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Forecasting errors in student media multitasking during homework completion

Charles Calderwood*, Jeffrey D. Green, Jennifer A. Joy-Gaba, Jaclyn M. Moloney

Virginia Commonwealth University, Department of Psychology, 806 West Franklin Street, P.O. Box 842018, Richmond, VA, 23284-2018, USA

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ABSTRACT

Media multitasking during homework completion has reached epidemic proportions in the modern educational environment. There is a crucial need to resolve the paradox of why students engage in these behaviors, even though they are linked to self-control and performance decrements. We evaluate the proposition that student media multitasking decisions are made in the context of inaccurate forecasts regarding the influence of these behaviors on affect, self-control, and performance. After providing forecasts to estimate the effects of media availability and media removal on these outcomes, sixty college students ($N = 60$) were randomly assigned to alternative media availability conditions as they completed an actual homework assignment during an in-lab session. Students predicted media use to result in lower negative affect and diminished self-control. The direction of these forecasts was accurate, with media availability resulting in decreased negative affect and diminished self-control during the homework session. Nevertheless, students exhibited moderate to large forecasting errors in predicting the magnitude of these effects. Although no evidence was attained to demonstrate forecasting errors when predicting homework performance, exploratory analyses suggested the presence of individual differences in the nature of these predictions, with 53.3% of participants predicting a performance decrement, 23.3% of participants predicting no difference, and 23.4% of participants predicting a performance gain under conditions of media availability. We discuss the implications of these findings for students and educators.

1. Introduction

Imagine that your boss has assigned you to update your department's website, a task that promises to be time consuming and boring to you. You plan to get through it by taking periodic breaks to surf the Internet, check your e-mail, and use your smartphone. How might access to these technologies—or lack thereof—influence your mood, self-control, and performance of this task? How would these effects compare to your predictions, such as forecasting how positive or negative you would feel if forced to avoid these potential distractions?

Students frequently multitask with media while completing homework (Calderwood, Ackerman, & Conklin, 2014; Foehr, 2006), despite evidence that these behaviors are associated with reduced academic performance (Junco & Cotten, 2012) that

* Corresponding author.
E-mail address: cccalderwood@vcu.edu (C. Calderwood).

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may stem from diminished self-control (Panek, 2014). When considering *why* students multitask with media, investigators have linked these behaviors to indicators of affective experience, such as negative affect (NA) (Calderwood et al., 2014) and emotional need satisfaction (Wang & Tchernev, 2012). However, researchers have yet to investigate the nature and accuracy of predictions that students make about the influence of media multitasking on their affect, self-control, and performance. We evaluate the possibility that media multitasking decisions in the homework environment are being made in the context of inaccurate affective, self-control, and performance forecasts.

We begin by providing an overview of the homework environment as a context in which to study media multitasking and discuss the strong need to understand factors motivating media use in the current college student population. Next, we describe alternative explanations for student media multitasking and identify students' beliefs and expectations as an understudied but important potential factor that may contribute to these behaviors. Following this discussion, we detail and provide justification for a series of hypotheses targeted at explicating the nature and accuracy of student media multitasking forecasts in the homework environment. The remainder of this paper is spent describing an experimental study designed to test these predictions in a college student sample.

1.1. Media multitasking in the homework environment

In the last decade, researchers have increasingly recognized that students frequently multitask with media while engaged in a range of academic tasks (Calderwood et al., 2014; Foehr, 2006; Fried, 2008; Hembrooke & Gay, 2003). From a theoretical perspective, media multitasking that occurs in the homework environment is a particularly interesting phenomenon, as this relatively unconstrained context allows students the opportunity to engage in a variety of behaviors along the multitasking continuum, which is argued to range from *concurrent* (i.e., two tasks at essentially the same time) to *sequential* (i.e., one task after the other) multitasking behaviors (Salvucci, Taatgen, & Borst, 2009). For example, when students exhibit micro-level deviations of attention away from their homework task to quickly respond to text or instant messages, they are performing behaviors that lie closer to concurrent multitasking. In contrast, when students take a prolonged break from their homework task to watch a video on YouTube, their behavior is more indicative of sequential multitasking. The richness of the homework environment as a media multitasking context is further enhanced when considering that such behaviors may be *productive* (i.e., texting a classmate to ask a clarifying question) or *distractive* (i.e., scrolling through Facebook) (Kraushaar & Novak, 2010). Accordingly, the homework environment is an ideal context in which to study the correspondence between students' expectations and experiences in relation to media multitasking, as this context allows them to engage in a diverse range of multitasking behaviors.

At this time, there is a prevailing view that the contemporary college student population typically take advantage of the media multitasking opportunities that the unconstrained homework environment affords. Often identified as the Net generation (Tapscott, 1998) or as Digital Natives (Prensky, 2001), it has been argued that within this group "… there seems little doubt that for a majority of students digital media and technologies play a key role in their personal and learning lives" (Judd, 2013, p. 358). Although critics have correctly pointed out that technology usage patterns within this group of students may not be as homogenous as their identifying monikers imply (e.g., Kennedy, Judd, Churchwald, Gray, & Krause, 2008), evidence suggests that many of these students use technology in the homework environment for non-schoolwork purposes (Calderwood et al., 2014), despite the potential negative impact of these behaviors on academic performance (Junco & Cotten, 2012). Accordingly, unlocking the paradox of why students engage in these potentially detrimental behaviors is a particularly salient research need within the contemporary college student population.

Extant explanations for media multitasking behaviors have tended to focus on situational contingencies, individual preferences (e.g., Cotten, Shank, & Anderson, 2014; Rosen, Carrier, & Cheever, 2013), and student motives (e.g., Hwang, Kim, & Jeong, 2014; Wang & Tchernev, 2012; Zhang & Zhang, 2012). For example, in a recent cross-sectional survey of Internet users in the United States and Taiwan, Kononova and Chiang (2015) found greater media multitasking behaviors to be predicted by media ownership, polychronicity (a tendency to do multiple things simultaneously; König & Waller, 2010), and four specific motives (control, entertainment, connection, and addiction). Taking a more process-based view of multitasking, other investigators have drawn inspiration from ego depletion perspectives that argue self-control to represent a limited resource (see Baumeister, Vohs, & Tice, 2007), conceptualizing media multitasking as a lack of self-regulation (Zhang, 2015). Although these efforts have illustrated enduring characteristics and motives driving student media use, as well as processes that may underlie off-task distraction while completing homework, there has been substantially less emphasis on the potential contributions of students' beliefs and expectations to media usage behaviors in the homework environment. Such an oversight is significant, in light of the long-standing recognition that beliefs and expectations contribute to behavioral intentions and actions (Fishbein & Ajzen, 1975). In the following sections, we develop and justify specific hypotheses targeted at explicating the nature and accuracy of expectations that students hold about the influence of media multitasking on affect, performance, and self-control in the homework environment.

1.2. Media multitasking and affect

Negative and positive affect (NA and PA) respectively refer to the experience of negative and positive mood states (Watson, Clark, & Tellegen, 1988). There have been few efforts to explore the relationships linking student media multitasking to these affective experiences (Calderwood et al., 2014; Mauri, Cipresso, Balgera, Villamira, & Riva, 2011), and no studies to our knowledge to evaluate the causal effects of media multitasking on state NA and PA during homework completion. Despite this lack of direct empirical research, several lines of evidence exist to suggest that student media multitasking will result in decreasing NA and increasing PA across the homework session. Completing homework requires sustained mental work, which by definition is accomplished against resistance (Dodge, 1913), and there is evidence that student affect is typically negative when completing homework (see Warton, 2001, for a review). In contrast, media multitasking has been shown to satisfy emotional needs for students (Wang & Tchernev, 2012), and engagement with some forms of media, such as social networking sites (Mauri et al., 2011), has been linked to positive affective states. In light of the role of past affect in the prediction of future affect (Loewenstein & Schkade, 1999), it is likely that students believe media multitasking to result in lower NA and higher PA during homework completion. Synthesizing these lines of research, we hypothesize that (1) students will predict that they will experience lower NA and higher PA when allowed to multitask with media and that (2) media multitasking during homework completion will result in decreasing NA and increasing PA across the homework session.

Hypothesis 1a. *Students will predict that they will experience lower negative affect when allowed to multitask with media.*

Hypothesis 1b. *Media multitasking during homework completion results in decreasing negative affect across the homework session.*

Hypothesis 2a. *Students will predict that they will experience higher positive affect when allowed to multitask with media.*

Hypothesis 2b. *Media multitasking during homework completion results in increasing positive affect across the homework session.*

1.3. Media multitasking, homework performance, and self-control

Several theorists have posited that the limited-capacity attentional system yields performance decrements when multitasking (e.g., Broadbent, 1958; Kahneman, 1973; Wickens, 1984), and these performance impairment effects have consistently been observed in academic contexts (Fried, 2008; Junco, 2012; Junco & Cotten, 2012; Karpinski, Kirschner, Ozer, Mellott, & Ochwo, 2013; Rosen et al., 2013; Sana, Weston, & Cepeda, 2013). More recently, diminished self-control has been supported as a mechanism linking media availability to performance (Zhang, 2015), and evidence has been attained to suggest that students are aware that media use impairs self-control (Panek, 2014). Despite these findings, there have been no studies to our knowledge to demonstrate these performance and self-control impairment effects using actual homework assignments completed while engaged in media multitasking, with investigators typically analyzing proxies for homework performance, such as reading comprehension (e.g., Bowman, Levine, Waite, & Gendron, 2010), rather than earned grades on homework assignments. However, it would be expected that multitasking performance and self-control impairment effects will extend to actual homework grades, as media multitasking compromises the devotion of attention and effort to the homework task. Accordingly, we expect students to predict media multitasking to yield reduced performance and self-control, and that media multitasking actually does result in lower performance and self-control.

Hypothesis 3a. *Students will predict that they will exhibit lower homework performance when allowed to multitask with media.*

Hypothesis 3b. *Media multitasking during homework completion results in lower homework performance.*

Hypothesis 4a. *Students will predict that they will experience lower self-control when allowed to multitask with media.*

Hypothesis 4b. *Media multitasking during homework completion results in lower self-control.*

1.4. Forecasting errors in student media multitasking

Forecasting refers to the process of making predictions about future feelings or behaviors (Gilbert & Wilson, 2007; Rosenzweig & Critcher, 2014). In recent years, evidence has mounted to suggest that people engage in forecasting to predict their affect (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998) and performance (Finley, Benjamin, & McCarley, 2014), but are not particularly accurate when making these forecasts (Finley et al., 2014; Wilson & Gilbert, 2005). Despite an increasing recognition that such forecasting errors may be commonplace (Dunn & Laham, 2006; Rosenzweig & Critcher, 2014); there has been no research to explore the accuracy of students' forecasts regarding media multitasking during homework completion.

1.4.1. Affective forecasts

When considering affective forecasts, there are three factors argued to contribute to forecasting errors that are relevant to media multitasking during homework completion. *Focalism*, a tendency to neglect context when predicting affect (Wilson, Wheatley, Meyers, Gilbert, & Axsom, 2000), may limit the accuracy of student affective forecasts by leading them to over-emphasize the affective benefits of media multitasking and under-emphasize aversive properties of the homework environment. Affective forecasts may also be influenced by the existence of *inaccurate theories* developed in response to frequently occurring events (Gilbert et al., 1998). The frequency with which students are called upon to complete homework during their educational careers (see Cooper, Robinson, & Patall, 2006, for a review) provides ample opportunity for such inaccurate theories to develop. Finally, affective forecasts have been shown to be characterized by *undercorrection*, in which people only imagine their initial affective response to an event, and fail to sufficiently correct for the passage of time (Gilbert et al., 1998). This source of error may manifest in a tendency to think only of the immediate benefits of media multitasking (i.e., "It feels good to take a break from my homework"), without accounting for the costs of sustained off-task distraction (i.e., "I feel bad when it takes a long time to complete my homework"). In combination, we posit that these factors will lead students to overestimate the affective benefits of media multitasking, meaning they will forecast lower NA and higher PA than they actually experience, and the affective costs of not media multitasking, meaning they will forecast higher NA and lower PA than they actually experience.

Hypothesis 5a. *Students overestimate the affective benefits of media multitasking.*

Hypothesis 5b. *Students overestimate the affective costs of not media multitasking.*

1.4.2. Performance and self-control forecasts

Investigators have recently begun to explore performance predictions in relation to multitasking, with conflicting findings emerging in the studies conducted to date. Researchers utilizing a dual-task paradigm have observed that people tend to overestimate the degree to which multitasking impairs performance (e.g., Finley et al., 2014), but other investigators have observed that people overestimate their multitasking abilities (e.g., Sanbonmatsu, Strayer, Medeiros-Ward, & Watson, 2013). In contrast, to our knowledge, no studies have been conducted to explore the accuracy of predictions that people make regarding the impact of multitasking on their self-control during task completion. Given conflicting findings regarding the accuracy of multitasking performance forecasts, and an absence of research regarding self-control forecasting, we did not form specific hypotheses regarding the accuracy of these forecasts. Instead, we investigate the accuracy of student multitasking performance and self-control forecasts during homework completion for exploratory purposes.

Research Question 1. *Do students accurately predict the influence of media availability on homework performance?*.

Research Question 2. *Do students accurately predict the influence of media availability on self-control?*.

2. Method

2.1. Procedure

We conducted an experiment in which students were randomly assigned to either use media as they normally would (*Media Availability condition*) or were barred from using media for non-schoolwork purposes while completing a homework assignment (*Media Removal condition*). Ninety-six undergraduate students enrolled in a psychology research methods class were invited to participate via a series of in-class announcements. Students were informed that they would first be asked to complete an at home questionnaire (AHQ) regarding their technology usage behaviors, and then would be asked to complete a homework assignment in the laboratory while wearing a point-of-view (POV) video camera. They were also told that they would be asked to allow their course instructor to provide the researchers with their grade on this homework assignment. Students were compensated with course extra credit if they chose to participate in this research.

Participating students completed a consent form and the AHQ and brought them to their in-lab session. All affective, performance, and self-control forecasts were provided in the AHQ, which students completed between the time when they received instructions for their homework assignment and the time when they arrived at their in-lab session to work on their homework assignment. Instructions for the homework assignment were given to each student during a meeting of a lab section of the research methods course via a detailed PowerPoint presentation provided by a teaching assistant using a template PowerPoint distributed by the instructor. In addition, students were given the rubric that included the percentage that each subsection of the paper was worth.[1] Accordingly, participants had received ample information about the homework assignment that they would be completing by the time that they were asked to provide forecasts.

Upon arrival at the in-lab session, participants were seated at a computer work station equipped with all hardware and software needed to complete their homework assignment. At this point, they were given instructions corresponding to their experimental condition assignment. Participants randomly assigned to the *Media Availability condition* were told that they were free to use technology as they normally would during the in-lab session, whereas participants randomly assigned to the *Media Removal condition* were instructed that they were not allowed to use technology for any purpose other than schoolwork during the in-lab session. Next, participants were fitted with a V.I.O. POV camera to monitor student media multitasking behaviors (see Calderwood et al., 2014). Students were then instructed to work on their homework for 60 min. Participants completed self-report measures of state affect at 0 min, 30 min, and 60 min of the in-lab session, and completed retrospective self-report measures of self-control at 30 min and 60 min of the in-lab session.

[1] The rubric only provided students with the total points possible for each section of the assignment, to give them guidance in the completion of the assignment. They were not given the exact breakdown of points in each section that was contained in the more detailed grading rubric utilized by teaching assistants when scoring the assignment.

Table 1
Item-level means, standard deviations, and internal consistency estimates for affective, performance, and self-control forecasts.

Variable	*M*	*S.D.*	1	2	3	4	5	6	7	8
1. Predicted negative affect (*Media Availability condition*)	1.47	.44	(.76)							
2. Predicted negative affect (*Media Removal condition*)	1.75	.55	.43**	(.76)						
3. Predicted positive affect (*Media Availability condition*)	2.53	.85	.00	.32*	(.91)					
4. Predicted positive affect (*Media Removal condition*)	2.64	.86	.19	−.20	.32*	(.91)				
5. Predicted performance (*Media Availability condition*)	86.63	7.76	−.11	−.13	.27*	−.07	–			
6. Predicted performance (*Media Removal condition*)	88.77	8.60	.01	−.37**	.06	.27*	.44**	–		
7. Predicted self-control (*Media Availability condition*)	3.23	.99	−.21	.05	.46**	−.02	.41**	−.13	(.81)	
8. Predicted self-control (*Media Removal condition*)	3.83	.89	−.12	−.29*	.11	.54**	.10	.20	.19	(.77)

Note. $N = 60$. Internal consistency estimates (α) are presented in parentheses. Media Availability condition refers to student affect, performance, and self-control forecasts made when anticipating being able to use technology as they normally would while completing homework. Media Removal condition refers to student affect, performance, and self-control forecasts made when anticipating only being able to use technology for schoolwork purposes while completing homework.
$^*p < .05$. $^{**}p < .01$.

Practical constraints (e.g., pace of participant sign ups, space constrictions, number of research assistants available to run the sessions) surrounding our data collection procedure, in which we had to run all participant sessions in the 1–2 week time period between when a homework assignment was distributed and when a homework assignment was due, necessitated that we collect data in three waves over the course of a semester using three different homework assignments.[2] Each homework assignment was designed to evaluate students' technical writing via the development of alternative portions of a scientific research paper (literature review, method, results, discussion), and took more than the allotted 60 min of the in-lab session to complete (a fact that we were able to verify using the video recordings). Accordingly, we feel that the use of these assignments allows confident generalization to homework contexts involving relatively demanding writing assignments, a common assessment format in the collegiate setting useful for developing a number of beneficial skills (see Melzer, 2009).

2.2. Sample

Of the 96 students enrolled in the research methods class, 69 students elected to participate (Response rate = 72%). The data of four participants were excluded because they encountered technical difficulties during the in-lab session, the data of two participants were excluded for careless responding, and the data of three participants were excluded because they did not submit their homework assignment. Thus, the final sample for statistical analysis consisted of 60 participants ($N = 60$). Thirty participants were randomly assigned to the Media Availability condition ($n = 30$), whereas 30 participants were randomly assigned to the Media Removal condition ($n = 30$).

Privacy concerns connected to participants being drawn from a single research methods class prevented us from collecting detailed participant demographic information. To enroll in the research methods class, students were required to have previously attained a minimum grade of C in both an introductory psychology course and a statistics course. Accordingly, this class is typically comprised primarily of upper-level (i.e., junior and senior) students. Additionally, the course is a required core course for psychology majors, and thus a disproportionate number of students of this major enroll in this class. Participants reported an average GPA of 3.07 ($S.D. = .48$), which is close to the national average of 3.11 at American colleges and universities estimated by Rojstaczer (2009).

2.3. Measures

2.3.1. At home questionnaire

Means, standard deviations, and internal consistency estimates for all affective, performance, and self-control forecasts contained in the AHQ are provided in Table 1.

2.3.1.1. Affective, performance, and self-control forecasts. Students predicted their affect, homework performance, and self-control if placed in each experimental condition. Predicted affect was measured using the 20-item Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), in which participants were asked to report the degree to which a series of mood-related adjectives describes how they would feel if placed in each scenario on a scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Predicted performance was measured using a single item in which participants were asked to estimate the percentage score that they would attain on the homework assignment if placed in each scenario. Predicted self-control was measured with a four-item adaptation of the Brief Self Control Scale (Tangney, Baumeister, & Boone, 2004), which included items from the original scale that could be adapted to the homework context (see Appendix). Participants were asked to indicate the degree to which they thought each statement would be true of them if placed in each scenario, on a scale ranging

[2] We found no evidence to suggest that students' affective, $F(2,57) = .08–.51$, n.s., self-control, $F(2,57) = .06–1.77$, n.s., or performance, $F(2,57) = .31–1.02$, n.s., forecasts differed as a function of which homework assignment students were making predictions about.

from 1 (*very UNTRUE of me*) to 6 (*very TRUE of me*). In both scenarios, participants were instructed to imagine sitting down to complete their upcoming homework assignment for their psychology research methods class. In the *Media Availability scenario*, they were then asked to report the degree to which they would experience each of the 20 mood-related adjectives, their predicted performance, and their predicted self-control if they were allowed to use technology as they normally would while completing their assignment. In the *Media Removal scenario*, participants were asked to report the degree to which they would experience each of the 20 mood-related adjectives, their predicted performance, and their predicted self-control if they were not allowed to use technology for any purpose other than schoolwork while completing this assignment.

2.3.2. In-lab surveys

Means, standard deviations, internal consistency estimates, and stability coefficients for the variables measured during the in-lab session are presented in Table 2. Identical versions of the state affect survey were administered at 0 min, 30 min, and 60 min, while an identical version of the self-control scale (which asked participants to make a retrospective report about the preceding 30 min) was administered at 30 min and 60 min.

2.3.2.1. State affect. State NA and PA were measured with the 20-item PANAS (Watson et al., 1988). Participants described the degree to which each adjective described the way that they felt at the moment on a scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*).

2.3.2.2. Self-control. Self-control was measured with an adaptation of the same four-item scale used to measure self-control forecasts. Participants indicated the degree to which each statement was true of them during the last 30 min on a scale ranging from 1 (*very UNTRUE of me*) to 6 (*very TRUE of me*).

2.3.3. Homework performance

Homework performance scores were calculated by teaching assistants who had no knowledge of which students were participating in the study or the conditions to which participating students were assigned. Grades were computed using a detailed grading rubric provided by the course instructor in which points were assigned based on the demonstration of competencies in writing specific sections of a scientific manuscript (e.g., literature review, method, results, discussion), adherence to current APA-style formatting/references, and writing style (e.g., grammar/spelling, clarity/conciseness, tone appropriate to scientific writing). After teaching assistants had assigned all grades, the course instructor provided the first author with homework performance scores for all participants who had consented to share their homework grade in connection with their participation in the study.

All homework scores are reported as a percentage score (0%–100%), representing the number of points from the grading rubric that a student earned divided by the number of possible points a student could have earned.

2.4. Video coding

Trained research assistants used the POV video recordings to code the frequency and duration of all non-homework related behaviors from eight different categories of distraction (see Table 3), using a coding scheme developed by Calderwood et al. (2014). For each distraction event, research assistants coded: (1) The distraction category or categories to which the behavior belonged; (2) The start time of the behavior during the laboratory session; (3) The end time of the behavior during the laboratory session; and (4) Any additional comments necessary to describe the target behavior. A double blind coding procedure was utilized, wherein the fourth author was blind to the experimental condition assignment of all participants while training and supervising coders, who were also blind to all experimental condition assignments while coding.

Table 2
Means, standard deviations, internal consistency estimates, and stability coefficients for all in-lab session variables.

Variable	*M*	*S.D.*	1	2	3	4	5	6	7	8	9	10
1. Multitasking frequency	3.63	6.28	–									
2. Multitasking duration	8.20	18.47	.67**	–								
3. Negative affect (T1)	1.34	.48	−.04	−.01	(.85)							
4. Negative affect (T2)	1.29	.40	−.12	−.11	.67**	(.82)						
5. Negative affect (T3)	1.27	.34	−.11	−.07	.63**	.87**	(.71)					
6. Positive affect (T1)	2.81	.76	−.20	−.28*	−.03	.05	.08	(.91)				
7. Positive Affect (T2)	2.65	.80	−.09	−.08	.13	−.14	−.08	.66**	(.92)			
8. Positive affect (T3)	2.69	.95	−.26*	−.16	.12	−.05	−.20	.55**	.76**	(.94)		
9. Self-control (T2)	4.56	.97	−.44**	−.29*	−.07	−.33**	−.25	.30*	.50**	.45**	(.77)	
10. Self-control (T3)	4.45	1.19	−.43**	−.28*	−.12	−.27*	−.34**	.23	.42**	.54**	.76**	(.86)

Note. $N = 60$. Internal consistency estimates (α) are presented in parentheses. T1 = First in-lab survey (0 min of in-lab session). T2 = Second in-lab survey (30 min of in-lab session). T3 = Third in-lab survey (60 min of in-lab session).
*$p < .05$. **$p < .01$.

Table 3
Frequency and duration of engagement in off-task distractions for participants randomly assigned to the media removal and media availability conditions.

Distraction category	Media Removal condition		Media Availability condition	
	Frequency mean (*S.D.*)	Duration mean (*S.D.*)	Frequency mean (*S.D.*)	Duration mean (*S.D.*)
Cellphone (reading/sending texts, Internet)	.20 (.93)	.20 (1.03)	2.33 (3.32)	2.12 (3.70)
Cellphone (talking)	0 (0)	0 (0)	.07 (.25)	.05 (.20)
Computer e-mail	.13 (.43)	.07 (.24)	.67 (1.58)	.57 (1.20)
Internet (non-homework)	.07 (.25)	.02 (.08)	1.43 (2.39)	1.51 (3.28)
Music setup	0 (0)	0 (0)	1.60 (3.11)	2.32 (7.56)
Music listening	0 (0)	0(0)	.53 (1.74)	7.42 (18.19)
Watching TV/video	0 (0)	0 (0)	.23 (.82)	2.12 (11.23)
Other (checking backpack, eating, drinking, etc.)	.13 (.43)	.40 (.90)	.17 (.65)	.38 (1.03)
Total (excluding "Other" category)	.40 (1.10)	.29 (1.07)	6.87 (7.58)	16.10 (23.74)

Note. Estimates of distraction frequency and duration were measured across a 60 min in-lab session. Duration estimates are in minutes.

For purposes of estimating inter-rater agreement, a randomly selected subsample of 25 of the video recordings ($n = 25$) were recoded by a different trained coder. Inter-rater agreement was estimated using a two-way mixed, absolute agreement, single-measures intraclass correlation coefficient (ICC; Hallgren, 2012; McGraw & Wong, 1996). Estimates of inter-rater agreement were high when considering both multitasking frequency ($ICC = .89$) and multitasking duration ($ICC = .99$).

3. Results

Our analyses proceeded in four stages. First, we compared the frequency and duration of media multitasking in the Media Availability and the Media Removal conditions as a manipulation check. Second, we ran a series of paired samples *t*-tests to compare students' forecasts if they were and were not allowed to media multitask while completing homework. Third, we explored the impact of media availability on the outcomes of state NA, state PA, homework performance, and self-control via four sets of analyses. For the affective outcomes, we ran two separate 2 (*condition*) × 3 (*time*) mixed-methods ANOVAs to investigate if being allowed to media multitask while completing homework results in decreasing NA and increasing PA. Because our hypotheses focus on the influence of media multitasking on changes in these state outcomes across the homework session, the Condition × Time interaction terms represent the direct tests of our hypotheses. For the homework performance outcome, we conducted an independent samples *t*-test to investigate the impact of media availability on performance. For the self-control outcome, we ran a 2 (*condition*) × 2 (*time*) mixed-methods ANOVA to investigate if media multitasking while completing homework results in lower self-control. Given that the two measurements of self-control asked students to retrospectively report their perceived self-control during the preceding 30 min (rather than their current state self-control), the main effect of Condition represents the direct test of our hypothesis. Fourth, to explore the accuracy of students' affective and performance forecasts, we ran a series of paired samples *t*-tests to compare students' forecasts against their reported state NA, state PA, and self-control during the in-lab session, as well as their actual homework performance score. For all analyses, we follow Cohen's (1988) recommendations for the interpretation of small, medium, and large effect sizes.

3.1. Manipulation check

Media multitasking frequency and duration estimates for the eight coded categories of off-task distraction are presented in Table 3, with estimates presented separately for the Media Availability and Media Removal conditions. Participants engaged in less media multitasking when assigned to the Media Removal condition, when considering both multitasking frequency, $t(58) = 4.62$, $p < .001$, 95% $C.I. = [3.67, 9.27]$, $d = 1.21$, and multitasking duration, $t(58) = 3.65$, $p = .001$, 95% $C.I. = [7.13, 24.50]$, $d = .96$. Effect size estimates quantifying the effect of the manipulation on multitasking behaviors were large in magnitude. Thus, we conclude that the experimental manipulation was effective.

When considering the nature of the activities that students in the Media Availability condition engaged in, cellphone use (reading/sending texts, Internet) constituted the most frequently occurring off-task distraction, while listening to music represented the longest duration off-task distraction. Within this condition, 63.3% of participants used their cellphone at least once during the in-lab session, while 13.3% of participants listened to music for at least 30 min of the in-lab session. These findings represent a replication of the most frequently occurring and longest duration off-task media use behaviors observed by Calderwood et al. (2014). When excluding the "Other" category (which did not represent off-task engagement with media) from calculations, students in the Media Availability condition engaged with an average of 6.87 off-task distractions for a mean duration of 16.10 min (26.83% of the 60 min study session).

3.2. The nature of students' forecasts

Hypothesis 1a and 2a respectively stated that students would predict that they would experience lower NA and higher PA when allowed to multitask with media during homework completion. Students predicted that they would experience lower

NA if allowed to multitask with media while completing homework, $t(59) = 3.98$, $p < .001$, 95% *C.I.* = [.14, .41], $d = .51$, with this effect characterized as medium sized. In contrast, we found no evidence to indicate that students predicted that they would experience higher PA if allowed to multitask with media while completing homework, $t(59) = .81$, $p > .250$, 95% *C.I.* = [−.15, .36], $d = .11$. This pattern of results provides support for Hypothesis 1a, but no support for Hypothesis 2a.

Hypothesis 3a posited that students would predict that they would exhibit lower homework performance when allowed to multitask with media. However, we found no evidence to indicate that students predicted that their homework performance would be lower if they were allowed to multitask with media, $t(59) = 1.91$, $p = .061$, 95% *C.I.* = [−.10, 4.39], $d = .25$. This pattern of results provides no support for Hypothesis 3a.

Hypothesis 4a proposed that students would predict that they would exhibit lower self-control when allowed to multitask with media. As anticipated, students predicted that their self-control would be lower if they were allowed to multitask with media, $t(59) = 3.87$, $p < .01$, 95% *C.I.* = [.29, .91], $d = .50$, with this finding characterized as a medium size effect. This pattern of results provides support for Hypothesis 4a.

3.3. *The effects of media multitasking on state affect, performance, and self-control*

Hypothesis 1b proposed that media multitasking during homework completion would result in decreasing NA across the homework session. Running of a 2 (*condition*) × 3 (*time*) mixed-methods ANOVA for the state NA outcome revealed no support for a main effect of condition, $F(1,58) = .28$, $p > .250$, $f = .07$, no support for a main effect of time, $F(2,116) = 1.49$, $p > .250$, $f = .16$, but did support the presence of a Time × Condition interaction, $F(2, 116) = 6.30$, $p = .003$, $f = .33$, with the magnitude of this interaction representative of between a medium to large effect size. Fig. 1 displays the nature of the observed interaction. No evidence was found to suggest that state NA differed at baseline as a function of condition assignment, $t(58) = 1.75$, $p = .085$, 95% *C.I.* = [−.03, .46], $d = .44$. However, state NA was observed to decrease across the in-lab session for participants in the Media Availability condition, $F(2, 58) = 8.75$, $p < .001$, $f = .55$, while there was no evidence to suggest that state NA changed across the in-lab session for participants assigned to the Media Removal condition, $F(2, 58) = .80$, $p > .250$, $f = .17$. In combination, this pattern of results provides support for Hypothesis 1b.

Hypothesis 2b stated that media multitasking during homework completion would result in increasing PA across the homework session. Analysis of the results of a 2 (*condition*) × 3 (*time*) mixed-methods ANOVA revealed no support for a main effect of condition, $F(1, 58) = .02$, $p > .250$, $f = .00$, no support for a main effect of time, $F(2, 116) = 1.76$, $p = .177$, $f = .17$, and no support for a Time × Condition interaction, $F(2, 116) = .93$, $p > .250$, $f = .13$. This pattern of results yields no support for Hypothesis 2b.

Hypothesis 3b proposed that media multitasking during homework completion would result in lower homework performance. However, no evidence was found to indicate that homework performance scores (grades) differed depending on whether students were or were not allowed to multitask with media, $t(58) = -.06$, $p > .250$, 95% *C.I.* = [−.18, 2.88], $d = .01$. Therefore, Hypothesis 3b was not supported.

Hypothesis 4b posited that media multitasking during homework completion results in lower self-control. Conducting a 2 (*condition*) × 2 (*time*) mixed-methods ANOVA for the self-control outcome, we obtained support for a main effect of condition, $F(1,58) = 6.08$, $p = .017$, $f = .32$, no support for a main effect of time, $F(1, 58) = 1.28$, $p > .250$, $f = .15$, and no support for a Time × Condition interaction, $F(1, 58) = 1.69$, $p = .199$, $f = .17$. As displayed in Fig. 2, the nature of the main effect of condition

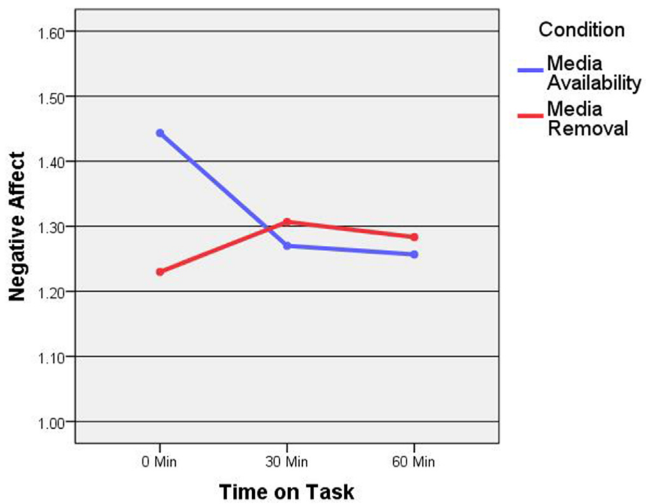

Fig. 1. State negative affect across 60 min of homework completion as a function of media availability.

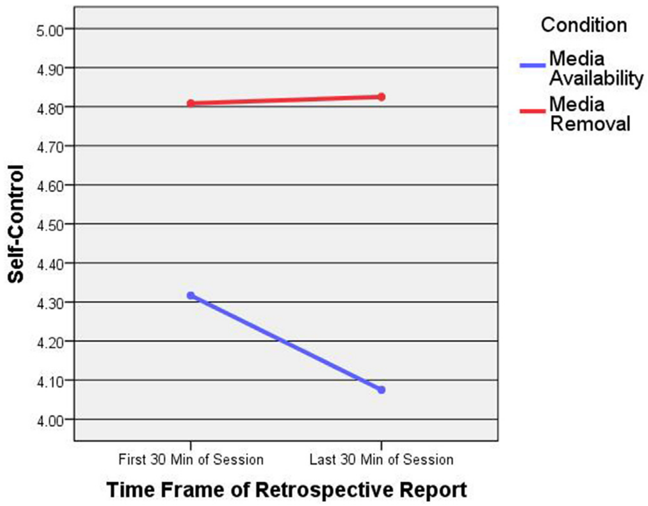

Fig. 2. Reported self-control across 60 min of homework completion as a function of media availability.

was such that participants in the Media Removal condition reported higher self-control across the in-lab session, and was representative of a medium to large magnitude effect. This pattern of results provides support for Hypothesis 4b.

3.4. The accuracy of students' forecasts

Hypothesis 5a posited that students would overestimate the affective benefits of media multitasking. To test this hypothesis, we ran two dependent samples *t*-tests comparing predicted and reported affect for the subsample of students assigned to the Media Availability condition ($n = 30$). Because students were asked to estimate their affect during the homework session in a more general sense (rather than at specific time points while completing homework), we compared students' predicted affect to their average reported affect across the in-lab session. We found no evidence to indicate that participants exhibited forecasting errors when predicting the effects of media availability on either NA, $t(29) = 1.73$, $p = .094$, 95% *C.I.* = [−.03, .33], $d = .32$, or PA, $t(29) = -1.25$, $p = .220$, 95% *C.I.* = [−.42, .10], $d = .23$, yielding no support for Hypothesis 5a.

Hypothesis 5b stated that students would overestimate the affective costs of being prevented from media multitasking. To explore this issue, we ran two dependent samples *t*-tests to investigate differences between students' predicted and reported affect for the subsample of students assigned to the Media Removal condition ($n = 30$). Students predicted that being barred from media multitasking would result in higher levels of NA than was actually observed during the in-lab session, $t(29) = 6.32$, $p < .001$, 95% *C.I.* = [.37, .73], $d = 1.15$, with the extent of this overestimation reflective of a large effect size. In contrast, we did not observe affective forecasting errors when students were predicting PA if barred from media multitasking, $t(29) = -1.00$, $p > .250$, 95% *C.I.* = [−.50, .18], $d = .18$. This pattern of results provides partial support for Hypothesis 5b, with the caveat that we had no evidence to suggest that students overestimated the effects of media removal on PA.

To investigate if students make accurate performance forecasts regarding media multitasking during homework completion (Research Question 1), we analyzed the accuracy of students' performance forecasts both when students were ($n = 30$) and were not ($n = 30$) allowed to multitask with media during homework completion. We found no evidence to demonstrate forecasting errors when predicting the performance effects of being allowed to multitask with media, $t(29) = -1.30$, $p = .205$, 95% *C.I.* = [−6.57, 1.47], $d = .24$, or being barred from multitasking with media, $t(29) = -.34$, $p > .250$, 95% *C.I.* = [−6.22, 4.45], $d = .06$. However, one possible explanation for these non-statistically significant findings suggested by the relatively large standard deviations of the performance predictions (*S.D.* = 7.76–8.60) is that individual differences contribute to divergent predictions for this outcome. In support of this view, we found that 53.3% of participants predicted that multitasking would impair their homework performance, 23.3% of participants expected multitasking to have no impact on their homework performance, and 23.4% of participants thought that multitasking would *increase* their homework performance. The presence of such individual differences may partially explain conflicting findings regarding the nature of multitasking performance forecasts observed in past research.

To explore if students make accurate self-control forecasts regarding media multitasking during homework completion (Research Question 2), we investigated the accuracy of students' self-control forecasts both when they were ($n = 30$) and were not ($n = 30$) allowed to multitask with media. Interestingly, participants *overestimated* the degree to which being allowed to multitask with media would result in lower self-control, $t(29) = 3.03$, $p = .005$, 95% *C.I.* = [.26, 1.31], $d = .55$, but *underestimated* the degree to which being prevented from media multitasking would result in higher self-control, $t(29) = -6.73$, $p < .001$, 95% *C.I.* = [−1.65, −.88], $d = 1.23$. Therefore, these results suggest separate types of forecasting errors regarding the influence of media availability on self-control during homework completion.

4. Discussion

We compared students' forecasts regarding media multitasking against their experiences by randomly assigning participants to media availability conditions using a within-participant design, a rare but advantageous methodological approach in forecasting research (Green et al., 2013). We observed that students predicted media availability to result in lower NA and diminished self-control. Using an actual homework assignment to explore the causal effects of media availability, we found the direction of students' predictions to be accurate, with media availability resulting in decreasing NA across the in-lab session and diminished self-control. However, the anticipated magnitude of these effects was inaccurate, with students overestimating the effects of media removal on NA, overestimating the effects of media availability on self-control, and underestimating the effects of media removal on self-control. Thus, student forecasts are rather inaccurate, particularly regarding perceived self-control.

Despite repeated suggestions that students may perform better without the potential distraction of technology (Bowman et al., 2010; Ellis, Daniels, & Jauregui, 2010; Kraushaar & Novak, 2010), investigators have yet to give sufficient attention to factors motivating off-task technology usage behaviors. Although researchers have observed a disconnect between what students expect and actually get out of multitasking (Wang & Tchernev, 2012), we provide the first evidence that media availability is a salient determinant of students' expectations in the homework environment. We observed that students expected a homework environment in which they were allowed to media multitask to provide the benefit of diminished negative affect, but the cost of reduced self-control. A natural extension of these findings would be to explore factors that students believe will mitigate or exacerbate these effects. For example, do students' expectations regarding the effects of media availability change if they anticipate a homework task to be more engaging? Moreover, would their expectations differ if planning to work on their homework in a more constrained setting, such as a "flipped class" in which traditional homework assignments are completed in the classroom? Or are student forecasts directly tied to media availability, irrespective of the characteristics of the homework task itself or the environment in which it is completed? Studies to explore such questions will provide researchers with a greater understanding of the nature of students' forecasts, and also may present promising avenues to influence student technology usage behaviors by attempting to alter characteristics of the homework task, the homework environment, students' expectations, or all of these factors.

The novel design of this study allowed us to disentangle the causal effects of media availability on a range of practically-relevant outcomes. Our use of random assignment and manipulation of media availability allowed us to extend previous findings regarding associations linking media use to affective experience (Calderwood et al., 2014; Mauri et al., 2011) and to performance (Zhang, 2015) to encompass stronger causal inference. What we do not yet know is whether variations in students' expectations across tasks with different demands influence their media use behaviors and associated academic performance outcomes. In this study, we observed substantial variability in students' expectations regarding the influence of media availability on their homework performance, with some students even anticipating a performance gain. Future research targeted at profiling the media use behaviors of students as a function of the nature of their media multitasking forecasts may show promise in diagnosing students who are likely to engage in excessive media use during academic task performance. Follow-up studies examining personality and individual difference correlates of media multitasking forecasts may also be useful to diagnose who may experience greater success under alternative task performance conditions. For example, based on extant theorizing and research to suggest that more extraverted individuals have a higher preference for arousal (Eysenck, 1967) and that task switching may have implications for physiological arousal (Yeykelis, Cummings, & Reeves, 2014), do more extraverted people expect to perform better when multitasking, and are these expectations accurate? Future research to more comprehensively incorporate individual difference variables into the forecasting process may yield a more nuanced view of the nature and accuracy of students' media multitasking forecasts.

Given that student forecasts were characterized by several inaccuracies, it would be useful to explore the possibility that students would benefit from being made aware of these forecasting errors. Although we found no evidence that media availability resulted in diminished performance on a single homework assignment in this study, investigators have linked media use behaviors to a number of broader academic performance impairments, most notably diminished learning (Fried, 2008) and lower GPA (Junco, 2012; Junco & Cotten, 2012). Accordingly, a greater understanding of the inaccuracy of media multitasking forecasts in student populations may help them choose to reduce their media use in the service of enhanced learning and academic performance. If awareness of forecasting errors is indeed found to have implications for media multitasking behaviors, this line of research could potentially lead to the development of targeted interventions designed to facilitate focus during homework task performance.

Although a major strength of this study was that we analyzed the nature and accuracy of student multitasking forecasts using an actual homework assignment, such an approach is not without limitations. In particular, we could not control if students had begun to work on their homework assignment prior to the in-lab session, and also could not prevent students from continuing to work on their homework assignment after the in-lab session was complete. Although this limitation is unlikely to have influenced our findings regarding the effects of media availability on state affect or self-control, it may in part explain why we did not find evidence to suggest homework performance differences as a function of media availability. If students in the Media Removal condition did indeed elect to continue their homework outside of the in-lab session while engaged in media use, these behaviors may have masked homework performance differences across the experimental conditions. Replications of this experimental design which contain longer in-lab sessions to allow homework performance completion or follow-up surveys assessing media use behaviors during continued task performance may provide greater clarification to the causal effects of media availability on homework performance.

The advantages of using an actual homework assignment rather than a more artificial laboratory task to explore student forecasts and experiences in relation to media multitasking also imposed practical constraints that entailed limitations. Specifically, the need to collect all forecasts and conduct all in-lab sessions within the 1–2 week window between when a homework assignment was distributed and when a homework assignment was due necessitated that we collect data using three different homework assignments over the course of the semester. This limitation represents a trade-off inherent in our decision to use an externally valid, actual homework assignment, as opposed to the more common but less externally valid approach of utilizing somewhat artificial laboratory tasks in studies of multitasking. When considering the similarities of the three homework assignments, which all represented relatively demanding technical writing tasks, and the lack of evidence to suggest divergent forecasting predictions as a function of which homework assignment was completed, it is unlikely that this limitation influenced our obtained results in this study. However, conceptual replications of our study using alternative types of homework assignments and laboratory tasks which tap different cognitive, perceptual, and motor demands that are argued to be relevant to multitasking (Salvucci & Taatgen, 2008) present promising avenues for future research.

While the random assignment of participants to alternative media availability conditions was a strength of this study, this approach necessitated that homework be completed in an artificial laboratory setting that may not be representative of the naturalistic homework environment. In addition to potentially limiting the range of distractions available to students (e.g., roommates, video games, television), it is possible that features of the laboratory environment may have altered participant's actions by making salient the fact that their behavior was being recorded and analyzed (see Adair, 1984, for a discussion of potential issues stemming from knowledge that behavior is being observed). Accordingly, it will be important for future researchers to replicate our findings in the naturalistic homework environment, a goal that could be accomplished using portable monitoring technologies (such as a POV camera or software to track computer-usage behaviors) that can be utilized outside of the laboratory setting.

5. Conclusion

Educators and researchers have expressed a growing concern that media availability is seriously compromising learning and performance outcomes in contemporary academic environments (Fried, 2008; Hembrooke & Gay, 2003). We have demonstrated that students report differential forecasts for the effects of media availability and media removal on their negative affect and self-control, providing evidence for a novel explanation to resolve the paradox of why students engage in media multitasking despite the potential for diminished performance and self-control deficits. Although students correctly predicted media availability to result in lower NA and reduced self-control, they exhibited moderate to large forecasting errors in predicting the magnitude of these effects. It is our hope that the identification of these forecasting errors will serve as an impetus for future research to explore why students media multitask when completing homework.

Appendix

Adaptation of select Brief Self-Control Scale items for the homework forecasting context

To what degree do you think that each of the following statements regarding your ability to focus on your homework would be TRUE of you if you **were/were not** allowed to use any technological devices (e.g., cell phones, laptops, mp3 players, other portable electronic devices) for any purpose other than completing schoolwork while (*insert assignment description*)?

1. I would be good at resisting temptation.
2. I would have strong self-discipline.
3. I would have trouble concentrating on (*insert assignment description*).
4. I would be able to work effectively on (*insert assignment description*).

References

Adair, J. G. (1984). The Hawthorne effect: a reconsideration of the methodological artifact. *Journal of Applied Psychology, 69*(2), 334–345.
Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. *Current Directions in Psychological Science, 16*(6), 351–355.
Bowman, L. L., Levine, L. E., Waite, B. M., & Gendron, M. (2010). Can students really multitask? An experimental study of instant messaging while reading. *Computers & Education, 54*(4), 927–931.
Broadbent, D. E. (1958). *Perception and communication*. Elmsford, NY: Pergamon Press.
Calderwood, C., Ackerman, P. L., & Conklin, E. M. (2014). What else do college students "do" while studying? An investigation of multitasking. *Computers & Education, 75*, 19–29.
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
Cooper, H., Robinson, J. C., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research, 1987 – 2003. *Review of Educational Research, 76*(1), 1–62.
Cotten, S. R., Shank, D. B., & Anderson, W. A. (2014). Gender, technology use and ownership, and media-based multitasking among middle school students. *Computers in Human Behavior, 35*, 99–106.
Dodge, R. (1913). Mental work: a study in psychodynamics. *Psychological Review, 20*(1), 1–42.

Dunn, E. W., & Laham, S. M. (2006). Affective forecasting: a user's guide to emotional time travel. In J. P. Forgas (Ed.), *Affect in social thinking and behavior* (pp. 177–193). New York, NY: Psychology Press.
Ellis, Y., Daniels, B., & Jauregui, A. (2010). The effects of multitasking on the grade performance of business students. *Research in Higher Education Journal, 8*, 1–10.
Eysenck, H. J. (1967). *The biological basis of personality*. Springfield, IL: Charles C. Thomas.
Finley, J. R., Benjamin, A. S., & McCarley, J. S. (2014). Metacognition of multitasking: how well do we predict the costs of divided attention? *Journal of Experimental Psychology: Applied, 20*(2), 158–165.
Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.
Foehr, U. G. (2006). *Media multitasking among American youth: Prevalence, predictors, and pairings*. Retrieved May 18, 2009, from http://kff.org/other/media-multitasking-among-american-youth-prevalence-predictors/.
Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education, 50*(3), 906–914.
Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J., & Wheatley, T. P. (1998). Immune neglect: a source of durability bias in affective forecasting. *Journal of Personality and Social Psychology, 75*(3), 617–638.
Gilbert, D. T., & Wilson, T. D. (2007). Prospection: experiencing the future. *Science, 317*, 1351–1354.
Green, J. D., Davis, J. L., Luchies, L. B., Coy, A. E., Van Tongeren, D. R., Reid, C. A., et al. (2013). Victims versus perpetrators: affective and empathic forecasting regarding transgressions in romantic relationships. *Journal of Experimental Social Psychology, 49*(3), 329–333.
Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: an overview and tutorial. *Tutorials in Quantitative Methods for Psychology, 8*, 23–34.
Hembrooke, H., & Gay, G. (2003). The laptop and the lecture: the effects of multitasking in learning environments. *Journal of Computing in Higher Education, 15*(1), 46–64.
Hwang, Y., Kim, H., & Jeong, S. (2014). Why do media users multitask? Motives for general, medium-specific, and content-specific types of multitasking. *Computers in Human Behavior, 36*, 542–548.
Judd, T. (2013). Making sense of multitasking: key behaviours. *Computers & Education, 63*, 358–367.
Junco, R. (2012). In-class multitasking and academic performance. *Computers in Human Behavior, 28*(6), 2236–2243.
Junco, R., & Cotten, S. R. (2012). No A 4 U: the relationship between multitasking and academic performance. *Computers & Education, 59*(2), 505–514.
Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs, NJ: Prentice Hall.
Karpinski, A. C., Kirschner, P. A., Ozer, I., Mellott, J. A., & Ochwo, P. (2013). An exploration of social networking site use, multitasking, and academic performance among United States and European university students. *Computers in Human Behavior, 29*(3), 1182–1192.
Kennedy, G. E., Judd, T. S., Churchwald, A., Gray, K., & Krause, K. L. (2008). First year students' experiences with technology: are they really digital natives? *Australasian Journal of Educational Technology, 24*(1), 108–122.
König, C. J., & Waller, M. J. (2010). Time for reflection: a critical examination of polychronicity. *Human Performance, 23*, 173–190.
Kononova, A., & Chiang, Y. (2015). Why do we multitask with media? Predictors of media multitasking among Internet users in the United States and Taiwan. *Computers in Human Behavior, 50*, 31–41.
Kraushaar, J. M., & Novak, D. C. (2010). Examining the affects of student multitasking with laptops during the lecture. *Journal of Information System Education, 21*(2), 241–251.
Loewenstein, G., & Schkade, D. (1999). Wouldn't it be nice? Predicting future feelings. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 85–105). New York: Russell Sage Foundation.
Mauri, M., Cipresso, P., Balgera, A., Villamira, M., & Riva, G. (2011). Why is Facebook so successful? Psychophysiological measures describe a core flow state while using Facebook. *Cyberpsychology, Behavior, and Social Networking, 14*(12), 723–731.
McGraw, K. O., & Wong, S. P. (1996). Forming inferences about some intraclass correlation coefficients. *Psychological Methods, 1*(1), 30–46.
Melzer, D. (2009). Writing assignments across the curriculum: a national study of college writing. *College Composition & Communication, 61*(2), 240–261.
Panek, E. (2014). Left to their own devices: college students' "guilty pleasure" media use and time management. *Communication Research, 41*(4), 561–577.
Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1–6.
Rojstaczer, S. (2009, March 10). *Grade inflation at American colleges and universities*. Retrieved from http://www.gradeinflation.com/.
Rosen, L. D., Carrier, M. L., & Cheever, N. A. (2013). Facebook and texting made me do it: media-induced task-switching while studying. *Computers in Human Behavior, 29*(3), 948–958.
Rosenzweig, E., & Critcher, C. R. (2014). Decomposing forecasting: the salience-assessment-weighting (SAW) model. *Current Directions in Psychological Science, 23*(5), 368–373.
Salvucci, D. D., & Taatgen, N. A. (2008). Threaded cognition: An integrated theory of concurrent multitasking. *Psychological Review, 115*(1), 101–130.
Salvucci, D. D., Taatgen, N. A., & Borst, J. P. (2009). Toward a unified theory of the multitasking continuum: from concurrent performance to task switching, interruption, and resumption. In S. Greenber, S. E. Hudson, K. Hinckley, M. R. Morris, & D. R. Olsen, Jr. (Eds.), *Human factors in computing systems: CHI 2009 conference proceedings* (pp. 1819–1828). New York, NY: ACM Press.
Sana, F., Weston, T., & Cepeda, N. J. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education, 62*, 24–31.
Sanbonmatsu, D. M., Strayer, D. L., Medeiros-Ward, N., & Watson, J. M. (2013). Who multitasks and why? Multitasking ability, perceived multitasking ability, impulsivity, and sensation seeking. *PLoS One, 8*(1), e54402. http://dx.doi.org/10.1371/journal.pone.0054402.
Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72*(2), 271–322.
Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York: McGraw-Hill.
Wang, Z., & Tchernev, J. M. (2012). The "myth" of media multitasking: reciprocal dynamics of media multitasking, personal needs, and gratifications. *Journal of Communication, 62*(3), 493–513.
Warton, P. M. (2001). The forgotten voices in homework: views of students. *Educational Psychologist, 36*(3), 155–165.
Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070.
Wickens, C. D. (1984). Processing resources in attention. In R. Parasuraman, & D. R. Davies (Eds.), *Varieties of attention* (pp. 63–102). San Diego, CA: Academic Press.
Wilson, T. D., & Gilbert, D. T. (2005). Affective forecasting: knowing what to want. *Current Directions in Psychological Science, 14*(3), 131–134.
Wilson, T. D., Wheatley, T., Meyers, J. M., Gilbert, D. T., & Axsom, D. (2000). Focalism: a source of durability bias in affective forecasting. *Journal of Personality and Social Psychology, 78*(5), 821–836.
Yeykelis, L., Cummings, J. J., & Reeves, B. (2014). Multitasking on a single device: arousal and the frequency, anticipation, and prediction of switching between media content on a computer. *Journal of Communication, 64*, 167–192.
Zhang, W. (2015). Learning variables, in-class laptop multitasking, and academic performance: a path analysis. *Computers & Education, 81*, 82–88.
Zhang, W., & Zhang, L. (2012). Explicating multitasking with computers: gratifications and situations. *Computers in Human Behavior, 28*, 1883–1891.