Ascending versus Descending Timers: Stress and Motivation

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Abstract: A paucity of research exists on how timed tasks affect stress and motivation. The current experiment aims to contribute to the modern understanding of these fields. Stress occurs when an individual is unable to cope with situational demands and experiences discomfort as a result (Cox, 1985). The behavioral model of motivation (Touré-Tillery & Fishbach, 2014) explains individual motivation during task completion. This experiment employed a within-subjects design to examine the impact that the direction (ascending vs. descending) of a digital clock timer has on stress and motivation using a card-matching activity. Stress was indicated by Emotional Stress Reaction Questionnaire (Larsson, 2010); score and motivation was measured by how efficiently and accurately the participants finished the assigned task. The participants (N=31) were all undergraduates attending Sierra Nevada College. In order to familiarize the participants with the goals and instructions of the full-length (5 min) card matching activity and minimize practice effects, a practice card matching activity was issued to all participants prior to the time measured experiment. Participants then completed the full-length card matching activity under ascending and descending timing conditions in counterbalanced order. To emphasize the presence of the timer in the experiment, the time present on a prominently displayed digital clock was noted following each match. Participants completed the ESRQ after each timing condition. While the paired t-test showed no significant difference (p=.318) in stress between timing conditions, a significant increase (p=.007) in motivation was measured when a descending timer was used. When applying the findings of the current study to a timed workplace or sports setting, the benefits of a descending timer in regards to motivation should be considered.

Introduction

We live in a society that emphasizes efficiency and time management. Due to the importance of time management, many tasks completed in workplace or school settings are timed tasks. Although these timed tasks play a role in our lives, little research has been conducted on how individuals are timed and the effect this timing method has on our motivation and stress. The differences in stress and motivation produced from the use of an ascending timer (e.g. a stopwatch) versus a descending timer (e.g. a countdown clock) have yet to be studied in detail. Kellogg, Hopko, and Ashcraft (1999) suggested time pressure was likely to lower performance as a function of anxiety. In their experiment, participants completed tasks involving arithmetic under timed and untimed conditions while math anxiety levels were tracked. They found that time pressure lowered performance on the arithmetic tasks, despite the math anxiety level of the participant (Kellogg, Hopko, and Ashcraft, 1999). Kellogg, Hopko, and Ashcraft (1999) suggested having a timer while completing arithmetic tasks added to the anxiety that participants felt. The aim of the current study was to examine the direction of timing and the impact on stress and motivation.

Workplace and school environments can be stressful. Minimizing this stress, when possible, may have increased long term health benefits. Stress occurs when an individual recognizes they are unable to cope with the demands of a situation and is often induced by life changing events (Chamberlain & Zika, 1990). Cox (1985) emphasized the centrality of the discrepancy between the level of demand present in a situation and an individual’s ability to cope with it in the definition of stress. Chamberlain and Zika (1990) thought differently than Cox, defining stress as the result of many small hassles in day-to-day life that manifest as anxiety (Chamberlain & Zika, 1990). Over time, these commonplace stressors can result in poor long-term health (Chamberlain & Zika, 1990). The current study utilizes the definition of stress provided by Chamberlin and Zika (1990). If stress is routine, but
Motivation is the second element of interest in the current study. Graham and Weiner (1996) discussed motivation in terms of an individual’s behavior and thought processes and described it as a complex and multifaceted concept. For example, when an activity is considered interesting, engrossing, and involving, individuals show greater motivation (Graham & Weiner, 1996), which could be considered the driving psychological force that produces action (Touré-Tillery & Fishbach, 2014). The behavioral model of motivation examines individual motivation during task completion, specifically focusing on speed, performance, and persistence (Touré-Tillery & Fishbach, 2014). Touré-Tillery and Fishbach (2014) stated the amount of time an individual takes to complete a task can be a good measure of an individual’s motivation. Another measure of motivation is performance (i.e., accuracy, amount of trials completed, and highest level of achievement) when completing a goal-related task (Touré-Tillery & Fishbach, 2014). The final behavioral measure of motivation is persistence. Persistence is how long an individual continues to pursue a goal, even in the face of inherent difficulty (Touré-Tillery & Fishbach, 2014). Outcome-focused motivation describes how motivated an individual is to reach the end of a desired goal (Touré-Tillery & Fishbach, 2014). Touré-Tillery and Fishbach (2014) described process-focused motivation as completing a task for the internal benefit of the task itself (e.g., enjoyment).

The matching activity completed by participants as part of the current study had the purpose of driving outcome-focused motivation. Participants were informed the goal of the matching activity was to match as many cards as possible. Individuals in anxious states tend to worry about the threat of not achieving a goal and may develop strategies to reduce this anxiety (Eysenck et al., 2007). The process efficiency theory was considered because of the possible impact it could have on working memory and, therefore, on feelings of stress. Process efficiency theory has two key elements, effectiveness and efficiency, that should be distinguished. Effectiveness is the quality of performance and is generally recorded using behavioral measures (Eysenck et al., 2007). Efficiency is the connection between effectiveness and the resources invested in reaching a desired performance level (Eysenck et al., 2007). Worry or self-preoccupation increase anxiety, over-evaluation of failure, and expectation of adverse consequences (Eysenck et al., 2007). Worry occurs in stressful situations, such as tests or evaluations, and can cause cognitive interference by consuming the attentional resources available in working memory (Eysenck et al., 2007). Since worrying took up valuable space in working memory, there was less space available for the processing of other concurrent tasks (Eysenck et al., 2007). Process efficiency theory is key to the current study because working memory will be more occupied as worry increases, reducing the amount of working memory space available to complete the matching task. The descending timing condition was hypothesized to create more worry, producing a decrease in the number of matches observed, and that both stress and motivation would be greater in the descending timing condition than the ascending timer.

Methods

The current study employed a single factor, two-level, within-subjects design to control as many extraneous variables as possible. Participants completed a task under two different timing conditions to facilitate examination of any resulting differences in stress or motivation. The independent variable of interest in the current study was the direction (ascending vs. descending) of a timer present during an assigned activity. Two dependent measures (stress and motivation) were considered.

Participants

The current study took place at a small private liberal arts college. Thirty-one undergraduate participants were selected via convenience sampling and offered research credit for their time. All participants provided informed consent.

Procedure

The study began with an instructional phase when the participants were informed about the rules for the matching activity and the overall experimental procedures. The matching activity employed in the current study involved flipping over playing cards in attempt to find exact matching cards. Twenty-eight exact pairs of playing cards were laid face down in a pre-determined order, unknown to the participant.

Participants were instructed to flip two playing cards over at the same time. If the playing cards matched, the exact pair was put aside and the
participant continued with the study. If the playing cards did not match, the participant flipped them to be facedown. It was communicated that the goal of the activity was for the participant to make as many playing card matches as quickly as possible.

Following the instructional phase, participants entered the practice phase during which they completed the matching activity using ten playing cards. This practice phase had several purposes, including familiarizing participants with the matching activity instructions, matching procedures, and minimizing potential practice effects. Participants were supplied with a timing sheet and an ink pen to indicate the time displayed on the clock every time they matched a pair of playing cards. Participants were instructed to document the time displayed on the clock to facilitate attention to the timer. A digital clock timer was placed prominently in front of the participant as they completed each matching activity. The placement of the clock timer was important to ensure visibility and facilitate attention. The ascending timer was a traditional timer starting at 00:00 and counting upwards to 05:00 (five minutes) in one second intervals. The descending timer was the same timer set to countdown from 05:00 to 00:00, also in seconds.

Following the instructional and practice phases, participants were exposed to each timing condition. The order in which participants were tested in ascending and descending timing conditions was counterbalanced, with half of the participants completing the matching activity with the ascending timer first and the other half of the participants completing the matching activity with the descending timer first. Five minutes were allotted for the matching activity associated with each timing condition.

After completing the first matching activity timing condition, participants were given a new board of playing cards to complete the second matching activity under the timer condition that had not yet been tested. The second matching activity was identical to the first, except the direction of the timer and the arrangement of the playing cards. A new arrangement of playing cards was used on the second test to further minimize practice effects. After completing each timing condition, participants answered the Emotional Stress Reaction Questionnaire (Larson, 2010). Participants were then provided with research credit.

**Materials**

A complete list of materials used in the current study can be found in Table 1. Informed consent forms were signed by and collected from each participant. Twenty-four decks of standard playing cards were used to compose the memory matching activity. Playing card layout was different between the two timing conditions but consistent across each level of the independent variable. In the interest of consistency, each participant worked with the exact same two playing card layouts to ensure consistency throughout the experimental procedure. The order that the playing cards were placed in for the matching activity was randomized in both timing conditions. Each playing card in the deck was given a corresponding number between 1 and 56. Playing cards were then sorted randomly using the random number generator in Microsoft Excel. This particular matching activity was chosen for use in this within-subjects design study to minimize the participant’s ability to learn the location of specific playing cards. One poker felt was used to keep the playing cards organized and stationary as participants completed both matching activities. A large digital clock with a red display was used to draw the participants’ attention to the timing factor.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Experimental Purpose</th>
<th>Number Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informed consent form</td>
<td>Gain consent from participants to participate in current study</td>
<td>31</td>
</tr>
<tr>
<td>Deck of Bicycle™ playing cards</td>
<td>Used for playing the memory activity</td>
<td>24</td>
</tr>
<tr>
<td>Poker felt</td>
<td>Felt to keep cards from slipping</td>
<td>1</td>
</tr>
<tr>
<td>Large digital clock (432 mm x 160 mm, red LED display, EU displays brand)</td>
<td>Digital clock used to show participants the timer</td>
<td>1</td>
</tr>
<tr>
<td>Emotional Stress Reaction Questionnaire</td>
<td>Questionnaire to establish levels of stress</td>
<td>62</td>
</tr>
<tr>
<td>Timing sheet</td>
<td>Timing sheet for participants to write time of clock on used by participants to notate timing sheet</td>
<td>31</td>
</tr>
<tr>
<td>Black Ink pen</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 1:** Materials employed in procedure. Table containing description of the materials needed and number required to complete procedure.

**Results**

**Stress Analysis**

It was hypothesized that stress, as measured by the ESRQ, would be greater in the descending timer condition than in the ascending timer condition.
The ESRQ consisted of 14 questions divided into 7 positive (relaxed, pleased, glad, alert, focused, concentrated, and energetic) and 7 negative (concerned, uncertain, disappointed, heated, mad, and angry) emotional questions (Larrson & Wilde-Larsson, 2012). Scores on the ESRQ ranged from -21 to +21, with a score of -21 indicating the dominant emotion was negative and a score of +21 indicating the dominant emotion was positive (Larrson & Wilde-Larsson, 2012). In the current study, the average participant ESRQ score was 5.5 in the ascending timer condition and 6.8 in the descending timer condition.

An Anderson-Darling (Anderson & Darling, 1952) test was applied to determine whether ESRQ scores were normally distributed. ESRQ scores were found to exist on a normal distribution, so a paired t-test was used to test for a difference in ESRQ scores between ascending and descending timing conditions. The null hypothesis was that no difference in ESRQ score existed between timing conditions and the alternative hypothesis was that a difference in ESRQ score between timing conditions would appear. The paired t-test (ds = 30, 95% CI) indicated no significant difference (p = .318) existed between stress in ascending and descending timing conditions (see Figure 1). Given this pattern of results, we fail to reject the null hypothesis and conclude ESRQ scores do not vary as a function of timing direction.

Motivation Analysis

It was hypothesized participant motivation would be higher in the descending timing condition than the ascending timing condition. Motivation was measured through performance (Touré-Tillery & Fishbach, 2014) and indicated by the number of matches made in each matching activity. The number of matched pairs made was higher in the descending timing condition with an average of 7.2, with the average number of matched pairs in the ascending timing condition at 5.8.

An Anderson-Darling (Anderson & Darling, 1952) test indicated the number of matched pairs existed on a normal distribution; paired t-tests were used to analyze differences in performance between ascending and descending timing conditions. The null hypothesis was that no difference in the number of matched pairs existed between timing conditions and the alternative hypothesis was that a difference in performance existed between timing conditions.

A t-test (ds = 30, 95% CI) showed significant difference (p = .007) in between ascending and descending timing conditions (see Figure 2). Given the pattern of results, the null hypothesis was rejected and the alternative hypothesis was accepted. It was concluded that motivation was greater when the matching activity was completed in the presence of a descending timer rather than an ascending timer.

![Figure 1](image_url)

*Figure 1.* ESRQ scores ranged from -21 to 21 (Larrson & Wilde-Larsson, 2012). Error bars reflect one standard deviation from the mean.
Discussion

It was predicted ESRQ scores would be lower in descending timing condition than the ascending timing condition. The results of the current study did not support this hypothesis, indicating that stress does not differ based on the direction of a timer present during task completion. Also, performance (expressed by the number of matches made) was predicted to be higher in the descending vs. ascending timing condition and the results of the current study confirm this prediction. As performance was higher in the descending vs. ascending timing condition, it could be inferred that motivation followed the same pattern, relative between the two timer conditions.

The current study fits into an area of literature where there is a paucity of existing research; current literature has not focused on the direction of timing and its effects. Previous research has, however, addressed anxiety and timing, suggesting that both anxiety and stress were likely to lower task performance (Kellogg, Hopko, & Ashcraft, 1999). The results of the current study validate further examination on the effect the direction of a timer has on physiological and psychosocial variables.

Motivation is key in both a work and school environment, so it is essential to understand how society can use it to maximize performance. Touré-Tillery and Fishbach (2014) discussed outcome-focused and process-focused motivation. Since the hypothesis that motivation increases in the presence of a descending clock was confirmed, the current study supports the idea that task motivation can facilitate achievement (Touré-Tillery & Fishbach, 2014). Process efficiency theory is important to consider, due to its effect on working memory. In the context of the current study where participants were concerned about the timer, their ability to retrieve information and bring it into their working memory inconsistently impacted performance. It is recommended that future research examine the relationship between working memory and performance more closely.

Generalizability

The current study has strong external validity, as the results can immediately be applied in workplace or school settings to maximize motivation via performance by implementing a descending clock during timed tasks. It would be of value to replicate the current study with a variety of populations to expand the range of generalizability.

Alternative Explanations

The pattern of results found in the current study may have been impacted by previous experience with the matching activity. Though the goal of the current study was not to test the participants’ memory, the memory ability of the participants may have affected the results. Had participants completed an activity they had never seen before, ESRQ scores may have been affected in different ways.

Methodological Issues

This experiment was a within-subjects design and, thus, participants may have been impacted by
practice effects. Although the matching activity was
closed to minimize practice effects, they still may
have operated to impact the pattern of results.
Counterbalancing was also used to minimize the
impact of practice effects on the results. Future studies
of a similar nature could either offer a greater time
between conditions or implement a between-subjects
design to extinguish the practice effect. Due to
cognitive interference and attentional resources
available in working memory (Eysenck et al., 2007)
some participants forgot the instructions while
completing the matching activity and attempted to take
shortcuts to maximize the matching speed. Although
participants were reminded and monitored to minimize
these behaviors, the time pressure may have led
participants to forget. It is also recommended that
future studies test participants in groups to minimize
the pressure that may come from a one-on-one testing
environment.

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