European Journal of Personality
Eur. J. Pers. **15**: 391–406 (2001)
DOI: 10.1002/per.413

Procrastination as Self-regulation Failure of Performance: Effects of Cognitive Load, Self-awareness, and Time Limits on 'Working Best Under Pressure'

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Abstract

Effects of cognitive load, objective self-awareness and time limits on the self-regulation of performance speed and accuracy were investigated between procrastinators and non-procrastinators. In experiment 1 chronic procrastinators completed fewer items (slow speed) and made more errors (less accuracy) than non-procrastinators under high but not low cognitive load conditions when the time span was limited and brief. In experiment 2 chronic procrastinators performed slower than non-procrastinators under a 2 second, but not under no limit, 1 second, or 4 second time limit conditions. Chronic procrastinators compared to non-procrastinators also performed more slowly and made more performance errors under objective self-awareness conditions regardless of the length of time. These experiments indicate that chronic procrastinators regulate ineffectively their performance speed and accuracy when they 'work under pressure' (defined by high cognitive load, objective self-awareness, and imposed time limitations). Copyright © 2001 John Wiley & Sons, Ltd.

Procrastination is the delay of a relevant and timely activity (Knaus, 1973), and a sizable number of normal, non-clinical adults in the U.S. (20%) self-identify as 'chronic procrastinators' across time and space (Harriott and Ferrari, 1996). Compared to non-procrastinators, chronic procrastinators more often protect their self- and social esteems by choosing environmental obstacles that handicap successful completion of a task (Ferrari, 1991b; Ferrari and Tice, 2000), avoid self-relevant information in order to complete easy, less effortful tasks (Ferrari, 1991d), suffer poor health because they choose to work too

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Contract/grant sponsor: DePaul University.
Conference's first day year: 2001.
Conference's last day year: 2001.
Conference name: Annual Meeting of the Society for Personality and Social Psychology.
Conference place: San Antoino, TX.

Received 25 January 2001
Accepted 21 May 2001

close to deadlines (Tice and Baumeister, 1997), and use delays as revenge against others despite the loss of potential positive relationships (Ferrari and Emmons, 1994). Chronic procrastinators compared to non-procrastinators also engage in strategic impression management (Ferrari, 1991c), behave in a perfectionistic manner for ingratiation purposes (Ferrari, 1992a), and recommend severe reprimands to peers who might demonstrate poor task performance (Ferrari, 1992b). In short, it seems that procrastination is an important psychological variable, and some people use this behaviour pattern frequently as a way to avoid or hide their possible lack of ability from themselves and others (cf. Ferrari, Johnson and McCown, 1995).

Effective self-regulation of performance requires a person to find an optimal balance between working on a task as fast as possible (i.e. speed) and maintaining a high degree of accuracy (Baumeister, 1997a,b; Bratslavsky and Baumeister, 1998; Vohs and Heatherton, 2000). For example, when completing an examination a student might benefit on their task performance if they regulated the time frame to perform in order to have extra time to check for accuracy in their answers. In the present study, self-regulation of performance by chronic procrastinators and non-procrastinators was examined experimentally under conditions of time limitations, cognitive load, and objective self-awareness.

Researchers have reported that chronic procrastinators (compared to non-procrastinators) spend less preparation time on tasks that were likely to succeed (Lay, 1990; Lay, Edwards, Parker and Endler, 1989), underestimate the overall time required to complete tasks (McCown, Johnson and Rupert, 1987), and spend less time searching for information needed to complete the task (Ferrari and Dovidio, 2000). Chronic procrastinators also self-reported that they have difficulty maintaining a balance between high performance speed and accuracy (Ferrari, 1993), although there have been no published laboratory-based, experimental assessments on how they actually perform when time limits are placed on their performance. Working on a project or task within a limited time frame may make chronic procrastinators feel anxious, depressed, or even bored, so they attempt to avoid starting or finishing the project (Lay, 1987, 1995, 1996; Ferrari and Beck, 1998). It is possible that when placed in stressful situations, such as *time limitations* for performance, chronic procrastinators compared to non-procrastinators may complete less of the specific task (i.e. avoid the task) in order to prevent any negative affect. In other words, although many frequent procrastinators may state that they 'work best under pressure' (e.g. imposed time limitation), their performance speed may actually suffer and they complete less accurately the task on hand (i.e. they 'choke under pressure': Baumeister, 1984).

Overwhelming situational demands other than limited time, such as competing cognitive activities (a *cognitive load* condition), may prompt some people to engage in self-regulation failure of effective performance (Baumeister, Heatherton and Tice, 1994; Vohs and Heatherton, 2000). Muraven, Tice and Baumeister (1998) found that self-regulation activities (e.g. mental control of thoughts) produced subsequent self-regulation failure. Ferrari and Dovidio (2001) found that decisional procrastinators (indecisives) compared to non-procrastinators were not able to process information effectively when the cognitive load to perform the task was high (counting the number of clicks presented while searching among a number of information elements). However, in that study there were no time limitations on a person's performance of the task. Nevertheless, the results imply that it is possible that self-regulation failure of performance may occur when chronic procrastinators engage in competing cognitive activities. Indirectly, Senecal, Koestner and

Vallerand (1995) supported this possibility by finding that self-reported academic procrastination by college students on tasks such as studying and reading were significantly related to self-regulation failure of affect. In the present study, chronic procrastinators compared to non-procrastinators were expected to engage in ineffective self-regulation of performance speed and accuracy when instructed to make both judgements between stimuli and memorizing random digits displays.

In addition to time limitations and cognitive load situations, the self-regulation of performance speed and accuracy by chronic procrastinators might be compromised by *objective self-awareness*. Carver and Scheier (1981, 1996) claimed that people placed in a situation where they observe their behaviour in a mirror are more likely to focus attention on their personal thoughts and feelings. Focusing on one's inner states when a mirror is present as opposed to absent intensifies one's affective experience to external stimuli (Carducci, 1997; Scheier and Carver, 1977). Objective self-awareness, then, may make attention to oneself especially unpleasant (Carver and Scheier, 1998; Duval and Wicklund, 1972; Wicklund, 1975), and heightened self-attention may prompt a person to do things that probably produce poor performance (Baumeister, 1977b; Jones and Berglas, 1978). It is possible that under conditions of objective self-awareness like the presence of a mirror, these poor expectations would be heightened, resulting in ineffective regulation of one's performance speed and accuracy (Carver and Scheier, 1996). The person may accept the costs and risks associated with performance failure in order to avoid public or private awareness of personal shortcomings (Baumeister, 1997b).

Ferrari has consistently found that procrastination tendencies were related to low self-esteem and low self-confidence, as well as concerns about public image, anxiety over task performance, and public and private self-consciousness (Ferrari, 1991a, 1991b, 1991c, 1992a). Procrastinators compared to non-procrastinators also have negative expectations about their present and future task performances (Ferrari, 1991b, 1991c). Within objective self-awareness manipulations, such as the presence of a mirror, poor expectations are heightened and more salient. It is very possible that persons with frequent procrastination tendencies under objective self-awareness conditions would focus on their perform inadequacies and shortcomings. Heightened self-awareness (mirror presence) by procrastinators about their potential performance inadequacies (accompanied by lack of self-confidence, anxiety over skills, and insecurities about task abilities: Ferrari *et al.*, 1995), make them unable to regulate effectively their performance speed and accuracy in a limited time span for completing a task. In short, chronic procrastinators would *not* perform 'well under pressure' of objective self-awareness; instead, they would demonstrate self-regulation failure of performance speed and accuracy.

In the present study, two experiments were conducted on the self-regulation of performance speed and accuracy of chronic procrastinators under limited time and external, situational pressures of cognitive load and objective self-awareness. Time limitations were expected to produce high states of anxiety and stress for chronic procrastinators who were to complete a target task. Competing cognitive activities (such as making judgements while memorizing random digits) were expected to place high cognitive demands on chronic procrastinators who must attend effectively to the task at hand. In addition, becoming the focus of one's own self-attention (working in the presence of a mirror) may raise awareness of one's inabilities, thereby producing poor performance speed and accuracy by chronic procrastinators. Thus, it was expected that persons with frequent procrastination tendencies would complete less of the experimental task (low speed) accompanied with more performance errors (low accuracy) under limited

time constraints and high cognitive load and when self-attention was heightened in the presence of a mirror.

EXPERIMENT 1

In the first experiment, participants were allotted a fixed and brief time frame to place an 'X' accurately inside as many circles as possible as the size of the circles became successively smaller under conditions of high versus low cognitive load and presence or absence of objective self-awareness. For chronic procrastinators, time limitations may produce a stressful situation, thereby hindering effective performance abilities. Furthermore, it was anticipated that chronic procrastinators compared to non-procrastinators would perform worse (i.e. higher error rates) when the cognitive load to perform the task was increased. Additional information processing might occupy too much of working memory for chronic procrastinators, resulting in depleted self-regulation resources for effective performance speed and accuracy. To the extent that chronic procrastinators also lack confidence about their abilities, it was expected that chronic procrastinators compared to non-procrastinators would demonstrate self-regulation failure of performance speed and accuracy when working under high self-awareness (mirror presence).

Method

Participants

A total of 93 college students (51 women, 42 men: age $M = 19.46$ years old, $SD = 2.22$) were recruited from a population of mid-western university participates enrolled in introductory psychology classes in exchange for course credit.

Psychometric Measures

Participants completed the *Adult Inventory of Procrastination* (AIP: McCown and Johnson, unpublished manuscript; see Ferrari *et al*., 1995 for actual items). This inventory consists of 15 items; each rated on a five-point scale ($1 = low$, $5 = high$) that assesses an individual's tendency to delay the beginning and/or completion of tasks. Procrastination scores were obtained by summing across response items (including seven items reverse scored); high scores were indicative of frequent procrastination. Sample items included 'I don't get things done on time' and 'I am not very good at meeting deadlines'. The scale has a coefficient alpha of 0.79 (retest $r = 0.71$; McCown and Johnson, unpublished manuscript), and the present sample obtained an alpha of 0.82. Validity studies indicate that high scores have been related to inefficient time management and delays in returning completed scales, filing income tax returns, and shopping for Christmas gifts (McCown and Johnson, unpublished manuscript, Ferrari *et al.*, 1995).

Procedure

At a large prescreening session during the first week of classes, all students enrolled in introductory psychology completed a demographic questionnaire and the AIP (embedded among several scales). Approximately two weeks later, participants signed up for course credit for an experiment labelled 'Speed–Accuracy', described as completing a set of tasks under time constraint. Participants were instructed to attend a laboratory room for a specific time and day. Upon entering the laboratory, each participant was asked by a male

experimenter (who was blind to the procrastination scores) to sit at one of three separate and independent workstations in a large meeting room. The experimenter informed the participants that this study involved speed and accuracy at a simple task that gradually increased in difficulty. Each participant then was asked to sign and date a consent form.

Participants were assigned randomly to either a low or high *cognitive load* condition. In the high load condition, participants were told that they were to memorize an eight-digit (random) number sequence (e.g. 3 5 5 6 3 6 5 7) that would be recalled at the end of the task. The digit sequence was printed on a 5 in $\times$ 8 in index card and placed face down to the left of the participant. The card was picked up, viewed, then replaced after a 10 s study period. At the end of the circle task (described below), participants in the high load condition had 20 s in which to recall and write the digit sequence on a sheet of paper. Participants in the low load condition did not receive a digit sequence to memorize.

Participants also were assigned randomly to either a low or high *objective self-awareness* condition. Participants in the low self-awareness condition did not have the presence of the mirror. In the high self-awareness condition, participants were seated in front of an 18 in $\times$ 18 in mirror positioned at the level of the desk upon which they would complete the task. It should be noted that despite the presence of the mirror the sitting positions of participants around the laboratory made it impossible for them to see either the face or the task performance of anyone else during the experimental session.

The experimenter then informed all participants that within a time limit of 2 min they were to place an 'X' inside a series of circles that became increasingly smaller. There were a total of 371 circles printed on the page, beginning with a diameter of approximately 1 in and decreasing in size to a diameter of 1/8 in. Participants were instructed to place the 'X' inside each circle as quickly and as accurately as possible.

At the end of the 2 min time limit, participants were asked to stop. All participants then were asked to open a folder located in front of them containing a set of eleven nine-point rating scales (1 = *not at all*; 9 = *very much*) and one item that assessed the percentage of other participants who would perform better than oneself. These 12 measures included five manipulation checks: (1) how important it was to have an accurate performance on the task; (2) how much he/she believed that the experimenter's presence affected their performance; (3) how much the time limitation affected performance; (4) how motivated were participants to perform quickly on the task; and (5) how much they felt the presence of other participants affected performance. Three other items assessed the participant's opinion on aspects of their performance, including (1) how well he/she believed they performed on the present task; (2) the percentage of others (0% to 100%) believed to have performed better than oneself on this task; and (3) how well he/she believed they would perform on similar tasks. Finally, there were four attribution items, to assess how much the completed task was an evaluation of (a) effort, (b) ability, (c) luck, and (d) task difficulty. After post-task measures were completed, the experimenter debriefed the participants by explaining the nature of the study and answered any questions.

Results

Individual differences in procrastination

Chronic procrastinators and non-procrastinators were based on AIP scores obtained from the prescreening session (group $Md = 39$; $M = 38.88$, SD = 10.47). Using a median split procedure, participants were categorized as 'chronic procrastinators' from those persons whose AIP score was greater than or equal to 39 ($M = 48.39$, SD = 8.18; $n = 48$: 28

women, 20 men). Participants were categorized as 'non-procrastinators' from persons whose AIP scores were less than or equal to 38 ($M = 27.83$, SD = 3.64; $n = 45$: 23 women, 22 men). There were no significant gender differences on AIP scale scores (consistent with the results of other studies; see Ferrari *et al.*, 1995), and no significant gender difference in the frequency of men and women across experimental conditions. Therefore, no further gender comparisons were assessed in this study.

Speed–accuracy assessments

For this study, the number of completed circles performed within the 2 min time limit was the dependent measure of performance *speed*. The proportion of circles where an 'X' was placed entirely within the circle and did not exceed the circle's boundaries out of the total number of completed circles was the dependent measure of performance *accuracy*. In other words, an 'X' was judged an 'error' if any extension was discernible beyond the boundary of the circle. An independent judge was used for inter-rater reliability of performance speed and accuracy. Median inter-rater agreement for accuracy was 93%.

A 2 (procrastination type: low versus high) × 2 (cognitive load: low versus high) × 2 (self-awareness: presence versus absence) ANOVA was performed separately for performance speed and performance accuracy as dependent variables. There were no significant three-way or two-way interactions on *performance speed*. However, there was a significant main effect for procrastination type, $F(1, 84) = 4.03$, $p < 0.04$. Chronic procrastinators completed significantly fewer circles ($M = 131.11$, SD = 24.05) than non-procrastinators ($M = 143.32$, SD = 21.58).

There was a significant two-way interaction for procrastination type and cognitive load on *performance accuracy*, $F(1, 89) = 3.96$, $p < 0.05$. Table 1 presents the mean number of circles completed accurately for chronic procrastinators and non-procrastinators under high or low cognitive load. Chronic procrastinators in the high cognitive load condition completed significantly fewer circles accurately than participants in the other three conditions.

Post-task measures

In addition, 2 (procrastinator versus non-procrastinator) × 2 (high versus low self-awareness) × 2 (high versus low cognitive load) ANOVA s were performed for each of the 12 post-task items. There were no significant interaction effects but a few main effects for procrastination types. Across these five nine-point item manipulation checks,

Table 1. Mean number of circles completed accurately under low and high cognitive load conditions for procrastinators and non-procrastinators in experiment 1

	Cognitive load	
	Low	High
Chronic procrastinators	141.67 (27.02)[b] ($n = 24$)	120.25 (26.73)[a] ($n = 24$)
Non-procrastinators	142.07 (23.45)[b] ($n = 23$)	144.60 (20.12)[b] ($n = 22$)

Value in parentheses is standard deviation.
Value in brackets is number of participants per cell.
[a,b]Same superscripts indicate values are not significantly different.

participants indicated that they felt it was important that they perform accurately on the task ($M = 7.01$), felt the time limit procedure had affected their performance ($M = 6.46$), were moderately motivated to complete the task quickly ($M = 4.95$), but did not think the experimenter was aware of their performance while working on the task ($M = 2.98$), nor that the presence of other participants in the room affected their task performance ($M = 3.05$).

Participants thought that few other participants had out-performed them ($M = 38.5\%$). However, chronic procrastinators were more likely to think they performed poorly on the present task ($M = 4.01$, $SD = 1.01$), compared to non-procrastinators ($M = 7.50$, $SD = 0.99$), $F(1, 89) = 6.96$, $p < 0.01$. Chronic procrastinators also thought that they were more likely to perform poorly on other similar future tasks ($M = 4.05$, $SD = 1.20$) compared to non-procrastinators ($M = 7.22$, $SD = 1.00$), $F(1, 89) = 6.40$, $p < 0.02$. In addition, chronic procrastinators were more likely to think that task difficulty affected their performance ($M = 7.55$, $SD = 1.97$) than non-procrastinators ($M = 3.25$, $SD = 2.02$), $F(1, 89) = 9.20$, $p < 0.005$.

Discussion

This study explored the effects of cognitive load and objective self-awareness under limited time constraint on the performance speed and accuracy associated with procrastination tendencies. Within a specific time limit to perform a task (a potential source of environmental 'pressure' or stress on performance), chronic procrastinators reduced their actual effort (low speed) and completed fewer circles than non-procrastinators. Furthermore, chronic procrastinators compared to non-procrastinators were less accurate in their performance in the high rather than low cognitive load conditions. These results suggest that persons with frequent procrastination tendencies may not effectively self-regulate an optimal mix between high performance speed and high quality performance accuracy (Baumeister, 1997a; Vohs and Heatherton, 2000), when the cognitive demands for a task are high. Consistent with other related research on decisional procrastination or indecision (Ferrari and Dovidio, 2000, 2001), competing cognitive activities produced stressful demands on chronic procrastinators, thereby heightening poor performance and not doing 'well under pressure'.

Contrary to prediction, objective self-awareness by procrastination type did not significantly interact (two way) to impact on the performance speed and accuracy of chronic procrastinators compared to non-procrastinators. Previous research had indicated that procrastination tendencies were significantly related to high self-consciousness (see Ferrari, 1991a, 1991c). It is possible that the present environmental manipulation of self-awareness (simply placing participants in front of a mirror) was insufficient to draw attention to the stimuli. Perhaps, for individuals with frequent procrastination tendencies, environmental stimuli that promote self-awareness need to be made salient. Further research on this variable seemed warranted and was explored in a second experiment.

The post-task item responses by participants also were informative. Chronic procrastinators reported low self-confidence about their performance abilities (consistent with previous research: Ferrari, 1991b), as reflected in their belief that they probably performed poorly on the present task and would perform poorly on similar tasks in the future. Chronic procrastinators, however, claimed that their poor performance was due to external factors (task difficulty), and not personal, actual effort. In fact, chronic procrastinators seemed unaware that they had actually reduced their performance effort by completing fewer circles. Chronic procrastinators in the present study may have attempted

to protect their self-esteem by attributing their performance to external attributes (Ferrari, 1991b; Ferrari and Tice, 2000). This first experiment suggests chronic procrastinators when 'working under pressure' may experience self-regulation failure of performance speed and accuracy.

EXPERIMENT 2

Experiment 1 demonstrated that on a relatively simple motor task with limited time, chronic procrastinators may be unable to self-regulate effectively both performance speed and accuracy. Chronic procrastinators attributed their present underachievement to external factors, yet predicted a future of similarly poor performance patterns. Still, one may argue that the experimental time constraint and conditions in experiment 1 did not produce a true situation where procrastinators could demonstrate that they 'work *best* under pressure'. In experiment 1, the time limitations did not allow for an exploration of the 'process' by which self-regulation failure occurs for chronic procrastinators. That is, while participants had a limited time to perform the task, it is possible that chronic procrastinators had the opportunity to slow down their performance and then check for accuracy. A second experiment was conducted in order to examine how chronic procrastinators performed in terms of speed and accuracy when they had limited time to check (or review) their performance.

Experiment 2 was conducted to assess whether self-regulation failure (low speed and high inaccuracy) of performance by chronic procrastinators would apply to more restrictive, stressful time constraint situations. The presence or absence of objective self-awareness (a mirror) again was manipulated, but under different levels of time constraint. These replications yet modifications of the previous experiment's procedures allowed for an analysis of whether poor task performance associated with procrastination under objective self-awareness conditions would emerge with varied time constraints.

Furthermore, total time to complete the task was recorded for participants in a no time constraint condition, which was not present in experiment 1. This procedure permitted an assessment of the length of time to complete the task with speed and accuracy and procrastination tendencies for high and low self-awareness conditions. In this second experiment, all participants were exposed to the high cognitive load situation (memorization of a random digit sequence) found to promote environmental stress (i.e. 'pressure') for chronic procrastinators more than non-procrastinators in experiment 1 and in other related research (e.g. Ferrari and Dovidio, 2001). Finally, in order to heighten performance motivation, the top three men and top three women were awarded a monetary prize for the best performances (i.e. high speed and low error rates). As a replication of experiment 1, it was expected that procrastination tendencies would be related to low speed and low accuracy within set time limits, especially under conditions of high self-awareness.

Method

Participants

A total of 226 college students (178 women, 48 men: M age $= 20.02$, SD $= 3.44$) attending the same university as cited in experiment 1 participated in this second study. These students were enrolled in introductory psychology classes and received course credit for

their involvement. Most participants were first or second year students (79.9%). None had been participants in experiment 1.

Psychometric Inventory

Participants in this study completed the AIP (McCown and Johnson, unpublished manuscript; see also McCown, Johnson and Petzel, 1989) discussed above. With the present sample, coefficient alpha was 0.74.

Procedure

At a large prescreening session, during the first week of classes, all students enrolled in introductory psychology completed a demographic questionnaire and the AIP embedded among several scales (in random order). Approximately two weeks later, participants signed up for course credit for an experiment with the same title and description as that of experiment 1. As participants entered the laboratory they were asked by a male experimenter (blind to their procrastination scores) to sit at one of three independent workstations located throughout the room, as arranged in experiment 1. The participants, before signing a consent form, were informed that the present study would include testing speed and accuracy while matching pairs of geometric shapes under time constraints. All participants then were instructed to study a random eight-digit number (for 20 seconds) that they would recall in order after completing the shape-matching task. Each participant was presented a packet of 45 shape pairs, one pair per page. Participants were instructed to determine whether or not each of the 45 pairs of irregular, complex geometric shapes matched or did not match by writing 'Y' or 'N' as appropriate in a blank space next to the shape pair as quickly and as accurately as possible. After the shape-matching task participants had only 10 seconds to recall and write down their serial digits.

Previous research indicates that procrastinators are more inclined towards a task when incentives are used to increase their motivation (Ferrari and Dovidio, 1997). All participants were told that the scores from the top three men and top three women would receive a monetary reward. After completing the shape-matching task, participants were asked to recall the random digit sequence and then asked to complete the same 12 post-task measures used as manipulation checks and performance appraisal questions in experiment 1. After all post-task measures were completed, the experimenter debriefed participants and answered any questions.

Participants were assigned randomly to either a low or high *objective self-awareness* condition, similar to the procedures discussed above in experiment 1. However, attached to the mirror was a bright post-note saying 'experiment 28 only,' and the experimenter drew attention to the mirror and note by asking participants to disregard the mirror because it was being used by another experimenter who shared the lab. This additional procedure was used in an effort to enhance the participant's awareness of the mirror's presence (Carducci, 1997). Each mirror was positioned so that participants could see only themselves in the laboratory and was unobtrusive to others in the room.

Participants also were assigned randomly to one of four *time limitation* groups. Participants either had no time constraint, or 1 second, 2 seconds, or 4 seconds per pair. Their task was to judge whether the two shapes matched and to record their judgment before being instructed to advance to the next pair in the package. In the three timed conditions participants were cued at each specific interval (i.e. every 1 second, 2 seconds, or 4 seconds) to flip to the next shape pair at the sound of a prerecorded beeping tone and to complete their packet as quickly and as accurately as possible. Pilot testing with a

small focused group of students ($n = 4$) indicated that it was possible (yet stressful at the 1 second condition) to complete most of the target-matching task under each of these time limitation conditions.

In the no time limit condition, the experimenter told the participant to complete the packet and cued them only to begin the packet. These participants were instructed to complete their packet 'as quickly and as accurately as possible' and say 'finished' when completed with the packet. The experimenter recorded the length of time (in seconds, using a standard stopwatch) to complete the packet by participants in the no time limit condition. This assessment was done unobtrusively, with the experimenter standing out of sight (behind a screen) of the participants. Packets were stapled in the top left or right corner to accommodate handedness preferences for participants.

Results

This second experiment was a 2 (procrastination type: low versus high) $\times$ 2 (self-awareness: low versus high) $\times$ 4 (time limit: 1 second, 2 seconds, 4 seconds, or no time limit) between groups design.

Individual differences in procrastination

Chronic procrastinators and non-procrastinators were based on AIP scores obtained from the prescreening session (group $Md = 41$; $M = 40.3$, SD = 8.2). Again using a median split procedure, participants were categorized as 'chronic procrastinators' from those persons whose AIP score was greater than or equal to 42 ($M = 48.5$, SD = 5.47; $n = 116$: 88 female, 28 male). Participants categorized as 'non-procrastinators' obtained scores less than or equal to 41 ($M = 32.24$, SD = 6.65; $n = 110$: 90 female, 20 male). There was no significant gender difference on self-reported procrastination scores, consistent with previous research (see Ferrari *et al.*, 1995) and experiment 1 above. No further gender comparisons were performed.

Speed–accuracy assessments

In this study, the number of shapes compared served as the dependent measure of *speed*. The proportion of shape pairs correctly compared (judged by the participant as matching or not matching) was the dependent measure of *accuracy.* An independent judge was used for inter-rater reliability of performance accuracy in these judgements, yielding a median inter-rater reliability of 94.5%.

Initially, a 2 (type: procrastinator versus non-procrastinator) $\times$ 2 (self-awareness: high versus low) $\times$ 4 (time limit: 1 second, 2 seconds, or 4 seconds, or no time limit) ANOVA was performed separately for performance speed and performance accuracy as dependent variables. There were no significant three-way interactions either for speed or for accuracy. There was a significant two-way interaction, however, on the number of shapes compared (*speed*) with procrastination type and time limit, $F(3,\ 208) = 3.94$, $p < 0.01$. Table 2 presents the mean number of pairs judged under each time limit condition for chronic procrastinators and non-procrastinators. Chronic procrastinators in the 1 and 2 seconds time limit conditions and non-procrastinators in the 1 second time limit condition compared significantly fewer shapes than participants in the other three time conditions.

There also was a significant two-way interaction on the number of shapes compared (*speed*) between procrastination type and self-awareness, $F(1,\ 208) = 4.99$, $p < 0.04$. Table 3 presents the mean number of shapes compared by chronic procrastinators and non-procrastinators across high and low self-awareness conditions. Chronic procrastinators in

Table 2. Mean number of shapes compared across time limit conditions by chronic procrastinators and non-procrastinators in experiment 2

1 second		
Chronic procrastinators	($n = 29$)	25.75 (3.29)[a]
Non-procrastinators	($n = 20$)	25.03 (3.36)[a]
2 seconds		
Chronic procrastinators	($n = 25$)	31.87 (3.87)[a]
Non-procrastinators	($n = 30$)	44.22 (1.60)[b]
4 seconds		
Chronic procrastinators	($n = 27$)	44.40 (1.82)[b]
Non-procrastinators	($n = 29$)	44.56 (0.97)[b]
No limit		
Chronic procrastinators	($n = 35$)	45.84 (0.50)[b]
Non-procrastinators	($n = 31$)	45.35 (0.10)[b]

Value in parenthesis is standard deviation.
Value in brackets is number of participants in that condition.
[a,b]Same suberscripts indicate values are not significantly different.

the high self-awareness condition (mirror presence) compared significantly fewer shapes than participants in the other three conditions. Furthermore, there was a significant two-way interaction on the proportion of shapes judged correctly as a match or a mismatch (*performance accuracy*) with procrastination type and self-awareness, $F(1, 208) = 5.98$, $p < 0.02$. Chronic procrastinators in the high self-awareness condition (mirror presence) were significantly less accurate than participants in the other three conditions (also see Table 3).

Post-task measures

A 2 (procrastination type) $\times$ 2 (self-awareness) $\times$ 4 (time limits) ANOVA also was completed for the post-task rating scale items. There were no significant interaction or main effects on the manipulation checks. As in the first experiment, participants felt that it was important to perform well on the task ($M = 7.01$); the presence of the experiments ($M = 3.11$) or of other participants ($M = 3.09$) in the room did not affect their performance. Overall, participants in this second study felt that they were fairly motivated to complete the task quickly ($M = 7.02$) but that the time limit procedure had affected their performance ($M = 7.99$).

Table 3. Mean number of shapes compared and proportion of shapes judged accurately across objective self-awareness conditions for chronic procrastinators and non-procrastinators in experiment 2

	Chronic procrastinators	Non-procrastinators
Objective self-awareness:		
Mirror absence	($n = 61$)	($n = 62$)
speed	41.99 (4.04)	43.62 (3.99)
accuracy	0.92 (0.06)	0.94 (0.05)
Mirror presence	($n = 55$)	($n = 48$)
speed	31.74 (4.46)	44.22 (3.69)
accuracy	0.74 (0.04)	0.93 (0.08)

Value in parenthesis is standard deviation.
Value in brackets is number of participants in that condition.

Participants also reported that they believed that few other participants had outperformed them on the task ($M = 34.2\%$). Chronic procrastinators, however, were significantly more likely to believe that they did not perform well on the present task ($M = 2.26$, SD $= 1.11$) compared to non-procrastinators ($M = 6.70$, SD $= 0.34$), multivariate $F(1, 209) = 4.77$, $p < 0.04$, and that they would not perform well on future, similar tasks ($M = 2.04$, SD $= 1.29$) compared to non-procrastinators ($M = 5.54$, SD $= 1.09$), multivariate $F(1, 209) = 3.55$, $p < 0.05$. Also, chronic procrastinators ($M = 3.14$, SD $= 1.79$) reported that luck affected their performance significantly more than non-procrastinators ($M = 2.64$, SD $= 1.72$), multivariate $F(1, 209) = 4.35$, $p < 0.03$.[1]

Discussion

In this second study (with high cognitive demands on all participants), compared to non-procrastinators chronic procrastinators completed less of the target task when the time to make judgements was quite limited. Examining the mean performance speed and accuracy for participants (see Table 2), regardless of procrastination type, participants in the 1 second condition compared few shapes and in the 4 second condition performed quite well with respect for speed and accuracy. It is possible that the 1 second condition was difficult for most participants, and the 4 seconds and no limit conditions were relatively easy for everyone. Therefore, no significant time limit interaction with self-awareness and procrastination type was obtained in this second experiment. However, in the 2 seconds condition the time pressure to perform quickly and accurately resulted in chronic procrastinators, but not non-procrastinators, not performing well under pressure. In fact, chronic procrastinators compared fewer shapes and made more errors than non-procrastinators under conditions of high objective self-awareness. As expected, in this study objective self-awareness may have caused these participants to reflect on their low expectations for success, thereby increasing the likelihood that chronic procrastinators would perform poorly (Carver and Scheier, 1981, 1996). Longer time to compare geometric shapes and less accuracy of those comparisons under objective self-awareness suggests that to some degree chronic procrastinators were unable to self-regulate effectively their performance speed and accuracy under time constraints (Baumeister, 1997a; Baumeister *et al.*, 1994, 1998); that is, 'working *poorly* under pressure'.

The post-task manipulation checks indicated that participants took the task seriously and were motivated to perform, despite time constraints. Chronic procrastinators compared to non-procrastinators, as in experiment 1, held low expectations for success for their present performance and were more likely to generalize poor performance expectations to future, similar tasks. Post-task measures also showed that chronic procrastinators were more likely than non-procrastinators to attribute their performance to external factors (luck). This fact reflects procrastinators' habit of citing external factors for their performance outcome, perhaps as an esteem protective strategy (see Ferrari *et al.*, 1995).

[1]Within the no time limit conditions of experiment 2, the relationship between participant's self-reported AIP scores and the set of follow-up items was assessed. This analysis permitted a way to see whether procrastinators were more likely to make external attributes for their performance (as noted in experiment 1) without the 'pressure' of time limitations. For participants in the high but not the low self-awareness condition who did not have a time limit to perform the task, AIP scores were significantly positively related to a belief that a higher percentage of others performed better on the task ($r = 0.392$, $p < 0.04$), and that one's present performance was attributed to the external factor of luck ($r = 0.510$, $p < 0.0050$).

General Conclusion

A common anecdote among some people, such as procrastinators, is 'I work best under time pressure'. Chronic procrastinators believe they have 'lots of time' to do a task (Lay, 1987, 1988, 1990), yet the present experiments when time was limited suggest they generally produced poor quality performance. When the task was a relatively simple motor activity performed within a fixed time constraint (experiment 1), chronic procrastinators compared to non-procrastinators completed less of the task and were less accurate under high cognitive load conditions. When the task was more complex (e.g. the cognitive load for the task was held high) and the time to perform the task limited (experiment 2; 2 s condition), chronic procrastinators compared to non-procrastinators did not perform well under pressure. In fact, chronic procrastinators in high but not low objective self-awareness conditions completed less of and were less accurate on the target task than non-procrastinators (experiment 2).

In the present studies chronic procrastinators seemed to demonstrate that objective self-awareness under high cognitive load and time limitations produces self-regulation failure of performance speed and accuracy. The popular notion of 'I work best under pressure' may not be so true for persons who are frequent procrastinators. Chronic procrastinators failed to regulate effectively their performance skills to get the best mix of speed to accuracy when time constraints were present. Across the two present laboratory experiments, chronic procrastinators demonstrated a poor performance outcome—they seemed to 'choke under pressure' (Baumeister, 1984), instead of 'doing well under pressure'.

In addition, chronic procrastinators on post-task measures (in both studies) self-reported that they expected their current and future performances to be poor, and they made more external attributions for their task performance such as task difficulty or bad luck. These results were consistent with other studies demonstrating that chronic procrastinators operate from low self-confidence and make situational excuses for their performance failures (e.g. Ferrari and Beck, 1998; see also Ferrari *et al.*, 1995). Unfortunately, the post-task items did not include a question that asked specifically and directly whether the experimental conditions were 'stressful'. Previous research found that chronic procrastinators report anxiety when working on real-world tasks (Ferrari and Dovidio, 2000; Lay, 1990; Pychyl *et al.*, 2000), and heightened self-awareness may be potentially stressful for anxious individuals (Carver and Scheier, 1998; Duval and Wicklund, 1972). It is not clear that single item, retrospective self-reports provide a true indication of actual stress or anxiety experienced by individuals. It seemed logical that the situational manipulations used in the present experiments would be stressful for participants and 'magnify' qualities of their situation.

Alternatively, it is possible that chronic procrastinators were acting impulsively, given the limited time to judge the task. While this possibility is speculative and needs further investigation, it is consistent with previous research that found procrastination tendencies related to dysfunctional impulsivity (Ferrari, 1993). It also may be argued across experiments that procrastinators compared to non-procrastinators were increasingly distracted or unable to concentrate on the tasks because of the situational demands, both facets of conscientiousness. Previous research demonstrated that some forms of procrastination are related negatively to conscientiousness (Johnson and Bloom, 1995), but unrelated to cognitive impairments (Ferrari and Dovidio, 1997) or attention deficits (Ferrari, 2000). Clearly, further research is needed to explore these possibilities.

Further research also is needed to assess chronic procrastinators in other situations where self-regulation success or failure may occur. Both experiments reported here took place in a controlled laboratory setting. Other experimental research that uses more naturalistic methods to explore procrastination in real life and that allows chronic procrastinators to be either successful or unsuccessful would add to our understanding of the linkage between procrastination and self-regulation. This information would permit assessments of the consequence of self-regulation failure by chronic procrastinators in 'real-time,' real-world situations (e.g. Pychyl *et al.*, 2000; Senecal *et al.*, 1995). The present studies demonstrate how several environmental conditions (cognitive load, objective self-awareness, and time limits) may promote poor performance for chronic procrastinators, seemingly unable to self-regulate effective performance speed and accuracy. Future research might explore how chronic procrastinators and non-procrastinators effectively self-regulate their performance speed only a performance accuracy only, compared to both speed and accuracy as examined in the present experiments.

ACKNOWLEDGEMENT

Funding for this research was provided through a 1999 DePaul University 'Competitive Research Grant' award. Portions of the studies were presented at the 2001 annual meeting of the Society for Personality and Social Psychology, San Antonio, TX. Gratitude is expressed to Marc Specter for data collection and entry, and Clarry Lay, Stephanie McGowan, and Ralph Erber for feedback on earlier versions of this paper.

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