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Impulsive Motor Behavior: Effects of Personality and Goal Salience

Jo-Anne Bachorowski and Joseph P. Newman
University of Wisconsin—Madison

This experiment used a circle tracing paradigm to extend our recent theoretical development concerning the contributions of extraversion and neuroticism to impulsive performance on continuous motor tasks. Subjects ($N = 137$) completed the Eysenck Personality Questionnaire and were randomly assigned to 1 of 2 circle conditions: The goal condition provided subjects with a salient behavioral end point for their tracings, whereas the no-goal condition promoted behavioral uncertainty. In both conditions, Ss were asked to trace the circle under neutral and inhibition instructions. Using Gray's impulsivity and anxiety dimensions to group subjects, impulsive subjects under inhibition instructions displayed significantly faster tracing speed than nonimpulsive subjects in the presence of a salient goal, whereas anxious subjects appeared behaviorally impulsive in a situation promoting uncertainty and response conflict. Conceptualizing impulsivity and anxiety in terms of extraversion and neuroticism, with impulsive Ss as neurotic extraverts and anxious Ss as neurotic-introverts, it is proposed that Ss' level of extraversion determines the type of stimuli to which they are responsive, and that level of neuroticism influences the magnitude of this reaction.

Inappropriate response modulation, particularly deficient response inhibition, has been a focal point of many theories of impulsivity (Buss & Plomin, 1975, 1984; Douglas, 1983; Gorenstein & Newman, 1980; Kagan, Rosman, Day, Albert, & Phillips, 1964; Kipnis, 1971; Ross & Ross, 1976; Shapiro, 1965). Several paradigms, including passive avoidance (Newman, Widom, & Nathan, 1985), response interference (Waid & Orne, 1982), and signal detection (Neuchterlein, 1983), have been used to examine inhibitory deficits. Such tasks provide information about the ability of impulsive subjects to inhibit responding during discrete trials and in response to intermittent stimuli. An alternative method of examining response modulation is to use continuous tasks. The dependent measures in continuous paradigms are typically response accuracy and the total time taken to complete a specific task, such as the time taken to trace a figure.

In the present experiment, a circle tracing task was used to extend our theoretical framework (see also Fowles, 1980; Gray, 1981) to impulsive performance on continuous motor tasks. It is advantageous to use this type of motor task to investigate impulsive behavior for several reasons: (a) Speed of movement is central to many descriptions of impulsive behavior; (b) continuous motor sequences, although common to many situations, are quite different from discrete movements; and (c) the task lends itself to manipulations that are useful for exploring stimulus dimensions that may interact with anxiety and impulsivity to influence impulsive motor speed. Briefly, we hypothesize that the personality dimensions of both impulsivity and anxiety contribute to impulsive behavior in continuous motor paradigms, but the situational cues eliciting impulsive behavior are quite different for these two dimensions.

Tasks similar to the circle tracing task have been used as measures of impulsivity with a variety of subject populations, including children referred for outpatient evaluation (Milich & Kramer, 1984), hyperactive children (Homatidis & Konstantareas, 1981), juvenile delinquents (Siegman, 1961), and normal adults (Bachorowski & Newman, 1985; Barratt, 1959; Barratt & Patton, 1983). Although many of these studies have required subjects to proceed as slowly as possible, because failure to inhibit movement is central to theories of impulsivity, other experiments have examined motor speed when subjects are asked to move as quickly as possible (Milich & Kramer, 1984), or under neutral instructions that include no mention of response speed (see Barratt & Patton, 1983). Each of these instructional conditions (slow, fast, and neutral) has met with varying degrees of success in discriminating between impulsive and nonimpulsive subjects. At best, the results have been provocative but unreliable. Rather than being a reflection of weak validity for the motor inhibition paradigm as a measure of impulsivity, it is possible that this unreliability is the product of differences in contextual variables among studies and the unsuspected contribution of anxiety to motor speed.

In our initial study (Bachorowski & Newman, 1985), we used a circle tracing task and found that impulsives were significantly faster than nonimpulsives under inhibition tracing instructions, supporting the hypothesis that impulsives have faster motor speed in a task calling for slow, controlled movement. Impulsive and nonimpulsive subjects did not differ under neutral tracing instructions. As is often the case in impulsivity research, how-

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Correspondence concerning this article should be addressed to Jo-Anne Bachorowski, who is now at the Department of Psychology, University of Colorado, 1200 Larimer Street, Denver, Colorado 80204.

ever, attempts to replicate these findings were only partially successful. In addition to inconsistent relations between impulsivity and tracing speed, under both neutral and inhibition instructions, our results suggested that anxiety as well as impulsivity was associated with individual differences in motor speed. Furthermore, we suspected that the contributions of impulsivity and anxiety to motor speed were governed by different components of the experimental situation. To reconcile the lack of consistency in results from one study to the next, we began to focus on the interaction between personality and the task demands of the circle tracing paradigm. Over the course of this research program, a theoretical understanding of the relations between personality and motor inhibition evolved.

Several experiments were conducted to investigate the effect that contextual features of the circle tracing task have on motor speed (e.g., Bachorowski & Newman, 1986). One principal manipulation involved the presence or absence of a behavioral goal. Fowles (1980), Gorenstein and Newman (1980), and Gray (1971, 1972, 1981) have proposed that, relative to nonimpulsives, impulsives are characterized by stronger approach behavior. We hypothesized that this predisposition would interact with situational factors, such as the physical features of the tracing task. For instance, the presence of a salient, concrete behavioral goal or end point may act as a stimulus for approach behavior. In performing the inhibition tracing, there is an inherent conflict between having to move toward a goal while inhibiting speed. Because of their stronger approach behavior, impulsives may be less able than nonimpulsives to inhibit their approach behavior when the situation includes a concrete goal. This hypothesis makes two assumptions: (a) Impulsives have stronger approach behavior than nonimpulsives, and (b) impulsives' approach behavior is triggered by environmental goal stimuli. Both of these assumptions are supported by theoretical and empirical accounts of disinhibited behavior (e.g., Barratt & Patton, 1983; Douglas, 1983; Fowles, 1980; Gorenstein & Newman, 1980; Gray, 1971, 1972, 1981, 1982a; Nichols & Newman, 1986; Shapiro, 1965; Zentall & Zentall, 1983).

We also thought it possible that situational goals are important in mediating the relations between motor inhibition and anxiety. However, we reasoned that anxious subjects are affected by different aspects of a goal situation and by different psychological mechanisms than are impulsive subjects. Specifically, we expected that anxious subjects would display impulsive motor speed *in the absence* of a salient behavioral goal. This hypothesis was predicated on the notion that anxious individuals are particularly prone to behavioral disruption when confronted with situational uncertainty (for discussions of the role of uncertainty in anxiety, see Epstein, 1972; Garber, Miller, & Abramson, 1980; Lazarus & Averill, 1972; Mineka, 1985). Thus, we expected that anxious subjects would display impulsive motor speed on the tracing task when confronted with the uncertainty inherent in situations that lack a concrete goal or end point.

Personality effects for motor speed with neutral tracing instructions have been inconsistent across studies (e.g., Bachorowski & Newman, 1986). Significant effects indicated that impulsives traced faster than nonimpulsives when a behavioral goal was present but that these groups did not differ in the absence of a goal (i.e., in situations characterized by uncertainty). Interestingly, the inclusion of a neutral tracing appears to have influenced whether impulsivity effects were obtained on the subsequent inhibition tracing. That is, effects for impulsivity have only been obtained when a first, neutral tracing was included. Anxiety measures have never related strongly to neutral tracing speed in our investigations.

Despite our use of the terms *impulsivity* and *anxiety*, we have come to rely nearly exclusively on the Extraversion (E) and Neuroticism (N) scales of the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975) for the measurement of these constructs for the following reasons: (a) Of the variety of personality inventories available, the relations between tracing speed and personality have been most consistent for E and N; (b) the observed relations between E, N, and motor speed have also been obtained in quite different behavioral paradigms (e.g., Nichols & Newman, 1986); and (c) the theoretical structures being developed to describe the psychological underpinnings of E and N mesh with our current understanding of individual differences in tracing speed. In particular, Gray's (1971, 1981) proposed dimensions of impulsivity and anxiety have proved useful in explaining the results. In Gray's model, the orthogonal axes E and N are rotated 45°. Using this perspective, the space between stable introversion (E−N−) and neurotic extraversion (E+N+) describes the impulsivity dimension; impulsives are characterized as having high E and N scores, and nonimpulsives score low on both scales. Anxiety is proposed to vary between stable extraversion (E+N−) and neurotic introversion (E−N+). Thus, anxious individuals are characterized by low E and high N scores, whereas nonanxious persons score low on N but high on E.[1] Using this perspective, it is important to note that Neuroticism is a hypothetical arousal dimension common to both impulsivity and anxiety (see also Wallace, Bachorowski, & Newman, in press).

In previous experiments (e.g., Bachorowski & Newman, 1986), we have made post hoc statistical comparisons to assess whether impulsives trace faster than nonimpulsives when a salient goal is present and whether anxious subjects trace faster than nonanxious subjects in situations characterized by uncertainty (i.e., the absence of a behavioral goal and minimal instructions). These unplanned comparisons suggested that this approach to understanding impulsive motor speed was promising; however, insufficient power has always precluded meaningful comparisons. The general pattern over the course of these studies has indicated that the combination of these dimensions, with concurrent attention to situational variables, may be fundamental to an understanding of impulsive motor speed.

The present experiment was designed to replicate and extend

[1] In this report, we have chosen to use the term *impulsive* to describe neurotic extraverts and the term *anxious* to denote neurotic introverts. Both of these terms are shorthand notations for a combination of psychological processes associated with extraversion and neuroticism. In our use of impulsivity and anxiety, we do not mean to imply that either is a unitary construct. Rather, we consider both constructs to represent particular combinations of extraversion and neuroticism. In this sense, we differ from Gray (1981), who maintains that the impulsivity and anxiety dimensions are primary.

the results that we obtained using the circle tracing paradigm, and was intended to be a direct test of our hypothesis regarding the relations among E, N, and motor inhibition tracing speeds. A neutral and an inhibition tracing were included in two circle conditions: One condition included a behavioral goal, whereas the other did not. Because of the inconsistent results we have obtained using a neutral tracing, no a priori predictions were made for the neutral tracings in this study. For the inhibition tracings, we hypothesized that both impulsives and anxious subjects would appear behaviorally impulsive through faster tracing speeds, but that the contexts eliciting impulsivity would differ. Specifically, it was predicted that impulsive subjects (E+N+) would trace more quickly than nonimpulsive subjects (E−N−) when the task included a concrete behavioral goal; furthermore, it was predicted that anxious subjects (E−N+) would display poorer motor inhibition than nonanxious subjects (E+N−) in the situation promoting uncertainty (i.e., the no-goal condition).

The rationale for inhibition tracing predictions flows from our understanding of extraversion and neuroticism (Wallace et al., in press), and uses the neuropsychological theory developed by Gray (1972, 1981, 1982a, 1982b; Gray, Owen, Davis, & Tsaltas, 1983) and elaborated by Fowles (1980). Gray's model of impulsivity and anxiety incorporates three arousal systems (Fowles, 1980): a behavioral activation system (BAS), a behavioral inhibition system (BIS), and a general arousal system. The BAS responds to incentives, such as cues for reward and relieving nonpunishment, and is analogous to an approach device. Fowles (1980) has described the BAS as an appetitive, reward-seeking system that functions to initiate approach behavior. Both the BAS and BIS have positive inputs to the general arousal system. When an adequate stimulus is registered by the BAS, its positive inputs to the general arousal system lead to an increase in the speed or intensity of subsequent behavior.

In contrast to the BAS, the BIS is responsive primarily to cues for punishment and nonreward; in addition, Gray has posited that novelty and uncertainty may activate the BIS (Gray, 1985). The initial effect of BIS activation is the interruption of ongoing behavior. However, activity in the BIS, as in the BAS, produces an increment in general arousal. In turn, this arousal leads to an increase in the intensity or vigor of whatever behavior follows the initial interruption. In the event that an individual continues with approach behavior, a seemingly paradoxical increase in response speed will be the consequence of BIS activation (see Gray, 1971; Nichols & Newman, 1986).

In using this model to predict behavior in the circle tracing paradigm, we make one assumption that is not explicit in Gray's description of the BAS: Behavioral goals can act as inputs to the BAS. This is not an unreasonable assumption: If uncertainty can act as an input to the BIS, then its converse, an identifiable approach stimulus, may be an adequate input to the BAS. The presence of a goal would then lead to an increase in the strength or speed of approach behavior consequent to BAS input to the general arousal system. Using this logic, individuals with more dominant BAS activity would be expected to be more responsive to behavioral goals.

An alternative means for understanding our predictions is to restrict focus to the orthogonal dimensions of E and N. Differences in E will determine the extent to which an individual is sensitive to either contextual uncertainty or concrete goal stimuli. Uncertainty will have a greater impact on BIS-dominant introverts, whereas a salient goal will evoke a greater response from BAS-dominant extraverts. The behavioral response to these stimuli is expected, however, to depend on the level of N. We consider the neuroticism dimension to be analogous to the degree of reactivity in Gray's general arousal system (Wallace et al., in press). Following Gray's (1971) statements regarding the effects of general arousal, then, a subject's level of neuroticism will tend to increase the vigor or intensity of behavior given an adequate stimulus. Thus, given an adequate eliciting stimulus (input to the BAS or the BIS) and a continuous motor task that precludes response inhibition, the fact that both anxious (E−N+) and impulsive (E+N+) subjects share a high degree of neuroticism will tend to elicit rapid responding in both groups.

Method

Subjects

Subjects were 137 male undergraduates enrolled in introductory psychology classes at the University of Wisconsin. They participated in this study in exchange for extra credit points.

Procedure

Prior to the task reported here, all subjects completed a computer-administered version of the EPQ and a computer-administered task used to assess passive avoidance. Subjects were consecutively assigned to either a goal or no-goal condition. They were tested individually and were seated at a right angle to one of four female experimenters. Motor speed was assessed with a circle tracing task. The two circles used corresponded to one of two experimental conditions. Each circle was 20 in. (50.80 cm) in diameter, drawn on a cardboard square, and covered with Plexiglas. The goal condition circle had a small line demarcating the starting and finishing point for the tracings. The words "GO" and "STOP," in ¾ in. (1.91 cm) high green and red lettering, respectively, were affixed on either side of the starting line in an effort to increase the salience of the goal. The no-goal condition circle had no markings on it.

Subjects in the goal condition were first asked to trace the circle (neutral tracing). After completing this tracing, they were told "good" in an effort to reduce stress associated with performance uncertainty. They were then asked to "trace the circle again, but this time as slowly as possible." No-goal condition subjects were first told to "trace on top of the black line" until the experimenter told them to stop. Subjects in this condition were asked to start their tracings in the same location as subjects in the goal condition to control for starting position and arm fatigue across conditions. To obtain a reliable estimate of completion time for a full tracing of the circle under neutral instructions in the no-goal condition, and without providing a behavioral goal for subjects' inhibition tracings, subjects were not told to stop on their first tracing until they had traced approximately 1¼ times around the circle. However, the time recorded for this tracing was the same in both conditions (i.e., the time taken to complete one full tracing of the circle). Having completed the neutral tracing, they were told "good" and were then asked to "trace on top of the black line again, but this time as slowly as possible" until they were told to stop.[2] A maximum of 720 s was allotted for the inhibition tracing in both conditions, but subjects were not informed of this maximum.

Results

Analyses were accomplished by dividing subjects into four groups using the medians of the distributions of the Extraversion (E) and Neuroticism (N) scales from the EPQ. The medians were 16 and 11 for E and N, respectively; these medians are comparable to those obtained in other experiments using college students in our laboratory (e.g., Bachorowski & Newman, 1986; Nichols & Newman, 1986; Patterson, Kosson, & Newman, 1987). These breakdowns resulted in 21 E−N−, 34 E−N+, 52 E+N−, and 33 E+N+ subjects. A three-way (E × N × Condition) analysis of variance (ANOVA) was then conducted for the neutral and inhibition tracings. For the neutral tracing, there was a significant effect for condition, $F(1, 132) = 6.76$, $p < .01$. Across personality measures, and as with previous experiments, subjects traced the circle faster in the goal condition than in the no-goal condition. There were no main effects for either E or N, nor were any of the interactions between personality or personality and circle condition related to motor speed on the neutral tracing. Two comparisons using the groups formed by Gray's dimensions of impulsivity and anxiety were conducted. The first was a comparison between impulsive (E+N+) and nonimpulsive (E−N) subjects within the goal condition, and the second was between anxious (E−N+) and nonanxious (E−N−) subjects in the no-goal condition. Neither comparison was significant for the neutral tracing, $F(1, 132) = 1.62$, *ns*, and $F(1, 132) = .55$, *ns*, for the impulsivity and anxiety comparisons, respectively.

The results for the inhibition tracing were consistent with our predictions using Gray's dimensions of impulsivity and anxiety. Within the goal condition, impulsives traced faster than did nonimpulsives, $F(1, 132) = 3.82$, $p = .05$; the means and standard deviations for the E+N+ and E−N− quadrants were, respectively, 121.78 (56.06) and 251.50 (202.55). Furthermore, the E+N+ subjects had the fastest inhibition tracing times of the four quadrants of subjects (see Figure 1). In the no-goal condition, the anxious subjects traced the circle significantly faster than the nonanxious subjects, $F(1, 132) = 8.86$, $p < .01$, as predicted by our use of Gray's model; the means and standard deviations were 184.60 (120.27) for the E−N+ quadrant and 361.46 (246.87) for the E+N− quadrant. Also, as depicted in Figure 1, the E−N+ subjects were the fastest of the four groups of subjects in the no-goal condition.

The results obtained from the three-way ANOVA (E × N × Condition) were also interesting. The condition effect for the inhibition tracing was similar to that for the neutral tracing: Overall, subjects traced the circle faster in the goal condition than in the no-goal condition, $F(1, 132) = 10.03$, $p < .01$. With respect to the personality variables, there was no main effect for E, $F(1, 132) = .02$, *ns*, but there was a significant interaction between E and condition, $F(1, 132) = 4.91$, $p < .05$, with extraverts responding significantly faster in the goal condition than in the no-goal condition, $F(1, 132) = 12.07$, $p < .001$. In addition, there was a main effect for N, $F(1, 132) = 5.72$, $p < .025$: Neurotic subjects traced faster than stable subjects in the inhibition tracing. Together with the nonsignificant N × Condition interaction, $F(1, 132) = .33$, *ns*, this finding indicates that neuroticism was associated with faster tracing regardless of condition. The three-way interaction of E, N, and condition was not significant, $F(1, 132) = .01$, *ns*.

Discussion

The results of this experiment provide evidence that both impulsive and anxious subjects may display poor motor inhibition on a task used traditionally as a behavioral measure of impulsivity. Furthermore, the presence of a behavioral goal versus the uncertainty associated with the absence of a clear end point was found to mediate the relations between personality and tracing speed under motor inhibition instructions.

Turning first to the analyses for the neutral tracing, neither extraversion nor impulsivity was related to tracing speed, thus adding to the inconsistencies in impulsivity results that have been observed for this tracing across studies (e.g., Bachorowski & Newman, 1986). At this point, we cannot offer a sound interpretation for these inconsistencies. Our experience suggests that the inclusion of a behavioral goal is necessary for obtaining impulsivity effects because these effects have never been achieved in the absence of a goal in the neutral tracing. The data from this experiment are consistent with previous results in demonstrating no significant effects for anxiety on the neutral tracing.

Although the direct relation between personality and speed on the neutral tracing has been inconsistent, our experiments (Bachorowski & Newman, 1986) indicate that the neutral tracing strengthens the impulsivity effects that are observed on the inhibition tracing. It may be that the opportunity to trace the circle under neutral instructions serves to establish a dominant response or engages an approach system in impulsives, making them less likely to modify this faster response set in the inhibition tracing (see also Barratt & Patton, 1983). That is, impulsives may be less capable of motor inhibition when their most recent motor behavior has been self-paced and faster than that required by the subsequent situation. Alternatively, it is possible that the opportunity to trace the circle under neutral instructions reduces uncertainty associated with performance, increasing the likelihood that nonimpulsives (including anxious subjects) will display adequate motor inhibition.

In discussing the results for the motor inhibition tracing, emphasis will be given to the joint influence of personality and contextual variables. We propose that impulsives' tracing speed in the goal condition was determined by their stronger approach behavior, relative to nonimpulsives, and that their predisposi-

[2] One reviewer noted that independent checks on the condition manipulations were not included in the procedure. The goal condition manipulation was assumed to be an adequate input to the BAS, whereas the no-goal stimulus situation was assumed to be an adequate input to the BIS. Because these inputs create inferred but not measurable internal states, they were not directly available to a manipulation check. Instead, these states are measured by assessing behavior presumed to reflect these states. In the future it may be helpful to use self-report measures to bolster interpretation of the condition manipulation.

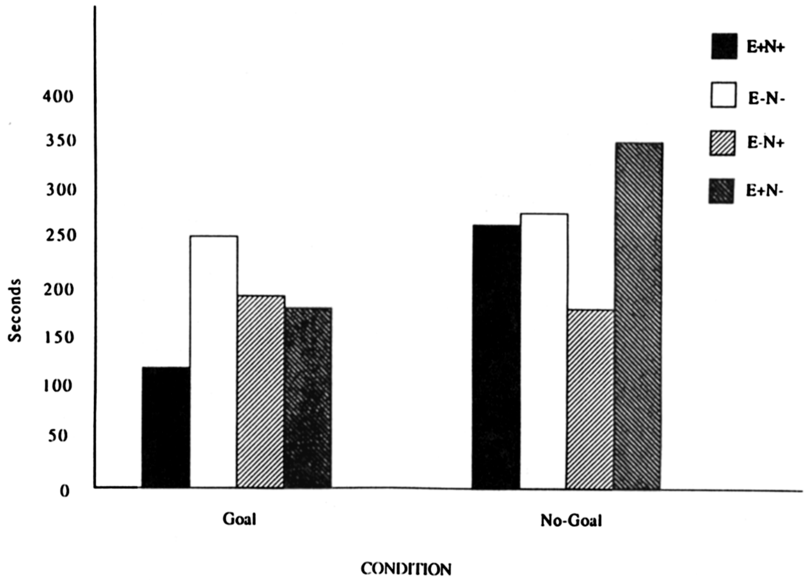

Figure 1. Motor speed for the inhibition tracing under goal and no-goal conditions. E = extraversion, N = neuroticism.

tion for stronger approach behavior was triggered by the presence of a salient behavioral goal and mediated by an increase in level of arousal (e.g., Gray, 1982a, 1982b).[3] Anxious subjects also demonstrated "impulsive" motor speed. However, we propose that the constitutional mechanism and situational determinants were quite different for these subjects. As for impulsives, we presume that the rapid tracing speed of anxious subjects reflected an increment in their level of general arousal. In contrast to impulsives, the increment in arousal driving the tracing speed of anxious subjects was produced when uncertainty was inherent in the situation. Although such an increment in arousal would normally engender behavioral inhibition in anxious subjects, it resulted in response facilitation when discontinuation of behavior was not an option (cf. Green, 1987).

This account of the inhibition tracing results incorporates our understanding of the orthogonal dimensions of extraversion and neuroticism. We assume that the level of extraversion determines sensitivity to behavioral goal stimuli. Extraverts are considered to be responsive to the presence of behavioral goals, whereas introverts are held to be especially reactive to the uncertainty associated with the absence of a clear goal. Neuroticism, being analogous to the degree of reactivity in Gray's general arousal system (Wallace et al., in press), determines the intensity of behavior. In a continuous motor task, reactivity will necessarily be reflected in more rapid tracing speeds. Therefore, given a motivationally significant input to either behavioral system, neuroticism will be related to tracing speed regardless of goal manipulations.

It is the specific combination of extraversion and neuroticism that will predict the behavioral response to goal manipulations. Thus, impulsives, with their particular combination of extraversion and neuroticism, are expected to respond strongly to the presence of a goal. Anxious subjects, on the other hand, are expected to react strongly to uncertainty by virtue of their location within Eysenck's two-dimensional space. The results of this study are notably consistent with this conceptualization. The significant extraversion by condition interaction demonstrates that extraversion was, indeed, mediating the relation between the goal manipulation and tracing speed. On the other hand, the significant main effect for neuroticism, in the absence of any interaction, illustrates that this component of personality was related to speed regardless of condition.

Other investigators have also used the constructs of arousal and goals in their explanations of disinhibited behavior (e.g., Barratt & Patton, 1983; Eysenck, 1981; Eysenck & Eysenck, 1985; Humphreys & Revelle, 1984; Zentall & Zentall, 1983; Zuckerman, 1978). Frequently, incentives are used to promote or magnify approach responding in impulsive subjects (e.g., Newman et al., 1985; Nichols & Newman, 1986; Pearce-McCall & Newman, 1986). To our knowledge, the importance of physical goal salience in provoking impulsive responding has not been explored. Thus, the current results seem to suggest that a salient goal may, like the opportunity to win tangible incentives, activate the BAS and, consequently, potentiate the approach behavior of impulsive subjects (cf. Gray, 1981).

[3] The use of the term *arousal* is admittedly problematic. This is exacerbated by several factors, including the vagaries associated with its use, the lack of a generally agreed upon index of arousal, and, in the present study, the absence of auxiliary measurement. In our use of the term, arousal is indexed by the speed or intensity of ongoing behavior. An "increment" or "increase in level of arousal" is assumed to be a phasic response and to have occurred when the behavioral output of one group of subjects is faster or more intense than a relevant comparison group. Therefore, we have used *arousal* as a mediating construct to account for predicted behavior.

We have argued that the impulsive behavior of anxious subjects is also mediated by an increase in arousal. However, the stimuli precipitating this arousal increment are quite different from those producing the increment in impulsive subjects. The present results implicate uncertainty as one important determinant of anxious subjects' deficient motor inhibition (for other discussions of the roles of arousal and uncertainty in anxiety, see Berlyne, 1960; Garber et al., 1980; Lazarus & Averill, 1972; Miller, 1979; Mineka, 1985). However, the fact that there were no relations between anxiety and motor speed in either neutral tracing indicates that uncertainty alone is not sufficient to engender impulsive motor speed. This variable appears to be critical only in a situation characterized by conflict between opposing response tendencies.

Finally, it is likely that our response format is another situational factor having an effect on the expression of impulsive responding. The significance of using a continuous motor task, as opposed to a discrete trial task, may also be elucidated with reference to Gray's model. Whereas response conflict tends to produce response interruption in anxious subjects (e.g., neurotic introverts) and response facilitation in impulsive subjects (e.g., neurotic extraverts) in a discrete trial situation (Nichols & Newman, 1986; Patterson et al., 1987), no such divergence is possible on a continuous performance measure. Given that subjects must continue their approach behavior in such tasks, the vigor or speed of responding will reflect the combined influence of BIS and BAS input to the arousal system (Gray, 1971). Importantly, this conceptualization indicates that under certain circumstances, anxious subjects may, like their impulsive counterparts, display a paradoxical facilitation of response speed (cf. Geen, 1987).

In summary, the results of this experiment and earlier experiments serve to highlight factors that may be complicating the assessment of impulsive behavior. In particular, specific contextual stimuli and anxiety can influence motor speed. Appreciating the impact of these variables will contribute to progress in comprehending the mechanisms of impulsive motor behavior. Further research designed to assess motor speed under conditions that enable independent manipulation and evaluation of arousal, response options, and the personality constructs of impulsivity and anxiety should provide a greater understanding of the complex interaction of personality and situational variables that contribute to impulsive behavior.

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