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The Influences of Day of the Week on Cognitive Performance

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Authors' contributions

This work was carried out in collaboration between both authors. Author BH designed the study, wrote the protocol and supervised the work. Author DD carried out all laboratories work and performed the statistical analysis. Both authors wrote the first draft of the manuscript and conducted the literature searchers and approved of the writing of this manuscript.

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ABSTRACT

Aim: The aim of the present study is to document and explain changes in cognitive performance that occur from day to day.
Study Design: This is a between-subjects design.
Place and Duration of Study: The University of Texas at San Antonio, Department of Psychology, 2006-2009.
Methodology: Two hundred and thirty fluent English speaking students from the Introductory Psychology classes from the University of Texas at San Antonio participated in this study for course credit. Each participant completed the component processes task [1], a measure of multiple cognitive processes, on either Monday, Tuesday, Wednesday, or Thursday. Data for Fridays were not collected because there was a lack of availability of participants and research assistants at the necessary times.
Results: The results revealed that performance for some cognitive processes vary as a function of the day of the week. Whereas cognitive processes used for learning and integrating new

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information were better later in the week, cognitive processes used for accessing what one knows remained unchanged.
Specifically day of the week influenced text memory such that performance was better on Thursday than on Monday (i.e., 83.1 versus 75.1), F (1, 88) = 6.22, P = .02. Further, day of the week also influenced the two composite measures text-based processes and learning processes such that performance for both of these measures was also better on Thursday than on Monday, minimum F (1, 88) = 4.87, P = .03. However, although performance on text inferencing and combined knowledge integration had a tendency to be better on Thursday than Monday, this tendency was not significant, maximum F (1, 88) = 3.27, P = .07. Further, performance did not differ on Monday versus Thursday for low-knowledge access, high-knowledge access, and the composite measure for knowledge access, maximum $F < 1.0$.
Conclusion: Taken as a whole, these results suggest that both teachers and students should consider the day of the week when trying to maximize cognitive performance.

Keywords: Day of the week; cognitive performance.

1. INTRODUCTION

In 2001, Hannon and Daneman developed a new individual-differences measure that provides estimates of a reader's ability to learn new text-based information, to draw text-based inferences, to access prior knowledge from long-term memory, and to integrate prior knowledge with new text-based information [1]. In their study Hannon and Daneman [1] showed that, when combined, these four components accounted for a considerable amount of variance in performance on a standardized measure of reading comprehension, and that the ability to integrate prior knowledge with text-based information was the single best predictor of reading comprehension ability; see also [2,3]. In this article, we show how Hannon and Daneman's [1] component processes task can be used to identify which component processes are most likely to vary as a function of day of the week.

Performing well academically is of primary concern to every college student. It is not only important for students to be alert during class but it is also important that their cognitive abilities are at their peaks while completing exams and measures of achievement such as the Verbal Scholastic Aptitude Test (i.e., VSAT) or the Graduate Record Examination (i.e., GRE). Indeed, it can be argued that the rapid pace of social and technical change in the last 50 years has created a great deal of emphasis on test performance in order to achieve one's economic and personal goals. It is not surprising then that research has been directed towards documenting and explaining factors that might influence cognitive performance. For instance, some research suggests that cognitive performance might be influenced by the time of day; that is, whether it is morning or evening [4-11]. The findings from this research are that, in general, immediate memory performance tends to be better in the morning in than the evening [4,5,7,11,12], whereas inferential productions about what is read tend to be greater in the evening than in the morning [8,10].

Other research provides evidence that cognitive performance might be influenced by a person's preference for a specific time of day; a preference which is usually assessed using a self-report questionnaire, such as the Morningness-Eveningness Questionnaire (i.e., MEQ) [13]. At one end of the continuum there are the extreme morning types who show a preference for waking up early and find it difficult to stay awake beyond their usual bedtime [14]. At the other end of the continuum there are the extreme evening types who often have difficulty getting up in the morning and prefer to go to bed late in the evening [14]. Most relevant to the present study is the finding that there are age-related differences in preference for the morning such that only 7% of college students are morning types in comparison to 75% of older adults [15].

Less attention, however, has been directed towards documenting and explaining changes in performance on cognitive tasks that occur from day to day. Further, the few studies that do exist are based on either very general measures of cognitive abilities [16] or a population of 8- and 10-year old school girls [17]. Nevertheless these studies have shown that performances on cognitive measures can fluctuate throughout the week. For instance, Laird [16] examined changes in daily performance from Sunday to Saturday using measures of arithmetic, comprehension, and reading time. Laird observed that cognitive performance peaked on Wednesday. In addition, although performance gradually approached a high point on Wednesday, performance abruptly declined to a very low level on Thursday. Like Laird [16], Guérin and colleagues [17] also showed that cognitive performance fluctuated from one day to the next. However, unlike Laird [16], the variations observed in their study were documented by administering both cognitive and physiological measures to a population of 8- and 10-year old school girls. More specifically, Guérin and colleagues [17] analyzed data pertaining to cognitive performance, oral temperature, and self-reported information on sleep onset and duration throughout a two week period. Although they observed no fluctuations in cognitive performance throughout the week for 8-year olds, Guérin and colleagues [17] did observe fluctuations in performance for 10-year olds. That is, on measures of letter and figure cancellation 10-year olds performed best the second day after a day off (i.e., they performed best on Tuesdays and Fridays when Sundays and Wednesdays were days that they did not attend school).

Taken as a whole, the findings of Laird [16] and Guérin and colleagues [17] seem to suggest that cognitive performance might be influenced by the day of the week. When students have a mental break, it appears that cognitive performance will peak a few days after that break. Of course, the studies of Laird and Guérin and colleagues [17] only scratch the surface. Indeed, one might wonder whether the findings of Laird's study are still applicable to college level students given that it is more than 80 years since his study. Further, Laird [16] and Guérin and colleagues [17] examined variations in cognitive performance on measures of general abilities (i.e., arithmetic, comprehension, and letter and figure cancellation) and so one might wonder whether cognitive performances on other more specific measures might also vary throughout the week. Therefore, the primary goal of the present study was to extend the findings of Laird and Guérin and colleagues [17] by examining whether there are variations in performance throughout the week on more specific component processes such as text memory, text inferencing, knowledge access, and knowledge integration. Based on the findings of Laird [16] and Guérin and colleagues [17], we hypothesized that performance on measures of these specific components should vary as a function of day of the week.

2. MATERIALS AND METHODS

2.1 Participants

A total of 230 students from the University of Texas at San Antonio Introduction to Psychology classes participated in this study for course credit. All participants were fluent in English and were tested in one session in groups of one, two, or three. Each participant completed a consent form, Hannon and Daneman's component processes task [1], a measure of multiple cognitive processes, on either Monday, Tuesday, Wednesday, or Thursday. Data for Fridays were not collected because there was a lack of availability of participants and research assistants at the necessary times.

2.2 Component Processes Task

Our measure of specific component processes was Hannon and Daneman's component processes task [1,3]; see also Hannon [18-22], Hannon and Daneman [23], and Hannon McNaughton-Cassill [24]. The component processes task provides estimates of a reader's ability to learn new text-based information, to draw text-based inferences, to access prior knowledge from long-term memory, and to integrate prior knowledge with new text-based information. The component processes task is based on a task by Potts and Peterson [25] but it accounts for considerably more variance in reading performance. Indeed research suggests that the component processes task accounts for an impressive 34-60% of the variance in performance on global measures of reading comprehension ability (i.e., the Nelson-Denny and the Verbal SAT) and up to 32% of the variance in performance on specific comprehension measures, each of which draws more heavily on one particular component process [1,18,19]. The component processes task is also better at predicting reading comprehension than typical measures of working memory or vocabulary [1]. In fact, it has been argued that the component processes task is as good at predicting reading comprehension as is another measure of reading comprehension ability [1].

In the component processes task, participants learn short, three-sentence paragraphs that describe relations among a set of real and artificial terms. For example,

> *A WEMP resembles a WHALE but is larger and weighs more.*

A whiskered TILN resembles a PIRANHA but is smaller and weighs more.

A LORK resembles a TILN but is smaller, weighs more, and is kept as a pet.

By using the relations described in a paragraph, students can construct two linear orderings (i.e., size linear ordering: *wemp* **>** *whale* **>** *piranha* **>** *tiln* **>** *lork* and weight ordering: *wemp* **>** *whale* **>** *piranha; lork* **>** *tiln* **>** *piranha*). However, because the facts that *a whale is larger than a piranha* and *a whale weighs more than a piranha* are not stated explicitly in the paragraph, students must access their existing world knowledge in order to construct the orderings. Students study each paragraph at their own pace and then respond to true-false statements that measure four different component processes: text memory, text inferencing, knowledge access, and knowledge integration.

2.2.1 Materials

The materials consisted of seven short paragraphs with the first one serving as practice. As in Hannon and Daneman [1-3], each paragraph consisted of three sentences with each sentence appearing one at a time in the middle of the computer screen in the standard order. Each paragraph included three nonsense terms (e.g., *WEMP, TILN, LORK*), two real terms (e.g., *WHALE, PIRANHA*), and two, three, or four semantic features.

Text memory, text inferencing, low-knowledge access, high-knowledge access, low-knowledge integration, and high-knowledge integration statements followed each paragraph. In total, there were 240 accompanying statements. Half of the statements for each type were true while the other half were false. The 84 *text memory* statements (i.e., *A WEMP is larger than a WHALE.*) assessed memory for information explicitly stated in the paragraph; no prior knowledge was required. The 36 *text inferencing* statements (i.e., *A PIRANHA is larger than a LORK*.) assessed information that was implied in the paragraph (i.e., *A PIRANHA is larger than a TILN; A TILN is larger than a LORK, so therefore a PIRANHA must be larger than a LORK.*); again no prior knowledge was required. In contrast, the two types of knowledge access statements measured access to prior knowledge; no new text-based information was required. Each of the 36 *low-knowledge access* statements (e.g., *A WHALE is larger than a GOLDFISH.*) included a term (*e.g., WHALE*) and semantic feature (*i.e., larger than*) that were explicitly stated in a paragraph and a term that was not (e.g., *GOLDFISH*). The 24 *high-knowledge access* statements (e.g., *SHARKS are typically vicious, whereas WHALES are not.*) required more extensive use of prior knowledge because they used a term (e.g., *SHARKS*) and a semantic feature (e.g., *are typically vicious*) not explicitly stated in a paragraph. Finally, the two knowledge-integration measures required participants to access their prior knowledge and integrate it with text-based information. The 24 *low-knowledge integration* statements (e.g., *A WHALE is larger than a TILN*) required accessing prior knowledge (i.e., *WHALES are larger than PIRANHA*) and integrating this fact with paragraph information (i.e., *A TILN is smaller than a PIRANHA*). Each of these statements included a nonsense term (i.e., *TILN*), real term (i.e., *PIRANHA*), and semantic feature (i.e., *smaller than*) that were explicitly stated in a paragraph. The 36 *high-knowledge integration* statements (e.g., *Like SHARKS, WEMPS do not typically fit in a fish tank.*) also required accessing prior knowledge and integrating this fact with paragraph information. However, these statements required more extensive use of integration processes because they required accessing prior knowledge (i.e., *SHARKS do not fit in a fish tank*) and integrating this fact from prior knowledge with a paragraph fact that was implied (i.e., *A WEMP is larger than a WHALE,* and because *WHALES* do not fit in fish tasks, neither can a *WEMP.*).

It is important to note that in Experiment 2 in Hannon and Daneman's study [1] found that the pattern of correlations among the four types of measures was consistent with their description. That is, text memory and text inferencing, the two measures that depended on new text-based information rather than prior knowledge, were highly correlated with one another (r = .83, P < .001), but were at best weakly correlated with the two measures of knowledge access, the measures that were dependent on just prior knowledge (range of correlations: .18 to .30, P = .02). On the other hand, the two types of knowledge integration measures, which depended on text-based information as well as prior knowledge, correlated with the two text-based measures (range of correlations: .54 to .70, P < .001) as well as the two prior knowledge access measures (range of correlations: .22 to .42). This pattern of correlations suggests that the ability to remember new information and the tendency to use world knowledge might be separate skills.

2.2.2 Procedure

The instructions directed students to use their world knowledge while performing the task. The presentation of a paragraph was self-paced. Students pressed the +-key for the first sentence of a paragraph and after learning this sentence, they pressed the +-key for the second sentence of a paragraph. At this point, the first sentence disappeared and the second sentence appeared. After learning a three-sentence paragraph in this manner, test statements for that paragraph appeared randomly, one at a time, in the middle of the computer screen. Each test statement remained on the screen for up to 12 seconds. If a student failed to respond to a test statement within the 12-second window, that test statement disappeared and the next test statement appeared. All response failures were classified as errors. Accuracy (i.e., number correct) was the primary dependent measure for each statement type; however, speed of responding (i.e., average reaction time for correct responses on all statement types) was calculated also as a measure of speed. After completion of the test statements for a paragraph, a pause screen appeared to provide a break before proceeding to the next paragraph. See [1] for similar instructions.

2.3 Statistical Analysis

For the descriptive statistics, which primarily determine replication of the internal pattern of results for Hannon and Daneman's component processes task [1], we used correlational analysis. For the critical analysis, which assessed the influences of day of the week, we used Analysis of Variance (i.e., ANOVA).

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics of Measures

The descriptive statistics for the cognitive measures are reported for the overall data as well as on a day-by-day basis (i.e., for Monday, Tuesday, Wednesday, and Thursday). Table 1 includes the means and standard errors for each component process of Hannon and Daneman's task [1] as well as the means and standard errors for the composite measures of text-based processes, knowledge integration, knowledge access, and combined learning processes. These composite measures were included in order to get a sense of how day of the week might influence "like" component processes; that is component processes that tended to serve similar functions. The composite measure for text-based processes was created by summing the z-scores for text-memory and text inferencing; the composite measure for knowledge access was created by summing the z-scores for low- and high-knowledge access; the composite measure for knowledge integration was created by summing the z-scores for low- and high-knowledge integration and finally, the composite measure for learning processes was created by summing the z-scores for text memory, text inferencing, and low- and high-knowledge integration. Low- and high-knowledge access were not included in the composite measure for learning processes because these two component processes measure efficiency at accessing what one already knows not one's efficiency at learning new information, see Hannon and Daneman [3] who also make a similar distinction. In general, the overall means of the component processes task are similar to those observed by Hannon and Daneman [1].

Table 1. Means and standard errors for component processes as a function of day of the week (N = 230)

Cognitive component	Overall	Monday	Tuesday	Wednesday	Thursday
Text memory (max=84)	77.4(.9)	75.1(1.9)	77.5(1.6)	76.6(1.8)	83.1(2.6)
Text inferencing (max=36)	68.8(.9)	66.6(1.8)	69.3(1.5)	68.4(1.7)	72.3(2.6)
Low-knowledge integration (max=24)	85.1(.7)	84.0(1.5)	85.4(1.3)	83.9(1.5)	88.5(1.8)
High-knowledge integration(max=36)	73.3(1.)	71.6(2.2)	73.2(1.5)	73.1(1.9)	77.2(3.0)
Low-knowledge access (max=36)	93.2(.4)	92.8(.7)	93.2(.6)	93.1(.8)	93.9(1.2)
High-knowledge access (max=24)	93.3(.5)	93.4(.9)	92.8(.8)	93.8(1.2)	93.6(1.3)
Combined text-based processes	.11(.1)	-.29(.2)	.07(.2)	-05(.3)	.69(.3)
Combined knowledge integration	.08(.1)	-.19(.2)	.04(.2)	-.11(.2)	.57(.3)
Combined knowledge access	.05(.1)	-.02(.2)	-.03(.2)	-.05(.2)	.69(.3)
Combined learning processes	.19(.2)	-.48(.4)	.11(.4)	-.15(.5)	1.26(.6)

Note. Standard errors are reported in brackets. Means for the component processes are reported in percentages; means for the combined measures are not reported in percentages

Table 2. Correlations among the component processes (n = 230)

Component process	1	2	3	4	5	6
1. Text memory	- - -	.81*	.64*	.66*	.34*	.22*
2. Text inferencing		- - -	.54*	.66*	.23*	.11
3. Low-knowledge integration			- - -	.66*	.46*	.37*
4. High-knowledge integration				- - -	.37*	.30*
5. Low-knowledge access					- - -	.56*
6. High-knowledge access						- - -

*Note: * P < .05*

Additionally, the overall pattern of correlations for the components of the component processes task replicated the pattern that was observed by Hannon and Daneman [1,2]. Specifically, as above Table 2 shows, the two text-based components, text memory and text inferencing, were highly correlated with each other (r = .81, P < .001) but were correlated to a lesser extent with the two knowledge access components, low- and high knowledge access (*range of* r = .11, P = .10 to r = .34, P < .001). On the other hand, the two knowledge integration components, low- and high-knowledge integration, were highly correlated with each other (r = .66, P < .001). Low- and high-knowledge integration also correlated with the two text-based components (*range of* r = .54 to .66, P < .001) as well as the two knowledge access components (*range of* r = .30 to .46, P < .001). Finally, the two knowledge access components, low- and high-knowledge access, were highly correlated with one to another (r = .56, P < .001). Taken as a whole, this pattern of correlations illustrates that the two text-based component processes might be tapping separate processes from the two knowledge access component processes (i.e., the ability to remember information from a text versus the ability to access real-world knowledge), but that the two knowledge integration component processes are tapping both the text-based and knowledge access processes.

3.2 What are the Influences of Day of Week?

In order to assess the influence of day of week on cognitive functioning, a one-way between-subjects ANOVA was completed for each component of the component processes task (i.e., one ANOVA for text memory, one ANOVA for text inferencing, one ANOVA for low knowledge integration, one ANOVA for high knowledge integration, one ANOVA for low knowledge access, and one ANOVA for high knowledge access) as well as for each composite measure (i.e., one ANOVA for text-based processes, one ANOVA for knowledge integration, one ANOVA for knowledge access, and one ANOVA for combined learning processes). Day of week was the between-subjects variable and it had four levels: Monday, Tuesday, Wednesday, and Thursday.

The results of the ANOVAs revealed that performances for the components of the component processes task did not vary as a function of day of the week, nor were there changes in the performances of the composite measures. As Tables 1 and 3 show, although performance on the measure for text memory tended to be better later in the week than earlier in the week (i.e., 75.1 versus 83.1), this tendency was not significant [F (3, 229) = 2.19, P = .09]. Further, none of the other component processes—text inferencing, low-knowledge integration, high-knowledge integration, low-knowledge access, and high-knowledge access—approached significance [*maximum* F (3, 229) = 1.30, P = .28], nor did performance on any of the composite measures [*maximum* F (3, 229) = 1.84, P = .14].

Looking at the means reported in Table 1 however, it appears that for some of the component processes there are some differences between performances on Thursday versus performances on Monday. For example, the 83.1 reported that text memory on Thursday is much higher than the 75.1 reported for text memory on Monday. Further, when the standard errors are considered for both of these means, there is no overlap; a finding that indicates that there is a significant difference between the means. One potential explanation for these paradoxical findings might be because of the limitations of the ANOVA statistic. The omnibus F used in ANOVAs statistically tests the *average* differences between the levels of an independent variable rather than the *actual* differences. If the average differences between levels are not significantly different then the ANOVA will be non-significant. In fact, this outcome will occur even when the actual difference between two levels of an independent variable is significantly different; as in our text memory result for example. Here the average of the differences between the four levels of the independent variable day of week was 3.8; a number that is certainly different from the actual differences, *range of differences* = 0.4 to 8.0.

In order to ascertain whether there are significant differences between performances on Monday versus performances on Thursday, a one-way between-subjects ANOVA was again completed for each component of the component processes task (i.e., text memory, text inferencing, low knowledge integration, high knowledge integration, low knowledge access, high knowledge access) and each composite measure (i.e., text-based processes, knowledge integration, knowledge access, combined learning processes). However for these ANOVAs the independent variable day of week included only two levels: Monday and Thursday.

The results revealed that cognitive performance for some of the component processes and composite measures varied as a function of day of the week. As Tables 1 and 4 show, day of the week influenced text memory such that performance was better on Thursday than on Monday (i.e., 83.1 versus 75.1), F (1, 88) = 6.22, P = .02. Further, day of the week also influenced the two composite measures text-based processes and learning processes such that performance for both of these measures was also better on Thursday than on Monday, minimum F (1, 88) = 4.87, P = .03. However, although performance on text inferencing and combined knowledge integration had a tendency to be better on Thursday than Monday, this tendency was not significant, maximum F (1, 88) = 3.27, P = .07. Further, performance did not differ on Monday versus Thursday for low-knowledge access, high-knowledge access, and the composite measure for knowledge access, maximum F < 1.0. Given that day of the week did not influence the measures for knowledge access but did tend to influence text memory, the composite measure for text processes, and the composite measure for learning processes, it appears that whereas day of the week does not influence one's ability to access what one knows it does influence one's ability to learn new information.

3.3 What are the Influences of Day of Week and Time of Day?

Although to-date only two studies have considered the influences of day of week on general cognitive performance [16,17] studies have considered the influences of time of day [4-8,10,11]. For this reason, we re-analyzed our data in order to assess the potential interactive influences of day of week and time of day on cognitive performance. A two-way between-subjects ANOVA was completed for each component of the component processes task and for each composite measure. The between-subjects variable "*day of week*" included two levels: Monday and Thursday and the between-subjects variable "*time of day*" also included two levels: 9:30-13:30 and 13:45-18:00.

Table 5 reports the results of the ANOVAs. As these results show, there were no changes in the influences of day of the week that we reported earlier. That is, whereas day of the week influenced text memory, combined text-based processes, and combined learning processes [minimum F (1, 86) = 3.88, P = .05], day of the

Table 3. Summary of ANOVAs for the influences of day of week on the component processes (n = 230)

Component	df	F	P-value
Text memory	3	2.189	.09
Text inferencing	3	1.233	.03
Low knowledge integration	3	1.297	.28
High knowledge integration	3	.925	.43
Low knowledge access	3	.222	.88
High knowledge access	3	.204	.89
Combined text-based processes	3	1.84	.14
Combined knowledge integration	3	1.287	.28
Combined knowledge access	3	.141	.94
Combined learning processes	3	1.80	.15

*Note. *denotes significance, P < .05*

week had little influence on text inferencing, low- and high knowledge integration, low- and high-knowledge access, combined knowledge integration, and combined knowledge access [maximum $F(1, 86) = 2.54$, $P = .12$]. Surprisingly, though, as Table 5 shows time of day had no significant influence on the component processes or the composite measures, all *F's* < 1.0. Nor were there any significant interactions between day of week and time of day, all *F's* < 1.0. These null findings in conjunction with the findings that day of the week does influence performance on some cognitive processes suggest that day of week may have more of an influence on higher-level cognitive processes than time of day does.

Table 4. Summary of ANOVAs for influences of day of week (i.e., Monday and Thursday only) on the component processes (N = 89)

Component	df	F	P-value
Text memory	1	6.22	.02*
Text inferencing	1	3.27	.07
Low knowledge integration	1	3.28	.07
High knowledge integration	1	2.29	.13
Low knowledge access	1	.69	.41
High knowledge access	1	.02	.88
Combined text-based processes	1	5.09	.03*
Combined knowledge integration	1	3.27	.07
Combined knowledge access	1	.34	.56
Combined learning processes	1	4.87	.03*

*Note. *denotes significance, P < .05*

Table 5. Summary of ANOVAs for influences of day of week and time of day on component processes (n = 89)

Source	df	F	P
	(a) Text memory		
1. Day of the week	1	6.09	.02*
2. Time of day	1	.13	.72
3. DOW x TOD	1	.16	.69
	(b) Text inferencing		
1. Day of the week	1	2.54	.12
2. Time of day	1	.33	.57
3. DOW x TOD	1	.18	.67
	(c) Low-knowledge integration		
1. Day of the week	1	2.43	.12
2. Time of day	1	.35	.56
3. DOW x TOD	1	.05	.82
	(d) High-knowledge integration		
1. Day of the week	1	1.46	.23
2. Time of day	1	.01	.93
3. DOW x TOD	1	.10	.76
	(e) Low-knowledge access		
1. Day of the week	1	.33	.57
2. Time of day	1	.04	.84
3. DOW x TOD	1	.10	.76
	(f) High-knowledge access		
1. Day of the week	1	.04	.85
2. Time of day	1	2.05	.16
3. DOW x TOD	1	.63	.43
	(g) Combined text-based processes		
1. Day of the week	1	4.53	.04*
2. Time of day	1	.24	.62
3. DOW x TOD	1	.00	.99

	(h) Combined Knowledge Integration		
1. Day of the week	1	2.25	.14
2. Time of day	1	.12	.72
3. DOW x TOD	1	.01	.95
	(i) Combined Knowledge Access		
1. Day of the week	1	.21	.65
2. Time of day	1	.49	.49
3. DOW x TOD	1	.41	.52
	(j) Combined Learning Processes		
1. Day of the week	1	3.88	.05*
2. Time of day	1	.01	.94
3. DOW x TOD	1	.00	.97

*Note. *significant with p < or = .05. DOW = Day of Week; TOD = Time of Day*

3.4 Discussion

Our results first showed that we replicated the internal structure of Hannon and Daneman's component processes task [1]. This replication provides some evidence that our population is normal. It also replicates the findings of other researchers [18-20]. In addition, our results extend the results of Laird [16] and [17] by showing that other cognitive abilities/skills, besides general abilities, such as arithmetic, comprehension, and letter and figure cancellation, can vary as a function of day of the week. Specifically, performance on the text memory measure was significantly better on Thursday than it was on Monday. Similarly, performance on the measure for combined learning processes was also better on Thursday than it was on Monday. On the other hand, performance on the measures for low- and high-knowledge access remained unchanged regardless of the day of the week. Because performance for those cognitive processes implicated in learning tended to vary as a function of day of the week, whereas performance for those processes used for accessing prior knowledge did not, the results of the present study suggest that not all cognitive processes are susceptible to changes in performance from day to day.

Of course, the findings of the present study only scratch the surface. Indeed, it is likely that other cognitive processes and/or resources are also influenced or not influenced by day of the week. Take working memory for starters. Given that working memory is an attentional resource shared by many cognitive processes, especially those processes used for learning and integrating text [1,2], it is quite possible that working memory capacities are slightly larger later in the week than earlier in the week. However, this is purely speculative and as to-date there is no evidence supporting our proposition.

4. CONCLUSION

In conclusion, we observed that performance for learning processes is better on Thursdays than Mondays, a finding should be of particular interest to students and teachers/professors. For students, it means that the best day for learning new information is Thursdays while Mondays appears to be significantly poorer. For teachers and professors it means that the best day to exam students is Thursdays because, on this day, important processes that are necessary for completing exams well are at their peaks.

CONSENT

The authors declare that written informed consent was obtained from all participants.

ETHICAL APPROVAL

All authors hereby declare that this study have been examined and approved by UTSA Institutional Review Board for research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hannon B, Daneman M. A new tool for measuring and understanding individual differences in the component processes of reading comprehension. Journal of Educational Psychology. 2001;93:103-128.
2. Hannon B, Daneman M. What do tests of reading comprehension ability such as VSAT really measure? A componential analysis. In A. V. Mitel (Ed.) Trends in educational psychology. Nova Science Publications. 2006;1-44.
3. Hannon B, Daneman M. Age-related changes in reading comprehension: An individual- difference perspective. Experimental Aging Research. 2009;35: 432-456.
4. Baddeley AD, Hatter JE, Scott D, Snashall A. Memory and time of day. Quarterly Journal of Experimental Psychology. 1970;22:605-609.
5. Dunne MP, Roche F, Hartley LR. Effects of time of day on immediate recall and sustained retrieval from semantic memory. Journal of General Psychology. 1990; 117(4):403-410.
6. Folkard S. Time of day and level of processing. Memory & Cognition. 1979; 7(4):247-252.
7. Folkard S, Monk TH. Time of day and processing strategy in free recall. Quarterly Journal of Experimental Psychology. 1979; 31(3):461-475.
8. Lorenzetti R, Natale V. Time of day and processing strategies in narrative comprehension. British Journal of Psychology. 1996;87:209-221.
9. Millar K, Styles BC, Wastell DG. Time of day and retrieval from long-term memory. British Journal of Psychology. 1980;71: 407-414.
10. Oakhill J. Effects of time of day on the integration of information in text. British Journal of Psychology. 1986;77:481-488.
11. Oakhill J, Davies AM. Time of day and the representation of text. Current Psychology: Research & Reviews. 1989;8(2):91-101.
12. Folkard S, Monk TH, Bradbury R, Rosenthall J. Time of day effects in schoolchildren’s immediate and delayed recall of meaningful material. British Journal of Psychology. 1977;68(1): 45-50.
13. Horne JA, Östberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. International Journal of Chronobiology. 1976;4:97-110.
14. Schmidt C, Collette F, Cajochen C, Peigneux P. A time to think: Circadian rhythms in human cognition. Cognitive Neuropsychology. 2007;24(7):755-789.
15. Yoon C, May CP, Hasher L. Aging, circadian arousal patterns, and cognition. In D. Park & N. Schwartz (Eds.), Cognitive aging: A primer. Psychology Press. 1999; 151-170.
16. Laird DA. Relative performance of college students as conditioned by time of day and day of week. Journal of Experimental Psychology. 1925;8(1):50-63.
17. Guérin N, Boulenguiez S, Reinberg A, Di Costanzo G, Guran P, Touitou Y. Weekly changes in psychophysiological variables in 8- and 10-year school girls. Cronobiology International. 1993;10:471-479.
18. Hannon B. Understanding the relative contributions of lower-level word processes, higher-level processes, and working memory to reading comprehension performance in proficient adult readers. Reading Research Quarterly. 2012a;47:125-152.
19. Hannon B. Test anxiety and performance-avoidance goals explain gender differences in SAT-V, SAT-M, and overall SAT scores. Personality and Individual Differences. 2012b;53:816-820.
20. Hannon B. Understanding the relative contributions of lower-level word processes, higher-level processes, and working memory to reading comprehension In D. E. Alvermann, J. Unrau, and R. B. Ruddell (Eds). Theoretical Models and Processes of Reading; 2013.
21. Hannon B. Are there gender differences in the cognitive components of adult reading comprehension? Learning and Individual Differences. 2014;32:69-79.
22. Hannon B. Hispanics’ SAT scores: The influences of level of parental education, performance-avoidance goals, and knowledge about learning. Hispanic Journal of Behavioral Sciences; 2015.
23. Hannon B, Daneman M. Revisiting the construct of “relational integration” and its

role in accounting for general intelligence: The importance of knowledge integration. Intelligence. 2015;47:175-187.

24. Hannon B, McNaughton-Cassill M. SAT performance: Understanding the contributions of cognitive/learning and social / personality factors. Applied Cognitive Psychology. 2011;25:528-535.

25. Potts GR, Peterson SB. Incorporation versus compartmentalization in memory for discourse. Journal of Memory and Language. 1985;24:107-118.

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