BEHAVIORAL DIFFERENCES BETWEEN EXTRAVERTS AND INTROVERTS IN BETTING SITUATIONS

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Thirty extraverts and 30 introverts were presented pairs of stimuli, differing in two dimensions, required to make choices by betting one or two chip(s), and, when successful, were rewarded with twice the number of chips bet. They were told that two different prizing rules, one rewarding 80% of a specified characteristic and the other rewarding 40% of another specified characteristic, would be applied. Half the subjects were given a predominantly favorable sequence with a correspondingly high rate of return, and the other half, an unfavorable one. Extraverts made significantly fewer 1-chip bets than introverts, irrespective of the favorability of sequence. Extraverts tended to make "riskier" choices more in and after prolonged favorability, but made more "less risky" ones significantly more in unfavorability than introverts. Introverts' "confused" choices when conditions were unfavorable prevented them from minimizing the loss of chips.

There have been many studies on extraversion-introversion differences in learning and cognitive processes in recent years. Most of them were inspired, more or less directly, by H. J. Eysenck's assumption that introverts are characterized by a high level of arousal (Eysenck, 1967). Thus most investigators in this area have started with simple learning experiments, e.g., conditioning or motor learning, where the relevance of arousal theory is clear, then proceeded to conduct experimentation on somewhat more complex learning processes, especially verbal learning and memory, interpreting the observed differences in terms of arousal theory.

According to M. W. Eysenck (1976), who reviewed articles dealing with extraversion-introversion differences in verbal learning and memory, "it is clear that explanations . . . in the light of arousal theory have been fruitful" (p. 87). Arousal theory has helped investigators to find several important, replicable results, and to extend the types of experimental situations systematically. Without arousal theory, studies in this area would have lacked coherence and unity. However, because of its powerful influences, extraversion differences in more complex learning and cognitive processes, for example, decision-making and risk-taking, to which arousal theory cannot easily be applied, have seldom been investigated.

Since impulsiveness in the widest sense or rhathaymia is one of the two components of extraversion (Eysenck & Eysenck, 1963; Eysenck, 1977), we can predict that extraverts will make decisions faster than introverts. That is, an extravert will draw a conclusion based upon fewer bits of information. We can also predict that, since this impulsiveness implies a lower level of fear-of-failure, extraverts will prefer gain-maximizing to loss-minimizing strategy in risk-taking. This second prediction, on
which our study focuses, was indirectly supported by Cameron and Myers (1966). Though they were not primarily interested in extraversion, their finding that "subjects high in exhibition, aggression, or dominance (by EPPS) tended to prefer bets with a high payoff and low probability of winning" (p. 59) was interpreted by M. W. Eysenck (1976) as suggesting introverts’ "greater cautiousness".

The present study aimed at investigating how subjects’ degree of extraversion determines their responses in continuous betting situations. Hypotheses, described in detail below, were derived directly from the definition of extraversion, that is, extraverts are impulsive while introverts show caution and restraint. Generally, we hypothesize that extraverts tend to adopt gain-maximizing strategy more often and loss-minimizing strategy less often than introverts, and therefore, to be more successful than introverts under favorable conditions with a high rate of reward, and less successful when conditions are unfavorable and the rate low.

**Method**

Sixty students, of whom half were extraverts and half introverts, were presented 12 blocks of five pairs of discrimination stimuli and required to make choices or "bets" under payoff conditions which initially were either favorable or unfavorable.

**Stimulus Cards**

The discrimination stimuli were presented on cards. Each card was a 27×19 cm piece of white drawing paper, having a pair of pictures which varied in terms of the kind of animal (ox or horse) and its color (red or blue). The pair of stimuli on each card had different "values" on both dimensions. Therefore, there were two types of pairs; "red ox—blue horse" and "red horse—blue ox". The cards were divided equally between them.

**Procedure**

Each subject was given 50 chips as "funds", He was required to choose one of the pair on each card presented, and to bet one or two chip(s) on it. Choices of "neither" and "both" stimuli were not allowed.

Subjects were told that two different rules of prizing would be applied. Under the "favorable" (ox-prizing) rule, 80% of "ox" choices were to be rewarded and selections of "horse" pictures were not rewarded at all. Under the "unfavorable" (red-prizing) rule, 40% of "red" choices were to be rewarded and none of the "blue" selections was rewarded. Subject was not told that red selections would have a constant rewarding rate of 40%, irrespective of the prizing rule, nor that only the rate for ox would be critical in judging the favorability of the rule being applied. Subject was also told that the rule would change sometimes during the sequence, but would be stable throughout several blocks. This last piece of information was proved to be necessary by a pilot experiment, because without it, both extraverts and introverts had anticipated much more frequent shifts and failed to show any stable choice patterns.

In fact, however, the number of rewarded oxen was intentionally varied from block to block. The favorable sequence of blocks, which was given to half the subjects, had a high reward rate for ox (3/5–5/5), suggesting that the favorable rule was being applied during the initial seven blocks, medium rate (2/5), uncertain as to the prizing rule, in the eighth and the ninth blocks and the low rate (1/5–2/5), suggesting the unfavorable rule was being applied during the last three blocks. The unfavorable sequence, which was given to the other half, had an "unfavorable" low reward rate for ox (0/5–2/3) during the initial seven blocks, "uncertain" medium rate (2/5–3/5) in the middle two blocks, and "favorable" high rate (3/5–4/5) during the last three blocks. Reward rates for "red" were nearly constant (about 40%), as predicted from the nature of the two prizing rules (because half the oxen were red). Rates of reward for each "cue" are shown in Table 1.

In order to give the impression that one of these rules was actually being applied, none
of the horses was rewarded when the rewarding rate of ox was high. Similarly, no blue pictures were rewarded when the rewarding rate of ox was low, and only red oxen were rewarded in the middle two blocks. Within these limitations, stimuli to be rewarded were randomly chosen to produce the necessary number, and were invariant over subjects for each sequence.

Subject was given twice as many chips as he had bet when he chose the rewarded stimulus. After he had responded to all five pairs by using a chip-placing sheet having 2 × 5 cells with numerals 1–5 only, the experimenter put the stimulus cards away. Then the experimenter informed subject of success or failure of his bet on each pair (subject could not know what figure was rewarded unless he memorized it), and gave subject the chips he had won. Chips bet were not returned regardless of success or failure. Therefore, subject could get 20 but his net gain was 10 chips at most.

The game was presented as if it were simulating managerial behavior and would reveal subject’s capacity as a manager of an enterprise. Subject was encouraged to get as many chips as possible.

Subject was given a practice task (PT) with pairs of stimuli having also two dimensions (kind of vehicle and its color), prior to the main part of the experiment. In PT, subject was told that one of the two prizing rules, i.e., 100% reward rate for black and 60% for car would invariably be applied throughout the blocks and they, therefore, should bet considering which rule was applied. In fact, black was rewarded at 100% through all six blocks for every subject. When subject selected “correct” stimuli, i.e., black, on all five pairs of two consecutive blocks, PT was terminated. A few subjects who could not reach the criterion before the sixth block were not given the main part of the experiment.

The experiment was conducted individually. It usually took 30 min altogether. Experimenterers were two female graduate students.

**Description of Performances within Block**

As mentioned above, both presentation and feedback (reinforcement) were given for each five pairs as a block. So, performance of the subjects was described in terms of number of chip(s) bet and choice response during each block. Degree of success (gain/loss of chips) was also calculated for a block as a unit, by the number of chips gained or lost.

### Number of chip(s) bet

Four number-of-chip(s)-bet patterns, exclusive and exhaustive, were distinguished.

- 2-bets: Betting two chips on all five pairs in a block.
- 1-bets: Betting one chip on all five pairs.
- ro2-bets: Betting two for red ox when available, and one on pairs without red ox.
- Variable-bets: Betting two on some pairs and one on others, but number of bet was not determined by types of pairs.

### Choice response

Four choice patterns, exclusive and exhaustive, were distinguished.

- Optimistic: Selecting ox, disregarding color, on all five pairs in a block.
- Pessimistic: Choosing red figure on all five pairs.
- Mixed: Responding to ox and red. Not only
TABLE 2

Risk scores for number-of-chips-bet and choice combination

<table>
<thead>
<tr>
<th>Score</th>
<th>Number of chip(s) bet</th>
<th>Choice response</th>
<th>Expected outcome under favorable rule</th>
<th>Expected outcome under unfavorable rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>2</td>
<td>Optimistic</td>
<td>6</td>
<td>-6</td>
</tr>
<tr>
<td>6</td>
<td>ro2</td>
<td>Optimistic</td>
<td>4.5</td>
<td>-3.5</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Optimistic</td>
<td>3</td>
<td>-3</td>
</tr>
<tr>
<td>4</td>
<td>ro2</td>
<td>Mixed</td>
<td>2.5</td>
<td>-2.5</td>
</tr>
<tr>
<td>4'</td>
<td>2</td>
<td>Mixed</td>
<td>2</td>
<td>-4</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Mixed</td>
<td>1</td>
<td>-2</td>
</tr>
<tr>
<td>2</td>
<td>ro2</td>
<td>Pessimistic</td>
<td>0.5</td>
<td>-1.5</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Pessimistic</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>1'</td>
<td>2</td>
<td>Pessimistic</td>
<td>-2</td>
<td>-2</td>
</tr>
</tbody>
</table>

red ox but both blue ox and red horse were selected in a block.
Irrelevant: Choosing at least one blue horse, which could not be a rewarded stimulus under either prizing rule.

Risk score. Since there were three main categories each for number-of-chips-bet and choice patterns, we had nine combinations of them, each differing in expected gain/loss of chips under the favorable and unfavorable rules. For example, the expected gain/loss for the 2-bets-optimistic combination was +6 when the favorable ox rule was applied (0.8*5*2*2-5*2) and -6 when the unfavorable red one was applied (0.2*5*2*2-5*2). Similarly, the expected values could be calculated for the eight other combinations. The two types of pairs were to appear 50% each and mixed choice pattern was considered to halve on the average probabilities of choosing ox and red for pairs without red ox. As can be seen in Table 2, seven combinations represented reasonable strategies differing on a gain/loss continuum, since the exact likelihood of either prizing rule being in effect was unknown. These were ordered and given “risk” scores of one to seven. (The larger the score, the riskier was the combination.) In other words, the riskiness of a combination of number-of-chips-bet and choice pattern here was defined in terms of range of outcomes, as had been done earlier (Rapoport & Wallsten, 1972). The two “unreasonable” strategies were regarded as “variants” of those obtaining similar payoff. No response pattern other than these nine was given a risk score.

Number of gained/lost chips. Gain or loss of chips during five pairs of a block was calculated by subtracting the number of chips bet from the number of chips gained. Possible scores ranged from -10 to +10.

Individual Performance Measures

The following 12 measures to represent an individual’s betting behavior were computed for each subject by putting together his performances on blocks homogeneous in terms of rewarding rates. Since, in either the favorable or unfavorable sequence, the favorable or unfavorable rule was consistently applied to the first seven trials, the betting behaviors on seven blocks from the second to the eighth block were grouped. On the other hand, the betting behaviors on the last four blocks (the ninth to the 12th) were also grouped because those were influenced by the changing and reversing rewarding rates after the eighth block. Frequencies of the main categories in terms of clear psychological differentiation, 2-bet and 1-bet, and optimistic and pessimistic choice patterns, were counted for each subject separately from the second to the eighth block and from the ninth to the 12th block. A mean risk score was calculated for each subject in the same way, excluding blocks with response patterns other than the nine listed in Table 2. As for cumulative gain/loss of chips, each subject was given separate scores.
for the performance on six blocks from the second to the seventh block and for the one on four blocks from the ninth to the 12th, excluding the one on the eighth block where the rewarding rates changed.

Selection of Subjects

The Awaji Extraversion-Introversion Test was given to about 500 undergraduate students enrolled in a course of introductory psychology. This test consists of 50 items describing one's own behavioral and emotional tendencies, each having two alternative answers, extraversive and introversive. There were, however, four permitted responses: "Extraversive" (worth four points), "introversive" (zero), "both" (two), and "undecided" (two). The maximum value of the extraversion quotient (EQ), the simple sum of item scores, was thus 200 (extreme extravert) and the minimum value zero (extreme introvert). For example, "I am sociable—I can't flatter people", "I can get along with anybody—I can’t associate with a person I dislike", "I am a quick decision-maker—I am a slow decision-maker", "I do not worry about trivial things—I am anxious about trivial things." (The first alternatives represent extraversive, and the last introversive.)

The Awaji Extraversion-Introversion Test was used in this study because the Japanese version of the Maudsley Personality Inventory (MPI) had not yet been available. The correlation coefficient between the Awaji Test and extraversion-introversion items from MPI was .63, when both were administered to 69 subjects not included in the present sample. Although both the Awaji Test and the MPI had many items pertaining to sociability, the Awaji Test contained, in addition, many items designed to measure quick vs. slow decision-making and worries about trivial things. The MPI contained a number of items relating to impulsiveness or vigor, but the Awaji Test did not.

Those whose EQ was above 130 were judged as extraverts and below 84, introverts. Thirty extravert and 30 introvert students (18 males and 12 females in each personality type), who had consented to participate in the experiment and reached the criterion in PT, served as subjects. Half of them were given favorable and the other, unfavorable sequence (15 extraverts and 15 introverts in each). The means and standard deviations of their EQ were 143 (SD, 14) and 147 (13) for extraverts in favorable and unfavorable sequences and 72 (12) and 79 (6) for introverts in the corresponding sequences.

Hypotheses

For reasons suggested above, extraverts, who are impulsive (in the widest sense) by definition, will prefer gain-maximizing strategy to loss-minimizing strategy, while introverts, who are restrained and cautious, will prefer the opposite. We derived the following four, more specified hypotheses as to extraversion-introversion behavioral differences in the present betting situations.

1. Extraverts will show 2-bets more often and 1-bets less often than introverts, because betting two chips maximizes gain / loss, while always betting one chip minimizes gain / loss.

2. Extraverts will show optimistic choices more often and pessimistic choices less often than introverts, because an optimistic choice pattern gives greater gain under the favorable (ox-prizing) rule, though it also gives greater loss under the unfavorable (red-prizing) rule, than pessimistic or mixed choices; pessimistic choices bring minimal loss when conditions are unfavorable, and result in minimal gain when they are favorable.

3. Extraverts will show greater risk scores on their overall betting strategy (combination of number-of-chips-bet and choice patterns) than introverts.

4. Extraverts will gain more chips than introverts in favorable blocks, where the rate of reward is high (4a), but lose more in unfavorable blocks where this rate is low (4b). There will be an interaction effect between extraversion and favorability (4c), because, the riskier the strategy, the more it will gain or lose, depending upon the rates of reward.
### Results

Means and standard deviations of the 12 measures describing individual performances are shown in Table 3 for each Extraversion × Favorability group. A two-way ANOVA was conducted on each of these measures, with extraversion and favorability as between-subject factors. The F-ratios obtained are shown in Table 4.

**Overall Extravert-Introvert Differences**

Hypothesis 1 regarding the number-of-chips-bet was examined by F-ratios re-
presenting main effect of extraversion on the first four measures in Table 4. Of these measures, one (number of 1-bets, blocks 2–8) showed a significant main effect of extraversion, and another (number of 1-bets, blocks 9–12) showed a nearly significant one (considering that the sample size was small, F and t-values of which probability is below 10% will be taken into account hereafter). From Table 3, it is clear that extraverts make fewer 1-bets than introverts. Though differences in number of 2-bets, either 2–8 or 9–12, were far from statistical significance, they were in the hypothesized direction, and consistent with the above-mentioned significant or nearly significant difference in number of 1-bets. Thus hypothesis 1 was, though incompletely, supported. (None of these four measures showed large F-ratio either for Favorability or Extraversion × Favorability interaction. Therefore, this hypothesis will not be examined separately for favorable-unfavorable sequence.)

Hypotheses 2 and 3, which concerned the choice responses and the risk scores respectively were tested by the next six measures. None of these showed significant or nearly significant main effects of extraversion. Therefore, both hypotheses were disconfirmed in the overall comparison. However, there was a significant or nearly significant interaction effect between extraversion and favorability on three of them: Number of pessimistic choices, blocks 2–8; number of pessimistic choices, blocks 9–12; and mean risk score, blocks 9–12. Therefore, these hypotheses were to be tested separately for both sequences together with hypotheses 4a and 4b concerning the number of gained/lost chips, though other measures regarding choices or risk score showed negligible interaction.

Hypothesis 4c predicting the interaction effect was examined by F-ratios representing Extraversion × Favorability on the last two variables regarding cumulative gain/loss. The measure of blocks 9–12 showed a significant interaction. Inspection of Table 3 suggests that, extraverts in changing and favorable blocks of the unfavorable sequence gained more chips than introverts, while extraverts in changing and unfavorable blocks of the favorable sequence lost a few more chips than introverts. Thus hypothesis 4c was apparently supported on this measure. (This point will be discussed in detail later.)

Incidentally, main effects of favorability were significant for number of optimistic choices, number of pessimistic choices, and mean risk score, all on blocks 2–8, and, to no one's surprise, cumulative gain/loss on both sequences 2–7 and 9–12. The first three of these differences clearly suggest that subjects of both personality types made more optimistic, gain-maximizing choices and fewer pessimistic, loss-minimizing choices in the favorable blocks in the favorable sequence than in the unfavorable blocks in the unfavorable sequence.

Differences in the Favorable Sequence

Extraverts made optimistic choices more and pessimistic choices less frequently than introverts either in the favorable blocks 2–8 or in the last four blocks. However, these differences were far from the level of statistical significance. Thus hypothesis 2 was not confirmed.

Extraverts showed greater mean risk score than introverts, and the difference approached significance in the last four blocks, \( t (28) = 1.80, .05 < p < .10 \). Hypothesis 3 tended to be supported.

In spite of the differences in the number-of-chips-bet, the cumulative gain and loss for both personality types differed little. Extraverts gained an average of about four more chips than introverts in blocks 2–8 and lost one more in 9–12, but both were statistically insignificant. Neither hypothesis 4a nor 4b was confirmed.
Differences in the Unfavorable Sequence

Extraverts, contrary to hypothesis 2, made significantly more pessimistic choices than introverts in the unfavorable blocks 2–8, $t(28) = 2.38$, $p < .05$, and insignificantly did so in the last four blocks. Unfavorable extraverts made twice as many pessimistic choices as favorable extraverts. Both unfavorable extraverts and introverts showed fewer optimistic choices than their favorable counterparts and the difference between personality types was negligible. Thus hypothesis 2 was strongly disconfirmed.

There was no marked difference in mean risk score either for blocks 2–8 or for 9–12. This was because while extraverts made fewer 1-bets than introverts, they also made more loss-minimizing pessimistic choices. Hypothesis 3 was not supported.

Difference in the number of gained / lost chips during blocks 2–7 was small: Both personality types showed an almost identical amount of loss during these blocks. Hypothesis 4b predicting extraverts' greater loss in the unfavorable blocks was not confirmed. However, extraverts gained significantly more chips than introverts in blocks 9–12, $t(28) = 2.23$, $p < .05$. Considering that introverts here showed a slightly larger mean risk score, the difference in gain could not be attributed to extraverts' gain-maximizing behavior. Rather, their relative success came from their making many more ro2-bets (E's 47% vs. I's 25%), which were most adaptive during the changing blocks, and fewer irrelevant choices (5% vs. 15%), which were never rewarded. In other words, hypothesis 4a expecting extraverts' greater gain in the favorable blocks was only apparently supported here. This implies that the obtained significant interaction effect on gain / loss 9–12 for hypothesis 4c was also apparent, that is, it could not be attributed to the differential riskiness in strategies of the two personality types as hypothesized.
tion. The same pattern of extraverts’ large and drastic change was observed also for the number of pessimistic choices 9–12 and the mean risk score 9–12. It should be noted that in Cameron and Myers’ study, where “extraverts” were less cautious, “gaining” bets always preceded “losing” bets. Secondly, it was predicted but not confirmed under the unfavorable prizing rule that introverts would make choices leading to minimal loss. Instead, they sometimes made somewhat “confused” or irrelevant choices there. In fact, introverts made 14% irrelevant choices in the total 12 blocks of unfavorable sequence (the corresponding figure for extraverts was 6%). Further, their responses tended to be “compromising” mixed choices (19% for introverts and 14% for extraverts), rather than effective loss-minimizing choices. This finding was consistent, if the present continuous betting situation is regarded as a learning task, with the previous ones that introverts performed more poorly than extraverts in harder learning situations (Allsopp & Eysenck, 1974; Bone, 1971; Howarth, 1969a, b). The inferior performance of introverts here can be explained either by too highly augmented arousal or subjective vulnerability to “failure”.

It should be noted that, although there were some differences in response patterns between personality types as mentioned above, the mean number of gained / lost chips were nearly the same. Extraverts seemed to gain slightly more in favorable blocks, especially in those following prolonged unfavorability, while equally losing in unfavorable blocks. The differences were not statistically significant even when the level of significance was set at 10%.

However, this objectively parallel gain / loss between extraverts and introverts did not bring about similarities in subjective feeling of success or failure. In this study, we did not administer a structured questionnaire to the subjects after the experiment. The subjects were only required to write a short paper about their impressions of the experiments. So we do not have precise verbal reports worth analyzing. However, preliminary analyses gave us interesting suggestions. Their verbal reports reflected personality differences in evaluating their performance. For example, eight extraverts wrote positive statements on the experiment, saying that it had been interesting for them, and/or that they had done rather well in it. None of the introverts reported such positive feelings. Six introverts wrote negative statements, some of which were negative evaluation of the experiment, e.g., “It was rather uninteresting”, others were excuses for their “failure” in the experiment, e.g., “I had a headache”. Only one extravert made such a negative statement. This tendency of introverts to make “negative” evaluation might be related to their poor performance in the unfavorable blocks.

It is quite conceivable that personality differences revealed through traditional personality measures relying upon subject’s verbal report reflect two things: Behavioral differences in daily life situations and subjective evaluation of such behavior. In differentiating these two components, it seems necessary not only to give the subjects a task situation but, at the same time, to require structured verbal reports on their behavior.

**References**


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