminations require little attention (Treisman, 1964; Treisman & Gelade, 1980).

In addition to distinguishing targets from distractors, both tasks were designed to require two further kinds of processing. First, each task required subjects to classify the individual elements of a target—the eight symbols of a visual string and the three (overlapping) tone pairs of an auditory sequence—into one of two categories (e.g., ascending vs. constant). Second, performance on each task also required storing these classifications in short-term or working memory (Baddeley & Hitch, 1974) and comparing the classifications of other stimulus elements with the stored judgments. It might be argued that the classifications of individual stimulus elements could occur in parallel. However, the comparison of each of these classifications with a result stored in memory may be assumed to be serial, at least initially. Any mismatch would indicate

a mixed stimulus (e.g., ascending and constant limbs) and terminate the comparison process, whereas classification of a pure stimulus (e.g., an ascending sequence) would necessitate exhaustive comparison of the results of each individual categorization with the category in memory.

Stimuli were presented in six blocks of 100 trials each. Accuracy on each task was estimated by the percentage of targets correctly classified, response latency by the median latency for correct responses. Responses occurring within 40 ms of stimulus onset were considered anticipatory responses and not counted. Responses with latencies greater than 2,040 ms were also ignored.

Focusing manipulation. As noted earlier, the percentage of stimuli that constituted targets was systematically manipulated to promote either a focus on the visual task or an equal division of attention between the two tasks. In the focusing condition, 90% of visual stimuli constituted targets, compared with 50% of auditory stimuli. In the divided attention condition, 50% of visual stimuli and 50% of auditory stimuli constituted targets. Thus, the difficulty of the auditory task was held constant, but the overall number of targets was allowed to vary between conditions.

In addition to target frequency, event frequency is another situational parameter that may affect subjects' distributions of processing resources. We therefore held event frequency constant across the two tasks in all conditions. Within each trial block, subjects received approximately 67 visual and 67 auditory task stimuli (i.e., two stimuli in each modality for every three trials). Thus, in every block of the focusing condition, subjects received approximately 60 visual targets (and 7 distractors) and 34 auditory targets (and 33 distractors). By contrast, subjects received roughly 33 targets (and 34 distractors) in each modality under divided attention conditions.

In presenting 60 (instead of 33) visual targets per trial block, we also increased the difficulty of the visual task. Thus, we were more confident in predicting poorer auditory task performance than better visual task performance in our focusing condition. In other words, given a greater relative frequency of visual targets, allocation of a higher proportion of processing resources to the visual task might be necessary simply to maintain performance at the same level as under divided attention conditions.

Single-task baselines. To provide a measure of the capacity each subject applied to the experimental situation, each subject completed 50 trials of each task under single-task conditions. The baselines were identical to the dual-task conditions that followed, with the exception that both baselines contained 25 targets (and 25 distractors), regardless of the dual-task condition to which subjects were assigned.

Procedure

Although the study took two semesters to complete, the same male experimenter administered the study throughout its duration. During the first semester, subjects completed the So scale and several other self-report inventories as part of a special screening session, whereas second-semester subjects completed the So scale as part of a large battery of questionnaires during one period of an introductory psychology class. In both cases, subjects whose So scores placed them in the extreme thirds of the pool were invited by phone to participate in the study to earn credit points toward their grades in introductory psychology. Subjects were informed that they would be paid based on their performance only when they arrived for behavioral testing.

Following a description of the study, all subjects completed the behavioral tasks in the following order: visual task baseline, auditory task baseline, and both tasks under either divided attention or focusing conditions. As in Study 1, all subjects were instructed to do their best on both tasks. In explaining the monetary contingency, subjects were informed that they could earn 1¢, 2¢, or 3¢ for every correct classification, depending on the speed of their response. They were also informed that

they would lose 1¢ for every response to a distractor, incorrect classification, or failure to make a response within the 2-s window allotted.

Subjects received accurate feedback regarding their performance on both tasks in every trial. During single-task baselines, feedback specified the correctness of responses. During dual-task trials, feedback communicated the amount of money won or lost on both tasks. (Monetary contingencies were operative only during dual-task trials.) During dual-task trials, subjects also received feedback regarding cumulative earnings every ten trials.

Following the first dual-task block, the experimenter left the room. Subjects were permitted to rest and stretch after every block of trials and instructed to start the next trial block when ready. They were paid and debriefed immediately following the end of the sixth dual-task block.

Results

Accuracy and response latency data for the two tasks were analyzed separately. The hand assigned to each task was included as a between-subjects variable in all analyses. Because pilot data had suggested that mixed stimuli (e.g., consonants plus numbers) were more difficult to classify than pure stimuli (e.g., consonant strings, number strings), type of target was also retained as a within-subjects factor.

Baseline Measures

Single-task performance on each task was analyzed by a $2 \times 2 \times 2$ (Group \times Condition \times Hand Assignment \times Type of Target) mixed-model ANOVA. These analyses revealed no group differences in baseline performance on either task. Low-So subjects correctly classified 66.7% of visual targets and 47.9% of auditory targets, whereas high-So subjects classified 66.8% of visual and 45.9% of auditory targets correctly. Average correct median response latencies were 1,128 ms and 1,014 ms (low-So) and 1,097 ms and 996 ms (high-So) for the visual and auditory tasks, respectively.

The effect of type of target was statistically significant in three of the four analyses, with poorer performance for mixed than for pure stimuli. However, higher order interactions indicated that the type effect for visual task accuracy was significant only for high-So subjects, whereas the type effects for auditory accuracy and visual response latency depended on both group and hand assignments. Subjects also classified visual targets more accurately before working on both tasks under focusing than under divided attention conditions. Because target frequencies had not yet been manipulated, this conditions effect is not discussed further.

Dual-Task Measures

Dual-task data were analyzed by ANCOVA procedures in which the single-task measure most closely related to each aspect of dual-task performance was used as a covariate in analyzing that aspect.⁶ For example, the analysis of auditory task re-

⁶ Because different baseline measures were available for trials with pure and mixed targets, each measure was used as a covariate for dual-task trials with the analogous type of target. Thus, two separate tests of the ANCOVA assumption of parallel regression surfaces were conducted for each dependent measure. Of eight regressions, seven indicated no

sponse latency employed single-task auditory response latency as a covariate.

In addition to type of target, dual-task data were blocked according to trial block and concurrent load. As noted earlier, each subject completed six dual-task blocks of 100 trials each. Two levels of concurrent processing load were distinguished. Subjects' classifications of auditory targets were divided into trials in which no visual stimuli were presented, and trials in which a visual target or distractor competed for subjects' attention. Similarly, visual task data were blocked according to whether or not any auditory events occurred during trials containing visual targets.

Hypotheses were tested through planned comparisons. To examine the prediction that individual differences characterize only the initial period of dual-task performance, planned comparisons collapsed across Blocks 2 and 3 (to provide a single estimate of early performance) and across Blocks 5 and 6 (to provide a single estimate of late performance). Block 1 was excluded from comparisons to allow subjects ample exposure to the target frequency manipulation before testing for group differences. Although Block 4 was excluded so that estimates of early and late performance would be equally reliable, Figures 2 and 3 display subjects' data for all six dual-task blocks. To aid the reader in understanding the many results to be discussed, we present planned comparisons first and then return to consider significant effects from the omnibus analyses on which these comparisons are based.⁷

Auditory task accuracy. As predicted, planned comparisons revealed that low-So subjects performed the auditory task significantly worse than high-So subjects during the early period under focusing conditions, $F(1, 317) = 6.16, p < .025$. Given a higher frequency of visual than auditory targets, low-So subjects correctly classified only 50.8% of auditory targets, whereas high-So subjects correctly classified 57.8%. As Figure 2 shows, the greatest relative performance deficit occurred in Block 2. As in our pilot study (Kosson & Newman, 1987), no group difference was evident in the late period of the focusing condition, where both low-So and high-So subjects correctly classified 63.4% of auditory targets.

Analogous comparisons under divided attention conditions suggested, as in Study 1, no differences in auditory task accuracy between low-So and high-So subjects either early (64.0% correct vs. 62.6% correct) or late (68.3% vs. 66.0% correct) in the dual-task blocks.

These comparisons were based on a $2 \times 2 \times 2 \times 6 \times 2 \times 2$ (Group \times Condition \times Hand Assignment \times Block \times Concurrent Load \times Type of Target) mixed-model ANCOVA. This analysis also revealed significant main effects for condition, $F(1, 52) = 5.45, p < .025$; block, $F(5, 265) = 38.39, p < .0001$; concurrent load, $F(1, 53) = 89.49, p < .0001$; and the covariate, $F(1, 52) = 45.00, p < .0001$, and a trend toward a significant effect for type of target ($p < .07$). The main effect for blocks again reflects improvement with practice. However, in this case, the increments proved reliable only between Blocks 1 and 2 and

between Blocks 3 and 4. As expected, the load effect indicates better performance in the absence than in the presence of a concurrent load, and the significant covariate indicates that single-task auditory accuracy predicts dual-task auditory accuracy.

The condition effect indicates poorer performance under focusing than under divided attention conditions. However, higher order interactions, including Block \times Condition, $F(5, 265) = 2.51, p < .05$; Block \times Type \times Condition, $F(5, 265) = 3.07, p < .025$; and Block \times Load \times Type \times Condition effects, $F(5, 265) = 11.03, p < .0001$, reveal that observation of a conditions effect depends upon particular levels of block, load, and type of target. Higher order effects involving load and type of target suggest that these effects also vary depending on specific levels of other repeated measures factors.

Auditory task response latency. An identical analysis was carried out on median response latencies. In this case, planned comparisons indicated no differences in the response latencies of low-So and high-So subjects, either early (920 vs. 908 ms) or late (812 vs. 813 ms) in dual-task performance under focusing conditions. Thus, the inaccurate secondary task performance of low-So subjects is not a function of their responding faster than high-So subjects.

There were no significant group differences under divided attention conditions either. However, under these conditions, there was a trend toward slower responses for low-So (876 ms) than for high-So subjects (815 ms) early on, $F(1, 311) = 3.01, p < .09$. No such difference was evident during the late period of the dual-task situation, where the corresponding latencies were 781 ms and 740 ms for low-So and high-So subjects. Thus, these data do not contradict the suggestion of a relative deficit associated with divided attention. Neither do they strongly corroborate such a deficit.

The overall pattern of main effects and interactions was similar to that in the preceding accuracy analysis. In particular, main effects were obtained for block, $F(5, 260) = 21.29, p < .0001$; and load, $F(1, 52) = 121.91, p < .0001$; and for a host of interactions involving block, load, type of target, and condition as reported earlier. Main effects for type of target, $F(1, 51) = 135.73, p < .0001$, and visual task hand, $F(1, 51) = 8.46, p < .01$, were also significant, with the latter reflecting faster responses with the dominant (right) hand. The main effect for condition was not significant, and the covariate, single-task response latency, was nearly significant, $F(1, 51) = 3.47, p < .07$. The only significant effects involving So were two five-way interactions involving load, type of target, visual task hand assignments, and condition or block. These latter interactions did not lend themselves to meaningful interpretation.

Visual task accuracy. As predicted, planned comparisons revealed no differences between groups during either the early or late period of the dual-task situation under focusing conditions. Given a higher frequency of visual than auditory targets, low-So subjects correctly classified 68.5% of visual targets in the early and 74.0% of visual targets in the late period of the dual-task situation, whereas high-So subjects correctly classified 71.6% and 73.7% of visual targets in the early and late periods, respectively (see Figure 3). Thus, as in Study 1, these data pro-

violations of the ANCOVA assumption. The exception was our baseline measure of visual task accuracy for mixed targets, suggesting caution in interpreting the ANCOVA based on visual task accuracy data.

⁷ All data reported here are available on specific request.

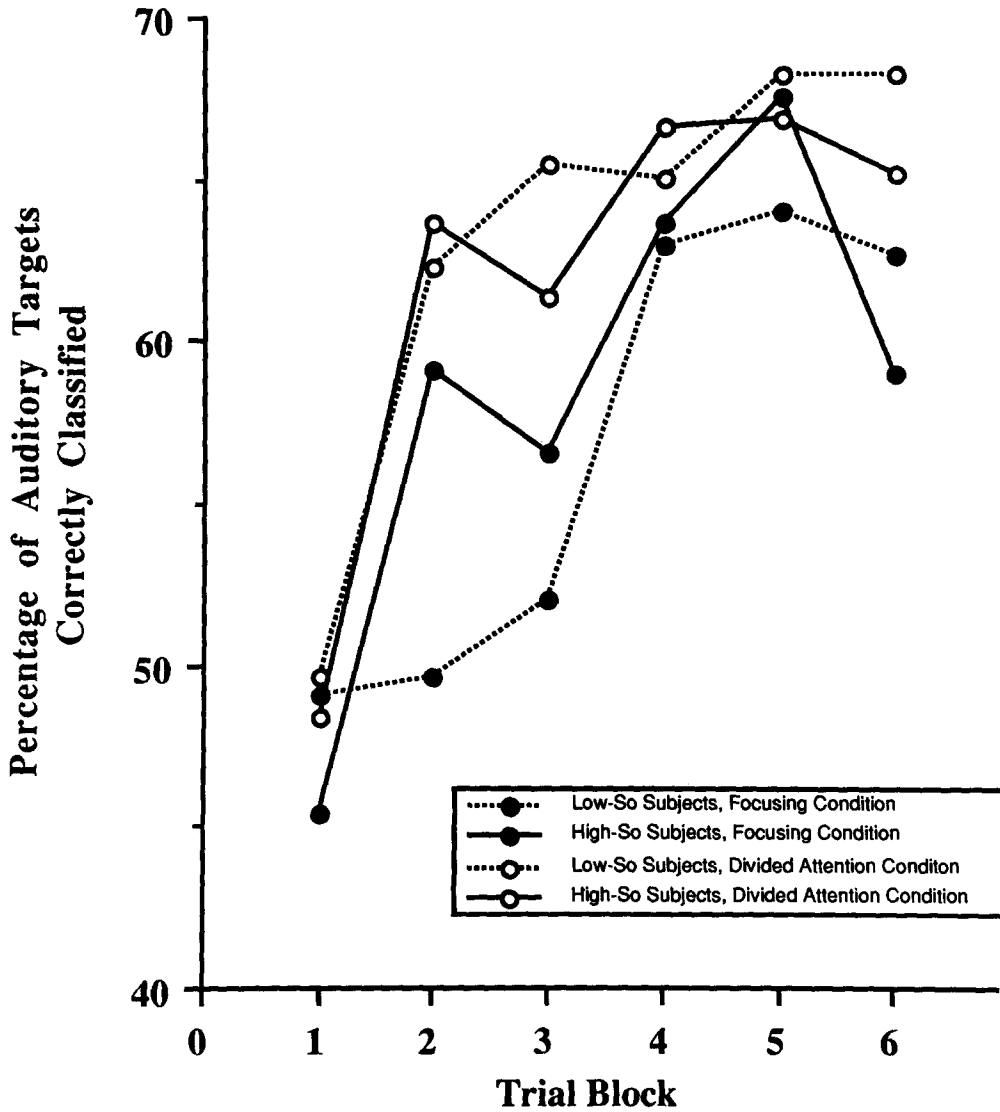


Figure 2. Auditory task accuracy under focusing and divided attention conditions. (So = Socialization scale; Gough, 1960.)

vide no evidence for low-So superiority in performance of a primary task.

Parallel comparisons of the two groups under divided attention conditions also indicate no significant group differences in visual accuracy. However, comparison of the two groups during the early period of this condition revealed a trend toward inferior performance for low-So subjects even though the two tasks presented equal numbers of targets, $F(1, 317) = 2.78, p < .10$. As Figure 3 illustrates, low-So subjects responded correctly to 67.8% of visual targets, compared with 72.0% for high-So subjects. This small difference in visual task accuracy disappears in the later period of dual-task performance, where low-So and high-So subjects correctly classified 69.8% and 70.9% of visual targets, respectively. The possible meaning of the two apparent trends under divided attention conditions will be discussed shortly.

The $2 \times 2 \times 2 \times 6 \times 2 \times 2$ (Group \times Condition \times Hand Assignment \times Block \times Concurrent Load \times Type of Target) mixed-model ANCOVA for visual task accuracy yielded significant main effects for block, $F(5, 265) = 49.90, p < .0001$; concurrent load, $F(1, 53) = 74.98, p < .0001$; and the covariate, $F(1, 52) = 35.00, p < .0001$. The main effect for blocks reflects reliable improvements in performance with practice through Block 4. There was also a statistically significant performance decrement from Block 5 to Block 6. The load effect reflects subjects' better performance on trials containing no concurrent load than on trials in which tone sequences competed for subjects' attention. The significant covariate indicates a significant relation between single-task and dual-task accuracy. Despite a trend toward a Group \times Block interaction ($p < .10$), there were no significant main effects or interactions involving socialization.

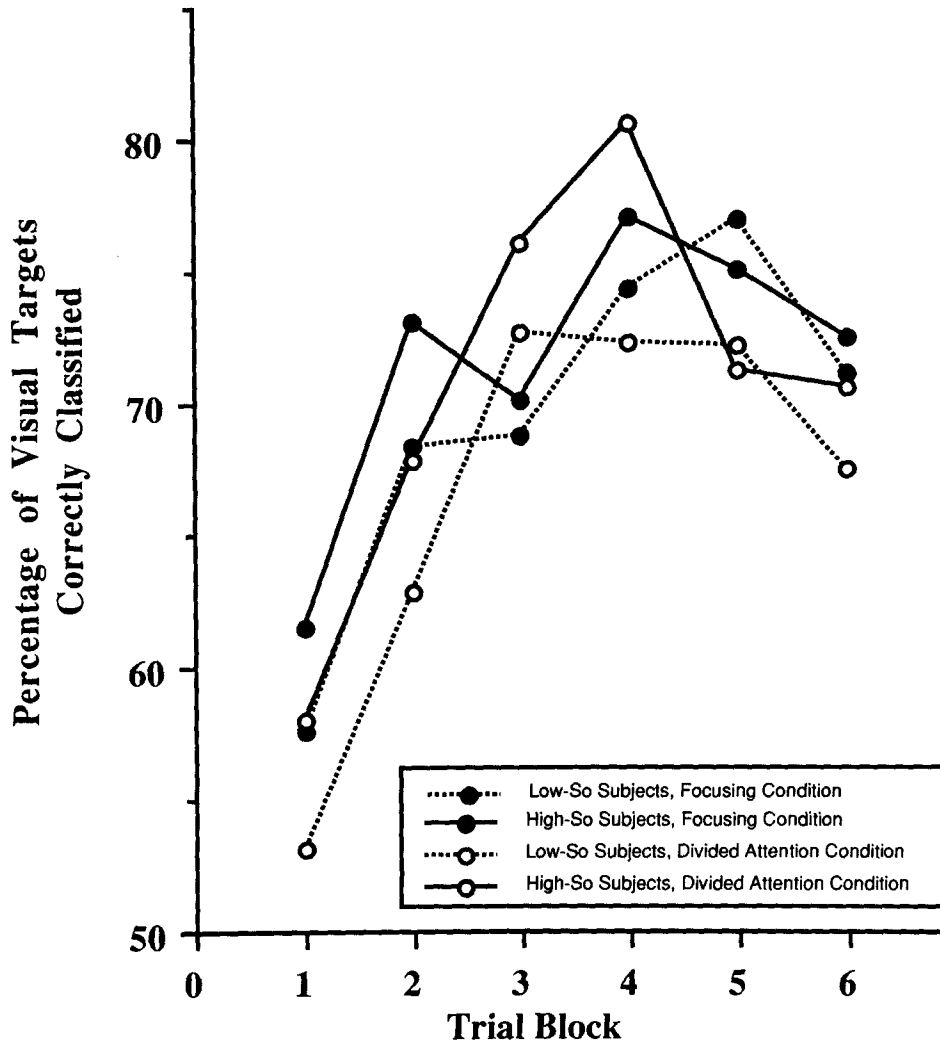


Figure 3. Visual task accuracy under focusing and divided attention conditions. (So = Socialization scale; Gough, 1960.)

The conditions effect was also nonsignificant. However, a Load \times Condition interaction, $F(1, 53) = 5.88, p < .025$, revealed the predicted superiority in visual accuracy under focusing than under divided attention conditions in the absence of a concurrent load but not in the presence of competing stimulation. Nevertheless, several higher order interactions, including Block \times Condition, $F(5, 265) = 4.46, p < .001$; Block \times Load \times Condition, $F(5, 265) = 4.53, p < .001$; and Block \times Load \times Type \times Condition effects, $F(5, 265) = 8.52, p < .0001$, indicate that the condition effects actually depend on specific levels of trial block, concurrent load, and type of target.

Finally, a Block \times Type of Target interaction, $F(5, 265) = 4.65, p < .0005$, showed that subjects classified a higher percentage of pure targets than mixed targets only during the first three blocks of dual-task performance. However, significant Load \times Type effects, $F(1, 53) = 17.29, p < .0005$, and Block \times Load \times Type effects, $F(5, 265) = 2.30, p < .05$, as well as the four-way interaction already mentioned suggest that the type effect, like

the conditions effect, depends on specific levels of all the repeated measures factors.

Visual task response latency. As expected, planned comparisons revealed no group differences in median response latency during either the early or late periods of either the focusing or the divided attention condition. Average median response latencies under focusing conditions were 1,068 ms (early) and 988 ms (late) for low-So subjects, compared with 1,061 ms (early) and 964 ms (late) for high-So subjects. Thus, the absence of primary task superiority for low-So subjects cannot be attributed to a more cautious approach to the visual task. No group differences emerged under divided attention conditions either, where low-So subjects responded, on average, 1,130 ms (early) and 1,093 ms (late) after target presentation, and high-So subjects' corresponding latencies were 1,117 ms and 1,063 ms.

Once again, the ANCOVA for median response latency revealed a similar pattern of main effects including significant

effects for block, $F(5, 265) = 49.51, p < .0001$; concurrent load, $F(1, 53) = 106.71, p < .0001$; and the covariate, $F(1, 52) = 13.36, p < .001$, as well as a main effect for condition, $F(1, 52) = 10.49, p < .005$. As in the above analyses, the conditions effect depends upon block, load, and type. Finally, in this analysis, the effect for visual task hand assignment approached but did not achieve significance, $F(1, 52) = 2.82, p < .10$.

Discussion

Despite the use of different processing tasks and a different focusing manipulation, the results of Study 2 corroborate those of Study 1 in almost all respects. Under dual-task conditions that emphasize the visual task, low-So subjects again displayed auditory task inferiority unaccompanied by any visual task superiority. These data provide further evidence that undersocialization is indeed associated with less attention to some important events under conditions that promote a focus on other events. They also strengthen the argument (see Study 1 discussion) that undersocialized individuals' attentional deficit is not a direct consequence of their allocating that attention to a more primary task.

In this study, we also observed two trends suggestive of early performance deficits under divided attention conditions. Technically, the lack of any statistically significant differences in this condition is generally consistent with the results of Study 1. That is, undersocialized individuals do not display a striking divided attention deficit like that reported for incarcerated psychopaths. However, it is tempting to interpret the near-significant differences in visual accuracy and auditory response latency, bearing in mind the absence of differences in auditory accuracy and visual response latency. Perhaps all that can be said is that these data are not fully consistent with the results of Study 1, showing no group differences, nor do they clearly corroborate previous evidence for divided attention deficits in psychopaths.

The present results also extend our knowledge of overfocusing in two important ways. First, the simultaneous recording of response latency and accuracy reveals a pattern of results inconsistent with interpretations in terms of subjects' response criteria. The auditory task inaccuracy of low-So subjects was unaccompanied by any faster response latencies. Thus, the secondary task deficit does not appear to reflect the kind of speed-accuracy trade-off that has sometimes been proposed to explain impulsive behavior (e.g., see Dickman & Meyer, 1988). At the same time, the failure to detect a visual task-accuracy advantage for undersocialized subjects cannot be ascribed to a hypothetical increase in their speed of responding. The use of both accuracy and response latency measures strengthens our confidence in the absence of any primary task advantage associated with the secondary task deficit.

Second, the differences between groups were significant only during the early period of dual-task trials. Given that all subjects improved substantially over trial blocks, it is possible that simple practice improves less socialized individuals' ability to divide attention under focusing conditions. On the other hand, the apparent instability of the secondary task deficit may reflect the eventual automatization of some aspects of the processing tasks we used. Whether such overfocusing would persist on

other tasks remains an open question. These results underscore the importance of further research examining the dual-task performance of undersocialized individuals over time.

The preceding interpretation of these data assumes that this study achieved the proper conditions for testing the overfocusing hypothesis. In particular, we assumed that our two tasks drew, to some extent, on a common pool of processing resources and that our focusing manipulation would induce subjects to distribute more processing resources to the visual task (and fewer to the auditory task) when the visual task presented more targets than when the two tasks presented subjects with an equal number of targets. The substantial effects we observed for concurrent load demonstrate that allocating additional resources to one task interfered with performing the other. The pattern of effects involving our focusing manipulation is less straightforward.

As noted earlier, the prediction of superior visual task performance under focusing conditions is complicated by the greater resource demands of the visual task under focusing than under divided-attention conditions (as a consequence of the presentation of more targets). In this study, main effects for condition appeared in two of the four analyses. That is, subjects' median response latencies to visual targets were faster when more visual than auditory targets were presented, with no corresponding loss in accuracy. Under these same conditions, subjects' auditory task accuracy was lower, with no corresponding speeding up of auditory response latency. Although these condition effects were qualified by higher order interactions involving block, load, and type of target, the trend in all four analyses was clearly toward better visual task performance under focusing and better auditory task performance under divided attention conditions, suggesting that the focusing manipulation produced different distributions of processing resources.

General Discussion

Taken together, the results of these studies suggest that the finding of secondary task inferiority in the absence of primary task superiority is a pattern with generality across processing tasks and focusing manipulations. These studies support explanations of impulsive, antisocial behavior in terms of less attention paid to some important events under conditions that promote a focus on other events of immediate significance. Given that undersocialized individuals do not outperform their more socialized counterparts on the task on which they focus, the mechanism underlying poor secondary task performance remains obscure. Two plausible mechanisms deserve mention.

Tipper (1985) has reported evidence in a selective attention paradigm suggesting that the inhibition of processing is not passive but active and theoretically separable from the enhancement of processing through attending. Tipper and Baylis (1987; see also Beech & Claridge, 1987) have recently suggested the possibility of stable individual differences in the extent of this process, which they term *negative priming*. One simple application of this principle to divided attention situations is that undersocialized individuals may be particularly likely to inhibit attention under certain conditions, including those that focus attention. In fact, Hare and his colleagues have demonstrated that psychopaths are electrodermally unresponsive in anticipa-

tion of aversive stimuli (see Hare, 1978, 1982) and display smaller event-related potentials following irrelevant auditory stimuli (Jutai & Hare, 1983). Of course, demonstrating active inhibition under selective attention conditions may be much simpler than showing that the same process is operative when antisocial individuals are trying to do two or more things.

If undersocialized individuals working at two or more tasks are especially prone to withdraw attention from secondary tasks, then focusing (and therefore overfocusing) may constitute a more natural, even habitual, cognitive style for undersocialized individuals than dividing attention (cf. Shapiro, 1965). The concrete example of a person contemplating a crime is illustrative: The person may begin by dividing attention between multiple inputs but may gradually come to be aware of and influenced by only one immediate goal or reward. The suggestion that psychopaths, like frontal patients, are stimulus bound (e.g., see Gorenstein, 1982) in itself proposes that a large category of secondary tasks are characteristically ignored: tasks without external stimulus referents. The present results show that, at least in the laboratory, undersocialized individuals' unresponsiveness to secondary tasks can also include unresponsiveness to clearly perceptible, task-relevant auditory stimuli. Perhaps discrepancies in incentive value (Study 1) or in the frequency with which tasks require on-line processing or action (Study 2) are also critical determinants of the extent of screening out in the real world.

An alternative perspective on the secondary-task deficits reported here is that demanding dual-task situations require human information processors to shift attention between tasks on a moment-to-moment basis (Kahneman, 1973). The processing resources that mediate shifts of attention may be directly affected by parameters that focus attention. In this context, when one of two concurrent tasks is given processing priority, low-So individuals may be less able than high-So individuals to disengage attention from a primary task channel (or primary task events), less able to reallocate attention in response to secondary task events, or less able to accomplish either of these things. Testing hypotheses for underlying mechanisms appears to require further research and different paradigms than those employed here (e.g., see Jonides, 1981; Posner, Inhoff, Friedrich, & Cohen, 1985).

The status of divided attention deficits is uncertain. Our studies with undersocialized individuals fail to confirm the pattern seen in psychopaths of deficits on both tasks under divided attention conditions. However, the observation of trends in this direction (for auditory response latency and visual accuracy) argues against rejection of the hypothesis. It is important both to examine further the divided attention performance of psychopaths and to test undersocialized individuals under conditions more comparable to those under which divided attention deficits are observed in psychopaths.

One final finding worth amplifying is that the secondary task deficit we observed in Study 2 was most prominent in Block 2 and had disappeared by the second half of the focusing condition. In life, people seldom receive the kind of practice that subjects commonly receive in laboratory studies. Whether that practice would lead undersocialized individuals to divide their attention more evenly between inputs with greater ecological validity is a question for further research. On the other hand, it

is important to keep in mind that the stability of the secondary task deficit has been examined with only one set of processing tasks. The deficit may prove substantially more refractory to practice with tasks that do not lend themselves to the development of automatization.

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