

Impulsivity in adults: motor inhibition and time-interval estimation

JO-ANNE BACHOROWSKI and JOSEPH P. NEWMAN

Department of Psychology, University of Wisconsin, Madison, WI 53706, U.S.A.

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Summary.—There is a need for the development of behavioral measures of impulsivity in order to elucidate the specific qualities of impulsive persons. The relationships between two behavioral measures of impulsivity and several personality inventories frequently used to assess impulsivity were examined using 40 male Ss. The behavioral measures involved a motor-inhibition (MI) task and time-interval (TI) estimation. The personality measures included the Extraversion (E), Psychoticism (P) and Neuroticism (N) scales of the Eysenck Personality Questionnaire (EPQ), Barratt's Impulsivity Scale (BIS) and Gough's Socialization Scale (So). Significant relationships between MI scores and E, BIS and a proposed dimension of impulsivity obtained by the formation of E-P quadrants were found. In addition, performance on this task was related to So, P and E-N quadrants in the predicted directions. The consistency of these results supports the use of this task as a behavioral measure of impulsivity in adults. Although personality inventory scores were not related to estimations, significant (negative) correlations were obtained between TI estimations and MI scores. The results indicate that TI estimation by itself is not an adequate measure of impulsivity, but does have implications for understanding impulsive behavior.

INTRODUCTION

The term 'impulsive' is used frequently in clinical practice to describe disinhibited behavior in both children and adults. Historically, there appears to be a split between the methodology used to investigate impulsivity in children and that used with adults. Studies with children have used behavioral tasks in conjunction with personality inventories and observational assessments; studies with adults have relied predominantly on personality inventories, often to the exclusion of behavioral measures. Although self-report measures are useful for identifying individuals' locations on an hypothesized trait dimension, these questionnaires are not as beneficial in elucidating the mechanisms of impulsive, disinhibited behavior. Behavioral measures may be capable of filling this gap.

Behavioral measures have been used successfully to discriminate children showing poor impulse control from those who do not, e.g. hyperactive children (Homatidis and Konstantareas, 1981; Kendali and Finch, 1979). One of the assumptions guiding these studies is that the behavioral expression of impulsivity involves several interrelated components. Most likely, the behavioral expression of impulsivity in adults also involves several components. However, it has not been established that adults identified as impulsive on the basis of personality inventories also score impulsively on behavioral measures of impulsivity. The present study was designed to determine the interrelationships between two behavioral measures and several self-report inventories which are frequently used as measures of impulsivity in adults.

The first behavioral measure was a motor-inhibition (MI) task. It was hypothesized that impulsive Ss would show less tendency to inhibit motor activity than non-impulsive Ss. Homatidis and Konstantareas (1981) reported data indicating that the task is able to discriminate hyperactive children from a control group. Thus, it may be expected that impulsive adults identified by their scores on personality inventories, also would be distinguished from controls by their apparently reduced capacity for MI. The second behavioral measure was a time-interval (TI) estimation task. Although the number of published reports on the relationship between TI estimation and personality variables is considerable, and the results are inconsistent, the task was included in this study to determine its relationship to MI in an adult population. Siegman (1961) reported negative correlations between motor impulse control scores and TI estimations. In this study, two hypotheses were made:

- (1) Ss identified as impulsive by personality inventories would tend to overestimate intervals as compared to non-impulsive Ss; and
- (2) TI estimation scores would correlate negatively with MI scores.

Several personality measures were used in order to determine the interrelationships between these measures of impulsivity and the two behavioral measures. The inventories included the Extraversion (E), Psychoticism (P) and Neuroticism (N) scales of the Eysenck Personality Questionnaire (EPQ; Eysenck and Eysenck, 1975), Barratt's Impulsivity Scale (BIS; Barratt, 1959) and Gough's Socialization Scale (So; Gough, 1956).

Impulsiveness is considered basic to the concept of extraversion (e.g. Eysenck, 1981), and the E scale is frequently used as a measure of impulsivity. It was hypothesized that extraverted Ss would demonstrate less of an ability to display MI and make larger TI estimations than introverted Ss. Gray (1970, 1972) proposed that orthogonal dimensions of impulsivity and anxiety are located within the two-dimensional space formed by I-E and N. The impulsivity dimension runs from stable-introverted (low-impulsive) to neurotic-extraverted (high-impulsive). It was hypothesized that E+N+ Ss would have lower MI scores and larger TI estimations than E-N- Ss. Due to the recent development of the P scale, little is known about the behavior of Ss endorsing these items. No *a priori* hypotheses were made with regard to P and its relationship to the other measures and the tasks, although these were examined.

The BIS is a second commonly-used measure of impulsivity. It was hypothesized that Ss scoring high on this scale would not demonstrate MI and would overestimate intervals. The So scale was included because of its use in research with psychopathic Ss, a population consistently described as impulsive. Although this scale does not have an explicit impulsivity component, it was predicted that So- Ss would perform impulsively on the behavioral measures as compared to So+ Ss.

METHOD

Subjects

Subjects were 40 male undergraduates randomly selected from a larger sample of students who participated in a group testing procedure which included the administration of the EPQ and So scale. Ss received extra credit points for group testing and were paid for their participation in this study.

Procedure

Subjects' ability to demonstrate motor control was assessed by use of a MI task. Testing was conducted on 2½" and 20" dia circles which were drawn on cardboard squares and covered with Plexiglas. Two sizes of circles were used to determine whether performance was consistent for groups across changes in task dimensions. Ss were first asked to trace each circle, and were then asked to trace each circle as slowly as possible. In order to control for individual differences in response to neutral instructions, the difference scores between the first and second tracings for each circle were used in the analyses. Smaller difference scores, as measured in seconds, indicate less of an ability to display MI than larger difference scores.

The procedure for TI estimation was a replication of that used by Siegman (1961). Ss were asked to estimate 5-, 15- and 25-sec intervals; the beginning and end of each interval was marked by the click of a stopwatch. In order to control for serial position effects, one-half of the Ss were presented the intervals in the order 5, 25 and 15 sec, and the other half received the reverse order of presentation. The order of presentation of the two circles was counterbalanced, and circle and TI task presentations were counterbalanced across Ss. Ss completed the BIS after the tasks.

RESULTS AND DISCUSSION

A correlation matrix of the EPQ, BIS and So scores is shown in Table 1. Significant correlations in the expected directions were obtained between E and BIS, and E and So. P correlated significantly with So in the negative direction; given the small range of P scores (0-9), it appears that Ss endorsing even a few P items may have a tendency toward socially-deviant behavior.

A median split was used to divide Ss into groups for each of the personality measures. Table 2 shows the results of the MI task for the personality inventories. There was a strong correlation ($r = 0.90, P < 0.001$) between Ss' scores on the 2½" and 20" circles, indicating that performance of Ss was consistent across the two conditions. Inspection of the data confirmed that it was the second tracing, when Ss were asked to trace the circles as slowly as possible, that produced the differences between groups. As hypothesized, extraverts obtained significantly smaller MI scores than introverts on both the 2½" and 20" circles. In addition, high BIS scorers obtained smaller MI scores than low BIS scorers; again, the results were significant for both circles.

In order to test the possibility that Gray's (1970, 1972) proposed dimension of impulsivity predicts performance on this MI task, Ss were divided into two groups: those who fell above the median on both the E and N scales; and those who fell below the median on both scales. This breakdown produced 10 Ss/group. The results for both circles were not significant. However, the differences between means were in the predicted direction.

Because of the recent development of the P scale, little research has been conducted on this dimension and its relationship to behavioral measures. The scale was included in the analyses because it contains an impulsivity component which is somewhat different than that of the E scale. It has been proposed that E and P may interact to form a higher-order factor of impulsivity (e.g. Levey and Martin, 1981; Frcka, Beyts, Levey and Martin, 1983). Frcka *et al.* (1983) reported that although there were no main effects for P or E, there was a highly significant $P \times E$ interaction on the overall level of eyelid conditioning. In the present study, there was no significant difference between P+ and P- Ss on either circle,

Table 1. Intercorrelations of personality measures

	EPQ-E	EPQ-N	EPQ-P	EPQ-L	So
EPQ-E					
EPQ-N	0.02				
EPQ-P	0.06	0.26			
EPQ-L	-0.22	-0.28	-0.30		
So	-0.38	0.04	-0.54	0.13	
BIS	0.65	-0.01	0.23	0.22	-0.25

$n = 40$ for all groups.

Table 2. Means and *F*-ratios for MI scores and personality measures

Measure	<i>n</i>	2½" Circle				20" Circle			
		High	Low	<i>F</i>	<i>P</i>	High	Low	<i>F</i>	<i>P</i>
E	20	29.58	70.35	7.74	<0.01	110.28	292.71	8.65	<0.01
BIS	20	33.28	66.64	4.85	<0.05	133.16	269.83	4.41	<0.05
E-N	10	30.11	60.11	2.00		114.94	200.67	1.28	
P	20	39.48	60.45	1.78		158.25	244.74	1.65	
E-P	11	19.44	75.56	9.86	<0.01	96.55	316.47	10.00	<0.01
So	20	55.20	44.73	0.43		230.44	172.75	0.71	

n refers to the number of Ss in each group. A median split was used to form the groups for each personality measure. The values reported for the circle are the mean difference scores (in sec) for that group.

although P+ Ss did tend to display less MI than P- Ss. However, when Ss were divided into E+P+ and E-P- quadrants, using the median values for both scales (11 Ss/group), there were significant differences for both circles. These results provide modest support for the notion that E and P may combine to produce a factor of impulsivity. However, the increment in variance accounted for by the addition of P to E did not approach statistical significance.

The final analysis for the MI task was with the So scale. The results were not significant but were in the expected direction, with So- Ss showing less MI than So+ Ss.

In assessing the results of the MI task, two interesting findings became apparent. The first is the relationships among the personality inventories and task performance. While So correlates negatively with E, and E correlates positively with BIS, the correlation between So and BIS is moderate and not significant. This may be due to the absence of an impulsivity dimension in So, and the explicit presence of this dimension in E and BIS; the negative correlation between So and E most likely reflects the sociability component of the E scale. These same relationships were seen in the analyses of MI performance: E and BIS scores differentiated between low and high MI scores, while So did not show a strong relationship to these scores. Because the strongest relationships were found on the personality measures which include an explicit impulsivity component, the results provide support for the use of this task as a measure of a MI component of impulsivity with adults.

A second interesting aspect of these data is the significant difference between E+P+ and E-P- groups in comparison to the weaker relationship between groups formed on the basis of Gray's impulsivity dimension. There are several explanations for these results. The first casts doubt on Gray's impulsivity dimension within the two-dimensional space of E and N. However, Gray has stated that this dimension is one of susceptibility to cues for reward, and it may be that reinforcement contingencies are necessary to detect impulsive performance when Ss are ordered along this dimension. An alternative explanation is one suggested frequently in recent literature and involves the specific changes in dimensions which occurred during the development of the EPQ. For example, Wilson (1981) stated that in adding the P scale to the Eysenck measures, some of the impulsivity component in the earlier E scale was placed in the P scale; therefore, "some of the previously adduced interactions may have gone, too (or disappeared altogether)" (p. 240). Using a new Impulsiveness questionnaire, Eysenck and Eysenck (1978) reported that impulsivity (Narrow) and venturesomeness both have positive loadings on E and P; therefore, E+P+ Ss will be high on both IMP and VENT (Frcka *et al.*, 1983). The present results provide behavioral data which support the hypothesis that E+P+ scores combine to form a factor of impulsivity that is not present in either scale alone.

The results of the TI estimation task are not as conclusive. Two hypotheses were made. The first was that impulsive Ss (as identified by personality inventories) would make larger TI estimations than nonimpulsive Ss. However, there were no significant differences in estimations between groups divided on either E or BIS. In addition, there were no differences between groups divided according to Gray's impulsivity dimension or between E+P+ and E-P- groups. Thus, none of the personality measures used predicted TI estimations.

The second hypothesis was that TI estimations would correlate negatively with MI scores; the correlations are shown in Table 3. For the 2½" circle, the correlation with the 25-sec interval was significant, and for the 20" circle, the correlations with the 5- and 25-sec intervals were significant. The remaining correlations were in the predicted negative direction. Thus, there appears to be a consistent trend for low MI scorers to make larger TI estimations despite the inability of the personality measures to differentiate between under- and overestimators.

Table 3. Correlations between MI scores and TI estimations

Circle size	5-sec interval		15-sec interval		25-sec interval	
	r	P	r	P	r	P
2½"	-0.29	<0.10	-0.17	NS	-0.36	<0.025
20"	-0.36	<0.025	-0.25	NS	-0.37	<0.025

n = 40 for each correlation.

These TI estimation results are difficult to compare to previous studies because of the different S populations and methodologies employed (i.e. the method of estimation vs the method of reproduction). Hogan (1978) hypothesized that time perception is a curvilinear, U-shaped function of both personality and stimulus-complexity dimensions. In neutral stimulus conditions, he predicted that extraverts would overestimate intervals due to their experiencing greater perceptual/cognitive boredom than introverts. Although there were no E-I differences in this study, Hogan's hypothesis fits nicely with the relationship between TI estimation and MI performance. Ss unable to demonstrate MI (perhaps because of an inability or unwillingness to tolerate the boredom associated with the task) are more likely to experience even these brief intervals as being longer. Although this relationship is not remarkably strong, it is consistent.

These results support the use of the MI task as a measure of impulsivity in adult populations. Future studies will attempt to determine the stimulus dimensions which facilitate MI in impulsive Ss. Also of interest is whether task performance can identify persons exhibiting behavior patterns thought to be associated with deficient inhibitory mechanisms, such as psychopaths, criminals and alcoholics (see Gorenstein and Newman, 1980).

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