

Effects of Punishment on Response Latency in Extraverts

Sharon L. Nichols and Joseph P. Newman
University of Wisconsin-Madison

Previous findings indicate that in comparison to introverts, extraverts are prone to form responses that are resistant to interruption by punishment. Because the tendency to stop and reflect following punishment may be crucial for subsequent learning, the present study was designed to examine differences between introverts' and extraverts' reactions to punishment using response latency on the trial following punishment as the dependent variable. Sixty-six extraverted and 66 introverted male undergraduates performed a pattern-matching task in which they received noncontingent 50% success and 50% failure feedback under three incentive conditions including *reward only*, *punishment only*, or *both*. As predicted, a significant interaction was found in the both condition, reflecting the tendency of extraverts to respond more quickly and introverts more slowly following punishment feedback than following reward feedback. No significant effects were found in the other two conditions; however, a tendency was noted for extraverts to respond more quickly overall when only reward was given. A second experiment using reward-only and punishment-only feedback replicated this finding and yielded a significant interaction of Group \times Condition. The results indicate that in contrast to introverts, extraverts are activated by the availability of reward and, paradoxically, that punishment may facilitate rather than interrupt extraverts' reward seeking behavior.

Learning to inhibit behavior that may lead to negative consequences (passive avoidance) is considered crucial to the development of socialization. As a result, investigators of psychopathy and extraversion, two individual difference variables associated with weak socialization, have focused on fear conditionability and response to punishment. If punishment is a key element in learning to control one's behavior, it is likely that understanding the effects of punishment on these individuals will be an important step toward explaining their lack of inhibitory control.

The most obvious explanation for the reduced impact of punishment in mediating the behavior of extraverts and psychopaths is that they are less sensitive to the aversive properties of punishment. If these individuals experience punishment as less aversive than do introverts and nonpsychopaths, they will be less motivated to inhibit behavior in order to avoid punishment. For example, on the basis of data suggesting that psychopaths may be distinguished by heart rate acceleration and a reduced skin conductance response in anticipation of an aversive event, Hare (1978) has proposed that psychopaths are more efficient than others at attenuating the effects of aversive stimuli. Similarly,

Gray (1981) has suggested that extraverts are less sensitive to cues for punishment than are introverts.

Recently, Gorenstein and Newman (1980) proposed that disinhibited individuals, including psychopaths and extraverts, may have a heightened response to reward that interferes with learning about cues for punishment. On the basis of the "septal" model proposed by these authors, Newman, Widom, and Nathan (1985) investigated the effect of incentive conditions on the passive-avoidance learning of extraverted and psychopathic subjects. Whereas extraverts performed as well as introverts on a task involving punishment only, they committed more passive avoidance errors on the same task when avoidance required inhibition of a response that was often rewarded. In related studies, Gorenstein (1982) and Waid and Orne (1982) demonstrated that disinhibited individuals have difficulty suppressing behavior that has been made dominant by any means, including but not restricted to positive reinforcement. These findings stimulated by recent physiological models of disinhibition suggest that approach responding is an important factor mediating inhibitory deficits and that theories of disinhibition must consider the interaction between approach tendencies and reaction to punishment.

In addition to highlighting the importance of approach responding, the septal model suggests that the failure of cues for punishment to inhibit approach behavior may be related to an *altered*, as opposed to an *attenuated*, reaction to punishment. Dickinson (1975), for instance, proposed that "septal damage . . . appears to produce a shift in the unconditioned reactions to primary aversive stimuli from suppression to activation." Similarly, Gray (1971) has hypothesized the existence of two separate physiological systems involved in the reaction to aversive stimuli, one mediating response suppression and the other mediating nonspecific arousal. According to Gray (1982), the septum is associated with a "behavioral inhibition system" that reacts to aversive stimuli by suppressing ongoing responding. In addi-

Preparation of this article was supported in part by National Institute of Mental Health Grant MH 37711-01 and MH 39221-01 to Joseph Newman.

This report is based on a thesis submitted by Sharon Nichols in partial fulfillment of the requirements of the Master of Science degree at the University of Wisconsin-Madison. We wish to thank Lyn Abramson and Tim Baker for their contribution to the thesis, and Cris Virgin and Judy Markgraf for their assistance in preparing this article. We gratefully acknowledge the contribution of Nancy Rotter in conducting the experiments.

Correspondence concerning this article should be addressed to Joseph Newman, Department of Psychology, University of Wisconsin, 1202 West Johnson Street, Madison, Wisconsin 53706.

tion, this system increases nonspecific arousal indirectly by producing an increment in a separate, general arousal system. An important implication of proposing separate mechanisms for arousal and inhibition is that punishment may occasionally result in increased arousal without interrupting ongoing behavior. If, for example, ongoing behavior is made resistant to interruption by some means such as increasing the salience of reward cues, the effect of punishment may be to facilitate rather than to interrupt such behavior.

Thus, consideration of the septal model suggests that in contrast to introverts, extraverts will be more likely to react to punishment feedback with response facilitation as opposed to behavioral inhibition. The purpose of this study is to investigate whether introverts and extraverts differ in their reaction to punishment in this manner, with introverts exhibiting slower responding and extraverts exhibiting response facilitation. Because Gray (1982) equates general arousal with behavioral intensity, which he infers from speed or force of responding, this investigation assesses extraverts' immediate reaction to punishment using response speed as the dependent measure. In addition, three incentive conditions are included to test whether or not extraverts' distinctive reaction to punishment, like their inhibitory failures, is most apparent under conditions involving the interaction of reward and punishment. In summary, this experiment was designed to examine the inhibitory versus the facilitative effect of punishment on introverts and extraverts under different incentive conditions.

To accomplish these goals, we used a pattern-matching task in which subjects were required to state whether or not two successively presented patterns were identical. Noncontingent feedback was used, with approximately half of the 41 trials resulting in success feedback, and the other half resulting in failure feedback. The dependent measure was the subject's response latency, in milliseconds, following presentation of the second pattern. To observe the effect of an overall context of reward or punishment, three task conditions with different monetary contingencies were used. In the *both* condition, subjects won or lost small amounts of money on each trial. In the *punishment-only* condition, subjects lost money on *incorrect* trials but could not win money, and in the *reward-only* condition, the subjects could only win money, with no monetary contingencies attached to failure trials. It was predicted that introverts would respond more slowly and extraverts more quickly following punishment than following reward. In addition, it was predicted that this differential reaction to punishment feedback would be most apparent in the condition involving reward and punishment.

Experiment 1

Method

Subjects. The subjects were 186 male undergraduates from the introductory psychology classes at the University of Wisconsin who volunteered to participate in the study for extra credit points toward their grade. Experimental tasks and personality questionnaires were administered by one of two female experimenters who was blind to the subject's extraversion score. Subjects were assigned to experimental group on the basis of scores on the extraversion scale of the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975) after completion of the study. Those subjects receiving an extraversion score below the median ($M =$

16) were classified as introverts (mean extraversion score = 11.23), and those with scores at or above 16 were classified as extraverts (mean extraversion score = 18.10). Assignment to experimental condition was random. Because 25 subjects per cell were considered optimal, as many subjects as possible were run by the end of the semester to ensure that all cells would be filled. Unfortunately, the resulting 186 subjects were distributed very unevenly across cells, with one cell containing 22 and other cells as many as 37 subjects. Therefore, only the first 22 subjects in each cell were retained for analyses. Supplementary analyses demonstrated that inclusion of the subjects that had been dropped did not attenuate the reported results (see Footnote 1).

Apparatus and materials. The experiment was conducted in a two-room suite using an Apple II-Plus computer and Sanyo 13" color monitor. The subject was seated at a table in front of the monitor and a response panel consisting of a black box with two buttons on top. The computer was located in the adjacent room. A computer program developed by the authors controlled the task presentation and recorded the subject's choice of button and response latency.

Experimental task. The task consisted of 41 trials. On each trial, a 6×6 white grid appeared on the screen against a black background for 850 ms. Nine randomly chosen squares in the grid were filled in with white. After a pause of 2 s, a second pattern appeared on the screen. On one half of the trials, this pattern was identical to the first grid; on the remaining trials, one square was shifted by one place. The second pattern remained on the screen until the subject responded by pressing one of two buttons indicating either that the patterns were identical or that they were different. All subjects received 50% noncontingent success and failure feedback, with an identical sequence of wins and losses. Feedback was presented immediately following the subject's button press on each trial and consisted of the words *correct* and *incorrect* in the reward/punishment and reward-only conditions, and *correct* and *wrong!* in the punishment-only condition. In addition, the feedback included information on the subject's monetary status. In the reward-only condition, this information, "You win \$.10," followed *correct* trials only, and in the punishment-only condition, "You lose \$.10," followed the *incorrect* trials. No monetary feedback followed the *incorrect* trials in the reward-only condition or the *correct* trials in the punishment-only condition. In the both condition, monetary feedback followed each trial. At the end of the task, which took about 15 min, subjects were asked to wait for the experimenter and informed of their final winnings (randomly assigned amounts ranging from \$1.80 to \$2.20).

Procedure. Subjects were given a consent form to read and sign and were then asked to fill out the Eysenck Personality Questionnaire as well as three other personality questionnaires in the waiting room. The other questionnaires were Schalling's (1978) Multicomponent Anxiety Inventory, the Socialization Scale of the California Psychological Inventory (Gough, 1960), and Barratt's Impulsivity Scale (1959). After approximately one half hour, the subject was taken to the experimental room and seated in front of the monitor. All subjects then received the following instructions:

This study consists of a series of trials in which you have to decide if two patterns match. On each trial, a pattern will flash briefly on the screen consisting of a grid with some of the squares filled in. Then it will disappear and, after a pause, a second pattern will come on that you can look at until you decide if the two patterns matched. Once you decide, press Button 1 (point) if they were the same and Button 2 (point) if they were different. After you press the button, the pattern will go off and you will receive feedback.

In addition, the following paragraphs were read to subjects depending on their experimental condition:

Both condition: In addition to the extra credit points, you will start this study with two dollars. Every time you are correct, you will win a dime, and every time you are incorrect, you will lose a dime. At the end of the experiment, you'll get to keep whatever money remains.

Table 1
Means and Standard Deviations (in Milliseconds) of Response Latencies Following Positive and Negative Feedback for Experiment 1

Feedback	Condition					
	Both		Reward		Punishment	
	Introverts	Extraverts	Introverts	Extraverts	Introverts	Extraverts
Positive						
<i>M</i>	1,888.91	2,111.09	1,971.04	1,665.23	1,737.50	1,839.00
<i>SD</i>	644.11	720.40	626.34	491.78	562.94	551.17
Negative						
<i>M</i>	2,030.64	1,941.54	1,923.18	1,654.04	1,802.09	1,811.95
<i>SD</i>	924.04	730.21	528.37	580.20	733.40	631.72
Total						
<i>M</i>	1,931.95	2,043.36	1,944.23	1,642.15	1,781.79	1,830.77
<i>SD</i>	716.06	722.06	565.81	499.18	575.45	556.03

Note. $N = 22$ for all cells.

Reward-only condition: In addition to the extra credit points, you will win a dime every time you're correct. At the end of the experiment, you'll get to keep whatever money you made.

Punishment-only condition: In addition to the extra credit points, you will start this study with four dollars. Every time you're wrong, you'll lose a dime. Try to keep as much money as you can. At the end of the experiment, you'll get to keep whatever money remains.

After the task, all subjects received their winnings and credit points and were debriefed.

The dependent measure was the latency between presentation of the second pattern and the subject's response in milliseconds.

Results and Discussion

For the analyses, subjects' response latencies were divided into those following positive feedback and those following negative feedback. Separate averages for *post-positive* and *post-negative* latencies were obtained for each subject. Separate analyses of variance (ANOVA) were conducted for each condition using extraversion as a between-subjects variable and type of feedback on prior trials as a within-subjects variable. The mean latencies for extraverts and introverts following each type of feedback in each condition are shown in Table 1. In the both condition, neither the main effect for extraversion nor type of feedback was significant ($F_s < 1.0$). As predicted, the Extraversion \times Type of feedback interaction was significant, $F(1, 42) = 5.73, p < .05$. Although none of the pairwise planned comparisons was statistically significant, the comparison of extraverts' response latencies following reward and punishment approached significance, $F(1, 42) = 3.40, p < .10$. In the reward-only condition, the main effect of extraversion showed a trend for extraverts to respond more quickly overall, $F(1, 42) = 3.21, p < .10$. However, consistent with prediction, the differing styles of reacting to punishment evidenced by the significant interaction in the both condition were not apparent in the reward-only and punishment-only conditions, which yielded no other significant main effects or interactions.¹ Thus, the results support the hypothesis that introverts and extraverts differ in their reaction to punishment. Relative to their response latencies following reward, introverts responded more slowly and extraverts more quickly following punishment.

In addition, the results suggest that a situation incorporating both reward and punishment is necessary for this effect to appear.

Another method of assessing introverts' and extraverts' reaction following punishment is to examine the frequency of individuals who responded more slowly (or more quickly) following punishment than following reward. Seventeen of the 22 introverts responded more slowly following punishment than after reward, whereas only 9 out of 22 extraverts showed this pattern. Using a chi-square analysis, this difference was significant beyond the .025 level, $\chi^2(1, N = 44) = 6.02$. With a stricter criterion requiring a difference of at least 100 ms, 16 out of 22 introverts responded more slowly after punishment than reward, compared with only 4 out of 22 extraverts. This difference was significant beyond the .001 level, $\chi^2(1, N = 44) = 13.2$.

Additional analyses used the other personality scales to determine their relation to subjects' response latencies. Because no a priori predictions were made regarding these measures, the analyses were considered exploratory and were conducted using overall ANOVAs with experimental conditions as a factor. In addition, all 178 subjects were included in these analyses so that sufficient subjects would be available for reliable estimates in analyses involving the interaction of personality factors (e.g., extraversion and neuroticism).

Of the additional measures investigated, neuroticism appeared to be the most important variable. A four-way ANOVA with condition, extraversion, and neuroticism as between-groups variables (using a median split on neuroticism to group subjects, $M = 11$) and type of feedback as a within-groups variable revealed trends

¹ The analyses reported here were also performed without the constraint of equal cell sizes, with essentially the same results. The both condition revealed no significant main effects; however, the interaction of extraversion with type of feedback was significant, $F(1, 57) = 6.88, p < .05$. The planned comparison of extraverts' latencies following reward and punishment (2,085.6 and 1,927.2, respectively) was also significant, $F(1, 57) = 5.13, p < .05$. In the reward condition, the main effect for extraversion became significant, $F(1, 57) = 4.25, p < .05$, again due to faster response latencies for the extraverts. No other significant main effects or interactions appeared in the reward and punishment conditions.

for neuroticism, $F(1, 166) = 3.39, p < .07$, and the extraversion by type of feedback interaction, $F(1, 166) = 3.16, p < .08$, and a significant three-way interaction of extraversion, condition, and type of feedback, $F(2, 166) = 3.49, p < .04$. The three-way interaction is consistent with the finding reported earlier that relative to introverts, extraverts are prone to respond more quickly after punishment than after reward in the both condition. This analysis also elucidated an unexpected and potentially problematic result, the long latencies displayed by extraverts, compared with introverts, in the both condition (see Table 1). The trend for neuroticism is due to stable (low neuroticism) subjects responding more slowly than neurotic subjects. This effect was especially apparent in the both condition (see Figure 1). Moreover, unlike the introverted group in this condition which contained a fairly even number of neurotic and stable subjects, the extraverted group included a preponderance (17 vs. 5) of stable subjects, causing the response latencies of the extraverts to appear slow. The response latencies of the neurotic extraverts in this condition were actually faster than the response latencies in any other cell. This relation of extraversion to neuroticism will be discussed further in the context of Experiment 2.

A comparable ANOVA involving extraversion and psychoticism revealed no significant main effects or interactions. A three-factor ANOVA using the Socialization Scale (So) as a grouping factor revealed a significant main effect for So, with low So subjects responding more quickly overall, $F(1, 169) = 4.32, p < .04$. Comparable analyses using Schalling's Psychic Anxiety Scale and Barratt's Impulsivity Scale revealed no significant effects, although the three-way interaction of impulsivity, condition, and type of feedback in the latter suggested a trend similar to the one observed for extraversion, $F(2, 172) = 2.14, p = .12$. That is, relative to nonimpulsive subjects, impulsive subjects responded more quickly after punishment than after reward in the both condition.

Finally, an interesting feature of these data concerns the fact that extraverts do not exhibit a general tendency to respond more quickly than introverts, as might be expected of a group generally considered to be impulsive. Table 1 also shows the mean response latencies, averaged over the entire task, for extraverts and introverts in each condition. The extraverts responded slightly more slowly in the both and punishment-only conditions, but more quickly in the reward-only condition. If, as suggested by Gray (1971), speed is indicative of a subject's level of general arousal, then it appears that the extraverts were more aroused or motivated in the condition in which they received only reward. Gray (1981) has suggested that extraverts are more sensitive to reward, whereas introverts are more sensitive to punishment. This sensitivity may be related to a tendency to be more easily motivated by appetitive situations. Because these results were interesting but unpredicted, we decided to repeat the reward-only and punishment-only conditions, using more salient feedback in hopes of magnifying the effect.

Experiment 2

Method

Subjects. The subjects in this experiment were 101 male undergraduates recruited in the same manner as for Experiment 1.² Again, subjects were assigned to conditions at random, and assigned to groups according

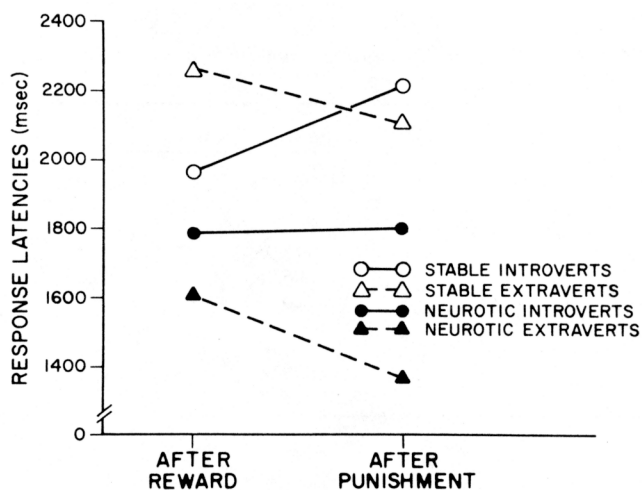


Figure 1. Response latency as a function of prior feedback and group membership for the both condition of Experiment 1.

to whether their extraversion scores were above or below the median (mean for introverts = 11.96, mean for extraverts = 18.20). The experiment and questionnaires were administered by a female experimenter who was blind to subjects' extraversion scores.

Procedure. The procedure was identical to that for the reward-only and punishment-only conditions of Experiment 1 with the exception of the feedback provided and the total winnings, which were constant for all subjects in each condition. The subjects still won or lost 10¢ on trials that involved monetary contingencies, but were provided with cumulative feedback. Subjects in the reward-only condition began the experiment with no money; on incorrect trials they received the feedback *Incorrect* in the center of the screen following their response and on correct trials they saw *Correct! Winnings = \$X.XX*, with their current winnings displayed. They finished the experiment with \$2.00. Subjects in the punishment-only condition started with \$4.00. On correct trials, they saw the word *Correct*; on incorrect trials, they saw *Wrong! Winnings = \$X.XX*, with their current monetary level. They finished the experiment with \$1.90 because of the uneven number of trials, but the experimenter used the excuse of having no change to pay them \$2.00. Thus, subjects saw their monetary status gradually increase or decrease as the task continued.

Results and Discussion

The results are consistent with those of Experiment 1. The overall response latencies for extraverts and introverts in each condition are presented in Table 2. ANOVA shows that there are no significant main effects for group or condition, but the interaction of condition and extraversion is significant, $F(1, 97) = 5.09, p < .05$. Planned comparisons suggest that the effect is largely due to the difference between extraverts' response latencies in the reward-only and punishment-only conditions, $F(1, 97) = 8.23, p < .05$. As in Experiment 1, extraverts responded more quickly in the reward-only condition than in the punishment-only condition. In addition, extraverts responded significantly faster than introverts in the reward-only condition, $F(1, 97) = 5.33, p < .05$. Introverts appeared to respond slightly faster in the punishment-only condition than in the reward-only condition,

² As many subjects as possible were run and retained for analyses in order to examine the joint effects of extraversion and neuroticism.

Table 2
Means and Standard Deviations (in Milliseconds) of Response Latencies for Experiment 2

Condition	Group	
	Introverss	Extraverss
Punishment only		
<i>M</i>	1,747.95	1,861.10
<i>SD</i>	506.96	586.20
<i>N</i>	20	30
Reward only		
<i>M</i>	1,802.08	1,489.35
<i>SD</i>	490.66	287.20
<i>N</i>	25	26

but planned comparisons showed this difference to be nonsignificant.

Although Gray (1981) associates introversion with susceptibility to punishment and extraversion with susceptibility to reward, he suggests a rotation of the dimensions of extraversion and neuroticism proposed by Eysenck. The diagonal running from neurotic introversion to stable extraversion, representing the "anxiety" dimension, would reflect differences in susceptibility to punishment. The "impulsivity" dimension, running from neurotic extraversion to stable introversion, would represent variation in susceptibility to reward. Extraversion, then, is a derived dimension reflecting *relative* sensitivity to signals for reward or punishment, whereas neuroticism reflects the combined degree of susceptibility to signals for reinforcement in general. Consequently, neurotic introverts would be expected to react most to signals for punishment, and neurotic extraverts to react most to signals for reward. In order to investigate these dimensions, subjects were divided at the median ($M = 10$) into neurotic ($M = 14.88$) and stable ($M = 6.00$) groups and average response latencies were computed for subjects in each of the resulting four quadrants for both conditions. It is interesting to note that the results appear to follow Gray's predictions. In the reward-only condition, the neurotic extraverts responded most quickly (1,424.7 ms, $n = 13$) and the stable introverts, who should be least susceptible to cues for reward, the slowest (at 1,952.5 ms, $n = 11$). According to a planned comparison, this difference was significant, $F(1, 93) = 7.03, p < .05$. The other two groups fell in between, 1,683.9 ms, $n = 14$, for neurotic introverts and 1,554 ms, $n = 13$, for stable extraverts. In the punishment-only condition, we found the neurotic introverts responding most quickly at 1,687.6 ms, $n = 10$, and the stable extraverts the slowest at 1,908.8 ms, $n = 15$. This difference was nonsignificant but lies in the direction predicted by Gray. Again, the other two groups responded at an intermediate speed, neurotic extraverts at 1,813.4 ms, $n = 15$, and stable introverts at 1,808.3 ms, $n = 10$. Thus, the group classified by Gray as most impulsive responded fastest in the reward-only condition, whereas the group considered most anxious was quickest in the punishment-only condition. This lends support both to Gray's dimensions and to the interpretation of overall response latency as reflecting a general arousal or motivational variable.

Because the quadrants formed from combining extraversion and neuroticism were in this case more revealing than extraversion

alone, we decided to re-examine the data from Experiment 1 utilizing this approach. As shown in Figure 1, the most striking differences in the both condition are now seen to lie along the impulsivity axis proposed by Gray. The neurotic extraverts responded 245.4 ms faster following punishment than following reward, whereas the stable introverts slowed down by 255 ms after punishment. Thus, including neuroticism appears to differentiate further introverts' and extraverts' distinctive behavioral styles.

General Discussion

As predicted, introverts and extraverts exhibited systematic differences in response speed following reward and punishment feedback. Although these groups are generally considered to differ in sensitivity to punishment, the response latency measures used in this experiment indicate that introverts and extraverts differ in their style of response to punishment as well as in sensitivity to punishment. Evidence for this difference in style of response to punishment is provided by the Group \times Type of Feedback interaction observed in the both condition of Experiment 1. In contrast to introverts, who responded more slowly on trials following punishment than after reward, extraverts demonstrated sensitivity to punishment by responding more quickly following punishment than after reward.

In addition, Experiment 1 provided evidence that motivational context is an important factor underlying group differences in reaction to punishment. As predicted, differences in introverts' and extraverts' reactions to punishment were apparent in the both condition but not in the conditions involving reward-only or punishment-only feedback. This pattern of results provides indirect support for our conceptualization of extraverts' paradoxical increase in response speed following punishment. In contrast to introverts, extraverts appear to react to the availability of reward by establishing a behavioral response set that is resistant to interruption. The resulting failure of punishment to interrupt responding allows the arousal associated with perception of this feedback to facilitate, or intensify, ongoing behavior.

Although not bearing directly on the issue of response to punishment, results from the reward-only conditions provided unexpected evidence that extraverts are more easily "activated" by the availability of reward than are introverts. The reward-only and punishment-only conditions were planned primarily as controls for the both condition of Experiment 1, but these conditions demonstrated that situational contingencies exert an important effect on the overall response speed of introverts and extraverts. A context of reward appears to potentiate a more rapid or impulsive style of responding in extraverts, whereas when only punishment is involved, extraverts respond more slowly than introverts. Brebner and Cooper (1974) have described extraverts as "geared to respond," as opposed to introverts, who are "geared to inspect." In a related psychophysiological account of introversion-extraversion, Stelmack and Plouffe (1983) also contrast introverts' apparently greater sensitivity to stimulation with extraverts' tendency to display bursts of motor activity. Although the data reported here were not designed to contrast stimulus and response sets, the current results suggest that such inclinations are related to or accentuated by motivational contingencies inherent in the situation.

As noted earlier, the framework provided by the septal model of disinhibited behavior affords a broader context for conceptualizing the impulsive behavior of extraverts and other disinhibited individuals. Gray (1971, 1982) in particular, has developed a physiological model that is ideally suited to accommodate interactions between response inclinations and incentive conditions. The model (see also, Fowles, 1980) includes three arousal systems, two that respond to different types of environmental contingencies and one which mediates nonspecific arousal. The behavioral inhibition system (BIS) responds to cues for punishment, frustrative nonreward, and novelty by inhibiting whatever behavior is operative at the time that the cue occurs. It also produces an increase in general arousal manifested as "an increment in the intensity of whatever behavior finally does occur" (Gray, 1975). The BIS acts in opposition to the behavioral activation system (BAS) which responds to cues for reward by initiating approach behavior and also increments general arousal. Thus, together with the general arousal mechanism, the BIS and BAS form a complex arousal system that mediates subjects' reactions to reward and punishment.

Because the BIS and BAS are mutually inhibitory and respond to different situational contingencies, individuals' tendencies to be more responsive to either reward or punishment would reflect, in theory, the level of activity in each of these systems relative to the other. Thus, a tendency for extraverts to overrespond to reward could result from either an overactive BAS or an underactive BIS. Our findings in the both condition, however, appear inconsistent with the notion that extraverts are characterized by a deficient behavioral inhibition system. When we examine individuals' immediate response to either punishment or reward, we find that extraverts are not simply unresponsive to cues for punishment, as one would expect from a dysfunctional BIS. Instead, they appear to respond more quickly following monetary loss than following reward, suggesting that they may experience an increase in arousal without an associated interruption of behavior. In addition, the apparent necessity of reward for potentiating extraverts' paradoxical reaction to punishment suggests that this reaction is related to the functioning of the BAS. That is, cues for reward appear to establish a BAS dominance in extraverts that makes them less likely than introverts to interrupt approach behavior despite cues for punishment or other environmental events to which the BIS responds.

Within this framework, the present results suggest an alternative conceptualization of extraverts' failure to inhibit punished behavior. In contrast to introverts, extraverts appear to be particularly activated by cues for reward. In turn, this response activation reduces the likelihood that cues for punishment will inhibit their goal-directed behavior. Accordingly, punishment will tend to facilitate ongoing behavior instead of initiating response interruption and inspection of environmental cues. As a result, extraverts may fail to learn the environmental cues necessary for the mediation of behavioral inhibition. This pattern of sensitivity to cues for reward and subsequent response facilitation by punishment was manifest particularly in neurotic extraverts. Results from Experiment 2 and from the both condition of Experiment 1 indicated that neurotic extraverts exhibited the fastest reaction times in conditions that included reward and, in addition, that this group was most likely to exhibit acceleration of responding following punishment.

As noted earlier, an important implication of extraverts' failure to interrupt responding following punishment is that it could interfere with their ability to learn from punishment by reducing the amount of time spent processing environmental cues associated with punishment feedback. Consistent with this speculation, Newman et al. (1985) reported that extraverts exhibited poorer passive-avoidance learning than introverts on a task involving reward and punishment feedback but not on the same task with punishment feedback only. Thus, extraverts' failure to learn from punishment in the Newman et al. experiment occurred under the same experimental conditions associated with relatively rapid responding after punishment in the present study. Although cues for punishment serve an important adaptive function in modulating approach behavior, resistance to interruption and reduced sensitivity to cues for punishment could, in addition, underlie potential strengths associated with extraversion. For instance, Tiggemann, Winefield, and Brebner (1982) demonstrated that extraverts are less susceptible to the helplessness inducing effects of noncontingent punishment, providing evidence that extraverts are more likely than introverts to persist in the face of frustration. Furthermore, a study by Pearce-McCall and Newman (1986) raises the possibility that introverts' and extraverts' divergent reactions to punishment may be associated with differences in such dimensions of cognitive style as optimism and perceptions of self-efficacy. They found that introverts reduced their expectations for success and the size of their wagers following pretreatment with noncontingent punishment, whereas extraverts increased their expectations of success and wagered more money following the punishment pretreatment.

Because of the complexities associated with interpretation of our response latency measures, the conclusions just mentioned must be viewed as speculative until the results have been replicated and extended using other measures of arousal and inhibition. In addition, it is important to examine more directly the possible link between inhibitory deficits and learning from punishment. Finally, replication and extension of these results in other syndromes of disinhibition, particularly psychopathy, may provide an alternative perspective on the failure of psychopaths to profit from their mistakes (Cleckley, 1976).

References

- Barratt, E. S. (1959). Anxiety and impulsiveness related to psychomotor efficiency. *Perceptual & Motor Skills*, 9, 191-198.
- Brebner, J., & Cooper, C. (1974). The effect of a low rate of regular signals upon the reaction times of introverts and extraverts. *Journal of Research in Personality*, 8, 263-276.
- Cleckley, H. (1976). *The mask of sanity* (5th ed.). St. Louis, MO: Mosby.
- Dickinson, A. (1975). Suppressive and enhancing effects of footshock on food-reinforced operant responding following septal lesions in rats. *Journal of Comparative and Physiological Psychology*, 88, 851-861.
- Eysenck, S. B. G., & Eysenck, H. J. (1975). *Manual of the Eysenck Personality Questionnaire*. San Diego, CA: ITS Publishers.
- Fowles, D. C. (1980). The three arousal model: Implications of Gray's two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology*, 17, 87-104.
- Gorenstein, E. E. (1982). Frontal lobe functions in psychopaths. *Journal of Abnormal Psychology*, 91, 368-379.
- Gorenstein, E. E., & Newman, J. P. (1980). Disinhibitory psychopathy: A new perspective and a model for research. *Psychological Review*, 87, 301-315.

- Gough, H. G. (1960). Theory and measurement of socialization. *Journal of Consulting Psychology, 24*, 23-30.
- Gray, J. A. (1971). *The psychology of fear and stress*. New York: McGraw-Hill Book Company.
- Gray, J. A. (1975). *Elements of a two-process theory of learning*. London: Academic Press.
- Gray, J. A. (1981). A critique of Eysenck's theory of personality. In H. J. Eysenck (Ed.), *A model for personality* (pp. 246-276). New York: Springer.
- Gray, J. A. (1982). *The neuropsychology of anxiety*. New York: Oxford University Press.
- Hare, R. D. (1978). Electrodermal and cardiovascular correlates of psychopathy. In R. D. Hare & D. Schalling (Eds.), *Psychopathic behaviour: Approaches to research* (pp. 107-143). New York: John Wiley & Sons.
- Newman, J. P., Widom, C. S., & Nathan, S. (1985). Passive-avoidance in syndromes of disinhibition: Psychopathy and extraversion. *Journal of Personality and Social Psychology, 48*, 1316-1327.
- Pearce-McCall, D. N., & Newman, J. P. (1986). Expectation of success following noncontingent punishment in introverts and extraverts. *Journal of Personality and Social Psychology, 50*, 439-446.
- Schalling, D. (1978). Psychopathy-related personality variables and the psychophysiology of socialization. In R. D. Hare & D. Schalling (Eds.), *Psychopathic behavior: Approaches to research*. New York: Wiley.
- Stelmack, R. M., & Plouffe, L. (1983). Introversiion-extraversion: The Bell-Magendie Law revisited. *Personality and Individual Differences, 4*, 421-427.
- Tiggemann, M., Winefield, A. H., & Brebner, J. (1982). The role of extraversion in the development of learned helplessness. *Personality and Individual Differences, 3*, 27-34.
- Waid, W. M., & Orne, M. T. (1982). Reduced electrodermal response to conflict, failure to inhibit dominant behaviors, and delinquency proneness. *Journal of Personality and Social Psychology, 43*, 769-774.

Received January 14, 1985

Revision received June 25, 1985 ■