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The Effects of Competition on Test Taking Speed

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Motivational factors have a large influence on the speed and effort driving behaviours and mental processes (Mir et al., 2011). These motivational factors, called incentives, come in 2 main classes: Intrinsic, a motivation driven by internal reward, and extrinsic, motivation driven by an external reward (Deci, 1972). The present study tested how motivational factors influence test taking speed under the influence of intrinsic or extrinsic incentives. Participants were asked to complete a simple match-to-sample task using a 26 symbol cipher, either at the same time as another participant, or by themselves, and were either instructed to complete it as fast as possible, or instructed to complete it at their own pace. A significant relationship was found for the main effect of the experiment—the influence of pairing on test-completion time ($F=6.05$, $p<.05$). The secondary effect of interest was the difference in completion time between pairs of participants. Again, this was found to be significant ($F=36.439$, $p<.05$). These results were discussed at length in terms of the variation in influence of competition and incentive in relation to the Yerkes-Dodson Law.

Motivation is widely believed to be the driving force behind all conscious behaviour. An increase in motivation has been found to enhance work-effort and performance (Chapman & Feder, 1917). On the behavioural side, motivation has demonstrated an ability to enhance reaction speed (Mir, Trender-Gerhard, Edwards, Schneider, Bhatia, & Jahanshahi, 2011), while on the cognitive side increased motivation has elicited an increase in IQ (Duckworth, Quinn, Lynam, Loeber, & Stouthamer-Loeber, 2011).
Competition and Performance

The instruments of motivation have been titled incentives and take two main forms: Intrinsic—a motivational factor resulting from internal rewards (e.g. satisfaction), and extrinsic—a motivational factor that results from an external reward (e.g. monetary reward) (Deci, 1972). These factors can be present both independent or in conjunction with one another. When in conjunction, extrinsic incentives have been found to possess the capability of undermining intrinsic incentives (Weiner, 1980).

While incentives have been found to increase both behavioural and cognitive effort, they also hold an inverse relationship with particularly challenging tasks (Broadhurst, 1957). The Yerkes-Dodson Law, as revised by Broadhurst (1957) states: “The optimum motivation for a learning task decreases with increasing difficulty” (p. 322). In other words, on a difficult task, too much motivation results in diminished performance. This inverse relationship between performance and motivational influence is largely due to a positive correlation between an increase in anxiety with an increase in motivation. This increase in anxiety bears a strong negative correlation with test performance (e.g. Cassady & Johnson, 2002). Thus, as motivation increases, so too does anxiety, resulting in lower performance. The optimal level of motivation in terms of performance has been demonstrated to be in the moderate range. Cassady and Johnson (2002) found an association between moderate levels of physiological arousal, which was caused by motivation, and higher exam performance.

The mechanisms driving the aforementioned correlation between motivation and test anxiety were proposed by Sarason (1961) as “heightened
Competition and Performance

physiological activity” and “self-deprecating ruminations” (p. 201-202). Thus, because of the correlation between anxiety and motivation, the increase of motivation also likely increases the prevalence of these two mechanisms. This helps to explain the processes governing the Yerkes-Dodson Law. On a difficult task this heightened physiological activity will reduce test performance (Cassady & Johnson, 2002), and these “self-deprecating ruminations” will occupy the cognitive space required to solve a problem.

Furthermore, the discrepancy between the correlations of motivation and performance between simple and complex tasks is due to the fact that test anxiety is far less to begin with on simple tasks (Cassady & Johnson, 2002). Thus, increased motivation on these tasks, while it may cause slightly more anxiety, does not hinder performance.

Opposite findings have been found for difficult tasks involving motor functioning. Healey and Landers (1973) showed that in high task-difficulty conditions, subjects with higher competition performed better than subjects in competitions involving less competition. Thus, the Yerkes-Dodson Law does not hold true for physically demanding tasks.

There is a positive linear correlation between competition and motivation: As competition increases, so too does motivation (Healey & Landers, 1973). Competition presents an interesting factor in its relation to incentives, as it is able to serve both as a basis for reward, and a motivating factor in and of itself. According to Atkinson’s achievement motivation theory, a key determinate factor in the tendency to approach success is the incentive value of success—the pride
Competition and Performance

associated with the achievement of a goal (Reitman & Williams, 1961). Thus, with increased competition, the incentive value of success becomes greater thereby heightening the value of a reward. Using competition as an incentive, the present study attempts to find empirical support for the notion that increased motivation will result in poorer performance on a cognitively taxing task.

Method

Participants

A convenience sample of 40 was conducted and comprised of 24 males and 16 females ranging between the ages of 16 and 60. Participants were recruited via telephone and testing was primarily conducted in participants’ homes. For the two conditions that involved the pairings of participants, subjects were primarily recruited as pairs, rather than matching random individual participants together. For the conditions using single participant testing, participants were typically recruited, one at a time, from a larger group and testing was conducted in a separate room to ensure minimal competition effects.

Materials

Each participant was given their own testing sheet with which to complete the task (Appendix A). The test sheet consisted of a cipher with 26 randomly selected symbols, each corresponding to a different letter of the alphabet. Beneath the cipher a set of symbols was presented, each with a horizontal line 5 mm below, leaving enough space for a participant to write down the letter that corresponded to the above symbol and indicating a blank that must be filled in.
Competition and Performance

The symbols corresponded to letters that made up the sentence “BRIGHT VIXENS JUMP AND DOZY FOWL QUACK.” This particular sentence was selected because it is an unfamiliar pangram—a sentence consisting of every letter of the alphabet at least once that the typical participant would not be familiar with prior to experimentation. The difficulty of the task was assumed to be a function of the number of novel symbols out of the total number of symbols. This assumption is based on the logic that if there are repeated symbols there will be less time spent consulting the cipher, as participants could potentially recognize repeated symbols. Thus, a difficult puzzle had a high percentage of novel symbols out of the total number. Since a difficult task was required to test the experimental hypothesis, a sentence with too many repeats would not suffice. Hence, a 32 character pangram consisting of 26 different symbols was employed to ensure minimal repetition of symbols and thus a more difficult task. The cipher-based task was used because it presented to possibility for a difficult task that anyone could complete with no background knowledge.

Task-completion times were recorded with the stopwatch function on the BlackBerry Bold 9700, with a lap function used to record the times for participants that were in pairs.

Procedure

Prior to testing, every participant was given a letter of information and a consent form that they were required to sign and date in order to take part in experimentation. Each participant in all four experimental conditions was given the same verbal description of the test. This entailed a basic introduction to the cipher,
which revealed that it consisted of 26 symbols, each of which corresponding to an
individual letter of the alphabet. They were then introduced to the task itself and
were instructed to use the cipher to match the symbols in the puzzle to their
 correspon ding letters and to write the letters on the line below each respective
 symbol. Participants were all also told that the symbols represented letters that
 formed a coherent sentence. 

For Condition 1, participants were tested one at a time in a room where no
one other than the participant and the experimenter were present. This ensured
minimal competition effects. Participants in this condition were not given any
instruction to complete the task as fast as possible. Participants in condition 2 were
again tested in a room with only them and the experimenter present. However,
these participants were then instructed to complete the task as fast as possible.
After matching the last letter of the task, the timer was stopped and the trial was
complete.

In Conditions 3 and 4 participants were tested in pairs. Like Conditions 1
and 2, testing was conducted in a room with only participants actively writing the
experiment and the experimenter present. In Condition 3 participants not
instructed to complete the task as fast as possible. In Condition 4 however, the
participants were instructed to complete the test as fast as possible. For both
Conditions 3 and 4, the trial was considered to be complete once both participants
in the pair had completed the task. After the first participant of the pair completed
the task, the lap function on the stopwatch was used to record their completion
Competition and Performance

time while ensuring that the timer continued without pause to record accurate completion time of the second participant in the pair to complete the task.

Results

The chief dependent variable of interest in the present study was the average task-completion time of each of the four groups while the main effect was the influence of group pairing on completion times. Task accuracy was not taken into account for the purpose of the present experiment and thus performance was solely based on task completion time. The average completion times of each respective group are shown in Table 1. These data are shown in Figure 1. A test of between-subjects effects revealed a significant effect resulting from pairing versus non-pairing testing conditions ($F(3, 37) = 6.05, p < .05$). Tests of within-subjects contrasts and within-subjects effects revealed no significant relationship of instructions of individual participants or instructions within different pairs, respectively ($F(3,37) = 1.584, p > .05; F(3,37) = 1.307, p > .05$). The raw data is presented in Appendix B.

The secondary variable of interest was the difference in completion times in Conditions 3 and 4 between the participant that finished first in each pair and the participant that finished second. The average completion time for the participant to finish first in each pair was 133.02-s and the average completion time for the participant to finish second in each pair was 173.28-s. A test of within-subjects contrasts revealed a significant relationship between order of completion and average completion time ($F(3,37) = 36.439, p < .05$). This relationship is illustrated in Figure 2.


**Table 1**  
Average Completion Times of Experimental Conditions in Seconds

<table>
<thead>
<tr>
<th>Condition</th>
<th>No Instruction</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>137.16</td>
<td>136.38</td>
</tr>
<tr>
<td>Paired</td>
<td>158.46</td>
<td>147.78</td>
</tr>
</tbody>
</table>
Figure 1. Average completion time in relation to the presence of instructions to complete the task as fast as possible for both single participants and paired participants.
Figure 2. Average completion time in relation to the order of completion within pairs of participants both in conditions where no instruction is given to go as fast as possible and in conditions where instructions are given to go as fast as possible.
Competition and Performance

Discussion

The results of the present study indicate that there is a significant relationship between both the effect of pairing on test performance, and between levels of performance of first participant to finish in a pair and the second participant to finish in a pair. The relationship that exists between pair versus single participants shows that single participants performed significantly better than pairs of participants on a difficult cognitive task. This finding supports the results found by Broadhurst (1957) and thus coheres to the Yerkes-Dodson Law. It also supports the notion that increased competition results in both increased motivation and test anxiety and thus reduces performance.

These results show that on difficult cognitive tasks, performance is diminished as competition and motivation are increased. They also indicate that there is little correlation between presence or absence of instructions to complete the task as fast as possible. This shows that the presence of the extrinsic incentives used in the study were no sufficient enough to undermine the intrinsic incentives elicited by competition and therefore contradict the findings of Weiner (1980).

Although the data support the hypothesis of the present study, there were minor experimental and control errors that could have had slight implications on the results. The most obvious experimental error was the effect of the experimenter in the testing room. This revealed to the participants that they were being timed and thus was likely a contributing factor to test anxiety, which would result in a decrease in performance.
In addition to this procedural error, there was the potential for a minor error in control with regards to the validity of the test. The cipher was designated as a difficult task based on the number of novel symbols out of the total number of symbols. In the test there were a total of 26 novel symbols out of a total of 32. This formula assumed that the greater number of repeated symbols, the easier the task due to the ability to remember symbols that have already been presented. While this formula makes logical sense, there were no formal efforts to measure the validity of the test.

As well as these procedural and control errors, there were some problems with the sample. To begin, the sample size of 40 was not large enough to reflect the true tendency of the greater population. Because of this, the age range and education levels of the participants should have been restricted to ensure that the results were a true reflection of that specific group. However, because no such measures were taken into account, as participants ranged between the ages of 16 and 60 and education was not accounted for, this sampling error could have had implications on the practical significance of the data.

Because of the minor implications of the experimental, procedural, and sampling errors, the results of the present study can be interpreted as a true reflection of the experimental variables. Thus, the present study indicates that the simultaneous testing of participants during results in diminished performance. As well, the results reveal a strong discrepancy between the average completion time of the first participant in a pair, and the average completion time of the second participant in that pair. This result is presumably due to a drop in the incentive
Competition and Performance

value of success for the second participant once the first participant completes the trial in conjunction with an increase in test anxiety. In other words, once the first participant in a pair completes the trial, the reward of completion is drastically reduced for the second participant. This reduction of the success reward is replaced by test anxiety and thus an increase in “self-deprecating ruminations” (Sarason, 1961). Therefore, the already slower completion time of the second participant in a pair is further hindered by the increase in test anxiety and the decrease in motivation.

Future studies should further examine the patterns of test motivation during the course of a test and their relation to competition. As well, future studies should test the effects of competition on varying task difficulty. The finding of Weiner (1980), that extrinsic incentives can undermine intrinsic incentives suggest that a larger extrinsic incentive should have been provided, rather than simple instructions to complete the task as fast as possible. For example, if a monetary reward was given to the participant in a pairing who completed the task first, or to individual participants that completed the task in under a certain time limit, the effects would presumably be enhanced. Thus, future studies should examine the same relationship in the present study, but with greater extrinsic incentives.

In conclusion the present study suggests that the effects of competition on a cognitive task hinder performance, and that participants in competitive scenarios that perform more poorly than other participants, are further inhibited by the effect of competition. The implications of these findings are vast, particularly in the scholastic domain. They suggest that test performance could be enhanced if
Competition and Performance

students were to write tests in isolation. Thus, real-world measurement of the difference in test scores between students who write in isolation versus students who write in a room with other should be examined.
References


Please complete the following by matching the symbol to the corresponding letter according to the cipher above.
## Appendix B

### Table 1
Raw Data Summary Chart

<table>
<thead>
<tr>
<th>Condition</th>
<th>Single Participants</th>
<th>Pair of Participants</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Instruction</td>
<td>Instruction</td>
<td>No Instruction</td>
<td>Instruction</td>
</tr>
<tr>
<td>1</td>
<td>2:15</td>
<td>1:55</td>
<td>2:21</td>
<td>2:16</td>
</tr>
<tr>
<td>2</td>
<td>2:16</td>
<td>2:05</td>
<td>2:53</td>
<td>3:00</td>
</tr>
<tr>
<td>3</td>
<td>2:30</td>
<td>1:54</td>
<td>1:47</td>
<td>1:57</td>
</tr>
<tr>
<td>4</td>
<td>2:15</td>
<td>2:36</td>
<td>3:18</td>
<td>2:33</td>
</tr>
<tr>
<td>5</td>
<td>2:23</td>
<td>2:30</td>
<td>2:55</td>
<td>1:44</td>
</tr>
<tr>
<td>6</td>
<td>2:10</td>
<td>2:25</td>
<td>3:21</td>
<td>2:29</td>
</tr>
<tr>
<td>7</td>
<td>2:17</td>
<td>2:11</td>
<td>2:20</td>
<td>2:36</td>
</tr>
<tr>
<td>8</td>
<td>2:25</td>
<td>1:30</td>
<td>3:15</td>
<td>2:50</td>
</tr>
<tr>
<td>9</td>
<td>2:08</td>
<td>3:00</td>
<td>1:45</td>
<td>2:29</td>
</tr>
<tr>
<td>10</td>
<td>2:13</td>
<td>2:38</td>
<td>2:30</td>
<td>2:44</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>2.286</strong></td>
<td><strong>2.273</strong></td>
<td><strong>2.641</strong></td>
<td><strong>2.463</strong></td>
</tr>
<tr>
<td><strong>(Minutes)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>