Framing a Dual-Task and its Effects on Performance and Mood

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Abstract

The present study investigated the framing of a dual-task and its effects on performance and mood. Framing a dual-task as either multitasking or an interruption deals with the interpretation of working on two or more tasks simultaneously, such as the nature of the presentation of the secondary task. A total of 81 undergraduate students (59 female) were recruited from Arcadia University to participate in the experiment. Participants were randomly assigned to either be multitasking (n = 28), interrupted (n = 28), or single-tasking (n = 25) with an essay task and an audio task. Participants' moods were surveyed before and after the tasks, and their perceived performance and actual performance on both tasks were calculated. A one-way analysis of variance (ANOVA) showed that tasks framed as multitasking performed the worst, rated lower on their perceived performance, and had a more negative affect than when tasks were framed as an interruption or those single-tasking. Results also found that tasks framed as an interruption rated highest on perceived performance, performed the best, and had a more positive affect than the multitasking and single-tasking conditions. Implications are that actual performance suffers regardless if a dual-task is framed as multitasking or handling an interruption, but will have a slightly better outcome when it is a quick interruption. However, it is best to focus on one task at a time to be more productive and produce minimal errors than to focus on multiple tasks simultaneously.

Keywords: multitasking, interruptions, dual-tasking, task performance, affect

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With the fast-paced and growing need to maximize performance by engaging in multiple activities or tasks, topics such as multitasking, interruptions, and job performance are gaining attention from researchers from the Cognitive Psychology and Industrial-Organizational Psychology fields. Multitasking can be best defined as the simultaneous execution of two or more tasks which require attention to be shifted between the tasks at hand (Colom, Martínez-Molina, Shih, & Santacreu, 2010; Conard & Marsh, 2016). Interruptions are often referred to as a temporary break or suspension in accomplishing a goal by diverting attention to the unplanned or unrelated tasks or events (Baethge & Rigotti, 2013; Szumowska & Kossowska, 2016; Szumowska & Kossowska, 2017). The measurement of job performance varies depending on the criteria of the researcher, but usually include variables such as job satisfaction, interpersonal relationships, task completion, and time and resource management (Baethge & Rigotti, 2013; König, Oberacher, & Kleinmann, 2010).

While research on these topics are vast and diverse in their sample populations and tasks, many of these studies have only measured the effects of dual tasks as either multitasking versus single-tasking, or multitasking with interruptions versus without interruptions. Additionally, these studies highlight personality differences and external factors in one's environment that determine an individual's ability to perform well while multitasking or handling interruptions. For researchers in the Cognitive Psychology field, studies were conducted in a controlled setting, such as in a research lab or classroom setting, whereas for researchers in the Industrial-Organizational Psychology and Management fields, studies were conducted in the field such as places of employment or through an online population. Despite the various settings, researchers

in all fields found similar results, but attribute the differences in performance to individual differences or environmental factors.

Multitasking

On any given day, many people will actively engage in multitasking behavior, but may not realize that they are or would not categorize it as multitasking activity. This is applicable to employees in the workforce, students in a classroom setting, and average individuals going about their day. While understanding the concept of multitasking as the skill to handle several tasks at once, many people classify this behavior as a strength without truly being able to predict their performance (Finley, Benjamin, & McCarley, 2014). Theorized or studied predictors of engagement in multitasking behaviors, such as multitasking work behavior, polychronicity (a continuum scale of levels of engagement and focus on tasks), impulsivity (the tendency to act with little to no thought on a whim), cognitive interference (i.e., other thoughts while working on a task), work demands (physical, psychological, social, or organizational efforts needed on the job), and family demands (i.e., home responsibilities) are constantly being examined in the workplace to have a better understanding of the types of traits that multitasking individuals possess. Having high levels of polychronicity, impulsivity, and work demands are traits that can predict which individuals are more likely to engage in multitasking behavior, although it is not a great predictor of which individuals will be able to perform better (König et al., 2010). Additionally, while there was not a statistically significant finding for family demands in individuals who engage in multitasking behavior, the mental transition between family demands and work demands require cognitive effort which negatively affect job performance (König et al., 2010; Smit, Maloney, Maertz Jr., & Montag-Smit, 2016).

Unfortunately, this is restrictive as it does not account for other individual or environmental factors that could help to identify types of people who are more likely to engage in multitasking behavior. It also does not specify at what levels of these traits do certain employees perform better while engaged in multitasking behavior. However, individuals in the United Kingdom participated in a computerized simulation task and a "real-life" scenario to examine the extent of performance differences between men and women while engaged in multitasking behavior. Even the differences in the type of tasks can alter one's individual performance between the two types of tasks. In both types of tasks, men and women were both slower while multitasking, but men performed worse than women did on both dimensions (Stoet, O'Connor, Conner, & Laws, 2013).

Even in school, students are more likely engaging in multitasking behavior, especially with the presence of a laptop in a classroom setting. With easy access to the internet, students can roam their social media pages, chat with their friends online, and work on assignments for another class. This interlaces cognitive interference and work demand (König et al., 2010), but in a classroom context. Students at the University of Vermont installed a spyware program that monitored their computer usage and activity throughout the semester. They self-reported on their laptop use on frequency, duration, and distractive versus productive computer use and compared it to their actual data. Students who multitasked more frequently for longer periods of time with distractive usage were more likely to do poorly in the class than the students who did not multitask as frequently, as often, or with as much distractive usage (Kraushaar & Novak, 2010). Students at Cornell University experienced the same fate, where half of the students were granted permission to utilize their laptops during the lecture and the other half were restricted from any laptop use. When given a surprise quiz based on the materials covered in class, students

that had their laptops opened performed worse on the quiz than the students who did not have their laptops opened (Hembrooke & Gay, 2003).

While Kraushaar and Novak (2010)'s and Hembrooke and Gay (2003)'s studies found a detrimental effect of classroom performance in students who multitasked using their laptops, it did not account for other factors in the classroom setting that may require the student to divert or split their attention from the lecture. However, rather than labeling it as multitasking behavior, laptop use can also be seen as a distraction to classroom learning. In another university, students completed weekly surveys on their laptop use, classroom experience, lecture material, and distraction of other students' laptops. Using laptops decreased one's likelihood of understanding the lecture material taught in class, and increased the chances of performing worse in the class. Additionally, another student's laptop use can be distracting to their classmates, which can also increase the chances of performing worse (Fried, 2008).

Interruptions

Interruptions are an inevitable experience that occur in different occupational settings, which can negatively impact one's performance and affect (Baethge & Rigotti, 2013). With many settings requiring a fast-paced work ethic and high production rate, working on more than one task at once has become the norm. Yet in doing so, it affects the individual's performance to successfully complete each task with minimal errors. On the surface, interruptions seem similar to multitasking, as both include working on multiple tasks in one given cognitive period. However, interruptions are unrelated tasks that can disrupt and interfere with our attention to the primary task at hand and can thus lead to frustration and forgetfulness (Baethge & Rigotti, 2013; Tremblay, Vachon, Lafond, & Kramer, 2012). Having the ability to ignore unrelated task interruptions, such as having high motivational rigidity or a need for cognitive closure

(Szumowska & Kossowska, 2016; Szumowska & Kossowska, 2017) or working in teams rather than individually (Tremblay et al., 2012), can reduce interference of engagement in interruptions and reduce negative performance outcomes. Additionally, external factors such as time restraints, mental demands, and the physical workspace setup can add unnecessary strain to the primary task and mediates the relationship between interruptions and performance satisfaction (Baethge & Rigotti, 2013; Lee & Brand, 2010).

To examine interruptions in the workplace, nurses from 10 German hospitals participated in a diary study where they reported any stressors, demands, and interruptions that occurred during three points in their work shift, as well as a nightly questionnaire on their well-being and job performance. Experiencing interruptions during workflow had harmful effects on performance satisfaction and irritation, as these nurses were more likely to forget their original intentions or tasks. Additionally, added mental demands and time pressure heightened the negative relationship with performance satisfaction and irritation (Baethge & Rigotti, 2013). Further, in a different occupational setting where the environment is not as demanding or stressful, such as in an office, employees still participate in task switches and interruptions while working on their initial task or project. These employees still experience numerous task switching and interruptions during a typical workday, but tasks that are more challenging are more difficult to switch back and forth from than less challenging tasks (Czerwinski, Horvitz, & Wilhite, 2004). There are variations of the complexities, durations, difficulties, and consequences of workplace interruptions experienced by an employee throughout various points in a day.

While workplace interruptions are inevitable due to the setting and nature of the occupation, task interruptions can also be simulated in a laboratory setting using a computerized simulation task. Interruptions can be experienced when people are working individually or

working in a pair. When working in a pair, sometimes only one member is interrupted, while other times both members are interrupted. Even while completing a computerized simulation task, interruptions are unavoidable but individuals who work in a pair perform better than individuals who work by themselves. Even when working in a pair, it is better to both be interrupted than only one member be interrupted (Tremblay et al., 2012). While interruptions are not ideal, the demonstration of only one member of the pair being interrupted catalyzes additional interruptions on the team. These interruptions can include pausing to try to catch the interrupted individual up with the task or to change focus onto the interruption and assess its relative importance at the moment. Regardless of the frequency or type of additional interruptions, it negatively impacts their communication abilities and resumption time (Conard & Marsh, 2016; Tremblay et al., 2012).

Furthermore, the presentation of the interruption, such as the frequency and duration, also affects performance. When working on a primary task, individuals may experience no interruption while working on their initial task, may experience one long, unrelated interruption, or experience many shorter, unrelated interruptions. When one is not interrupted, the primary task is completed at a faster rate than those who are interrupted once or multiple times. However, being interrupted once is still better than being interrupted multiple times as it does not require as much cognitive effort in task switching (Conard & Marsh, 2016). Although it is not always ideal or possible to control for the types of interruptions and the frequency or duration of them, there are some aspects that can help to limit these distractors or interruptions in the space or places that an individual occupies. Likewise, individual differences can mediate the relationship between experiencing interruptions and performance. Individuals with higher levels of personal control in their job environment are less likely to be interrupted or distracted, and rate higher on their

perceived performance than individuals with lower levels of personal control (Lee & Brand, 2010).

Performance and Mood

Job performance is more than reaching a goal and the ability to complete a task. It encompasses a range of other facets, such as an employee's satisfaction with the job they completed, or the relationships that they have with their coworkers and team (Baethge & Rigotti, 2013; König et al., 2010). It also includes the physical space that the person is in or uses and its functionality to optimize performance while minimizing distractors and interruptions (Lee & Brand, 2010). When there are higher levels of interpersonal interactions and personal control, and lower levels of conflict and work demand, work conditions are optimal and can attenuate any negative job performance, negative satisfaction, and negative mood (Pooja, De Clercq, & Belausteguigoitia, 2016). However, this is not limited to employees in the workforce; performance is a conceptual notion that is applicable to those at home, in school, out in public, and in a laboratory setting.

Additionally, perceived performance also plays a role in how people actually perform and how they feel during and after the task. Perceived performance is defined as the individual's personal belief of how well they completed or accomplished a task (Lee & Brand, 2010). If an individual has a lot of restraints or demands, being constantly interrupted, or is forced to constantly multitask to reach a goal, their perception of their performance will be low, and thus will also increase the chances of a more negative mood state (Pooja et al., 2016). However, if the individual is more motivated and has a strong social relationship with their peers, can optimize their job performance, and control for external distractors, they will have a higher perception of

their performance and thus experience more positive mood states (Gillet, Becker, Lafrenière, Huart, & Fouquereau, 2017).

Military personnel from the French Air Force with high motivation profiles (e.g., more work engagement, more support, self-determined) had a more positive affect whereas soldiers with low motivation profiles (e.g., less work engagement, less support, moderate to low motivation) experienced more negative affect (Gillet et al., 2017). Employees from a Mexican company were also asked about their job performance by asking them to assess the extent that they underwent certain job stressors, such as work overload and interpersonal conflict, and the level of organizational commitment and social interactions they had at the company. Employees who had lower levels of negative job stressors had high levels of social interactions and were more likely to have positive interpersonal relationships and social interactions (Pooja et al., 2016).

Present Study

It is important to continue to study and investigate the cognitive abilities that determine an individual's performance and achievement when handling multiple tasks, whether they are related to one another, or presented as an individual or a series of tasks. Additionally, further research is needed to examine the way framing a task as multitasking or as an interruption affects how someone performs or how they think they performed compared to their actual performance, as well as their mood before and after the task. There are limitations in the research on identifying the different individual or personality trait differences that would determine if someone is more likely or less likely to engage in multitasking behavior or in interruptions and distractions. There are also external environmental factors that contribute to the well-being and performance of those who participate in such behavior, whether it is at work, in a classroom, or

even driving a car. These findings can help to limit any negative or disruptive stimulants that can result in worsened job performance and personal well-being and mood. It can also help to detect the types of characteristics of people that would perform well in certain settings that require a fast turnover rate or cognitively busy task environment.

The present study aimed to investigate the framing of a dual task as either a multitasking study or an interruption study and its effects on participants' performance, perceived performance, and mood. To measure for differences in these variables, three conditions were created: multitasking, interruptions, and single-tasking. The first hypothesis predicted that the participants in the interruption condition would a) perform worse, b) have a more negative affect, and c) rate lower on their perceived performance than those in the multitasking condition. The second hypothesis predicted that the participants in the multitasking condition would a) perform worse, b) have a more positive affect, and c) rate lower on their perceived performance than those in the single-tasking condition.

Method

Pilot Study

A pilot study was conducted to troubleshoot the technical aspect of the experiment to ensure that it would run smoothly during an actual participant's turn. During the pilot study, it was found that both audio recordings' speed were too fast, and there was a glitch in the second recording in which there was a long pause before it played the rest of the recording. Both audio recordings were redone and retested again and did not have any issues or glitches. This final version was used for the remainder of the experiment.

Participants

Eighty-eight participants, 22 male and 66 female, over the age of 18, participated in this experiment. The mean age of the sample was 20 years old (SD = 1.3). Five participants, all

female over the age of 18, participated in the pilot study and were excluded from the data analyses. All participants were Arcadia University undergraduate students enrolled in the Psychology courses that have a research participation requirement and were recruited through the Sona Web System and by word-of-mouth. Participants who signed up through the Sona Web System received 1 credit for their participation. Two additional participants were excluded from the study due to incomplete responses on surveys and questionnaires (n = 81, 59 female). All participants signed an informed consent form with the approval of the Internal Review Board of the Committee of the Protection of Research Subjects at Arcadia University.

Materials

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegan, 1988). Participants' mood states were measured with the Positive and Negative Affect Schedule (PANAS) before and after the experiment. This scale consisted of 20 words that describe different feelings and emotions, and each item was rated on a scale from 1 to 5, with 1 indicating "very slightly or not at all" to 5 indicating "extremely". Internal consistency for the positive affect items ranged between .86 - .90, and the negative affect items ranged between .84 - .87. Test-retest reliability for positive affect items was reported as .79, and negative affect items was reported as .81 (Watson et al., 1988).

Essays. Sample elementary school level narrative essays were used for the primary task, where participants had to identify spelling errors in two essays written from third graders. These were one-page, double-spaced essays with a total of 30 spelling errors – one essay with 13, another with 17 mistakes.

Audio Task. The audio recording was recorded on a voice recorder app on an iPad Mini, using a free, online text-to-speech reader to narrate the secondary task. Microsoft Office

PowerPoint 2016 was used to present the audio task on a Dell desktop present in the research room at a 50% volume. All slides' backgrounds remained white and were left blank except the last two slides which contained specific instructions and the secondary task for the single-tasking condition participants. A stopwatch was used to measure the time it took participants to finish the two tasks, up to 10 minutes. Koss UR 5 On-Ear 3.55mm headphones were used for the audio task.

Audio Task Answer Sheet. Participants were instructed to write down the answers to the 10 questions presented on the audio task. The questions were presented as two separate calls with five questions each. Each question was presented with four possible answers to choose from. There was also a section on the bottom for the researcher to write down the time it took the participant to complete the experiment.

Performance Questionnaire. After the experiment, participants were asked to fill out a performance questionnaire, where they rated on a scale of 1 – 100 how well they believed they performed on the primary task, the secondary task, and collectively. This measure was considered the participants' perceived performance.

Demographic Form. At the end, participants were asked to fill out a demographic information sheet, which identified their age, gender, race or ethnicity, major, minor, class year, and what they believed the purpose of the experiment was. However, participants' names, emails, or student ID numbers were not collected, but instead were identified by their participant number.

Procedure

Participants were called into a small research room and asked to read over and sign the consent form before beginning the study. Once the form was signed, they were asked to

complete a pre-experimental mood questionnaire, the PANAS. Once completed, the participants were randomly assigned to one of three conditions: multitasking condition, interruption condition, and single-tasking condition, with the latter condition used as a comparison group. Participants were given an envelope which contained the specific instructions for their conditions, and a folder which contained the essays for the primary task and a blank answer sheet for the secondary task. The multitasking and interruption conditions had very similar instructions, substituting key words such as "multitasking" and "interruptions" to manipulate the framing of the dual task. The single-tasking condition had instructions to focus on the primary task first, before moving on to the secondary task.

The primary task asked participants to highlight all the spelling errors in the two essays provided. The secondary task presented as an automatic audio message at the two-minute mark and five-minute mark preceded by a two-second ring, where it asked two sets of five trivia questions that the participants had to answer. For participants in the single-tasking condition, they were instructed to mute and ignore the audio task and proceed with the primary task only. When they were done with finding the spelling mistakes, they were then instructed to play the audio recording to complete the secondary task. For all participants, once they were given the materials, participants had up to ten minutes to complete the task, but were allowed to finish sooner.

When the participants either finished both of the tasks or reached the ten-minute time limit, materials for the tasks were collected and the time to complete the task was recorded. Participants were then given a performance questionnaire, a post-experimental mood questionnaire, and a demographic information sheet to complete. Participants were also asked if they had any ideas as to the purpose of the study (as a means to exclude any data from

participants who suspected or knew I was measuring multitasking versus interruption on mood and performance), debriefed, and thanked. All participants were granted participation credit through the Sona Web System.

Results

Claim

The current study claimed to find a causal relationship between the type of dual-task (multitasking, interruption, or single-tasking) and performance (perceived and actual) and affect. Namely, those interrupted would perform worse, have a more negative affect, and rate lower on their perceived performance than those multitasking, whereas those multitasking would perform worse, have a more positive affect, and rate lower on their perceived performance than those single-tasking.

Data Preparation

Spreadsheet. A Google Excel spreadsheet was created to manually record collected data from each participant. The spreadsheet included columns for participant number, condition, the 20 responses for mood pre-experiment, number of spelling errors correctly highlighted in both essays, the 10 responses to the audio task, the three responses to the perceived performance questionnaire, the 20 responses for mood post-experiment, the demographic information, time it took participants to complete the task (up to 10 minutes), and miscellaneous notes. Additional columns for the composite scores for the PANAS and performance measures were added after the raw data were cleaned and coded.

Cleaning. Responses from incomplete tasks were discarded from the data set used for the statistical test. Additionally, questionnaires with response sets where participants answered using all extreme scores (e.g., 1 or 5) or all neutral scores (e.g., 3) were discarded from the data

set. Participants' performance data were graphed to identify any outliers in a normally distributed graph, which were also discarded from the data set used for the statistical test. To determine strong reliability in the mood questionnaires, Cronbach's alpha was used.

Coding. All categorical responses, such as gender, race, and major, that were being analyzed were coded with a numerical label (e.g., female = 0, male = 1). When calculating the composite score for the PANAS, negative affect items were reverse scored and then added with the positive affect items. Participants' actual performance scores were calculated based on correct responses divided by total possible responses.

Workspace. Google Excel was used by the researcher to manually record and store collected responses, as well as clean and code the data. SPSS was used to run the statistical tests to identify any outliers in a normally distributed graph, analyze differences between conditions, and subsequent analyses the researcher wanted to test.

Primary Analysis

To test both of the hypotheses - that is, that those being interrupted would perform worse, have a more negative affect, and rate lower on their perceived performance than those multitasking (Hypothesis 1), and that those multitasking will perform worse, have a more positive affect, and rate lower on their perceived performance than those single-tasking (Hypothesis 2) - a one-way analysis of variance (ANOVA) with one independent variable with three levels on performance and affect was used. The data used were cleaned and coded to ensure normal distribution, meeting the assumptions for the primary analysis. The data collected for the one-way ANOVA statistical test are all continuous.

The one-way ANOVA found that there was not a statistically significant difference in participants' actual performance on the essay task, $F(2, 78) = .76$, $p = .470$, the call task, $F(2, 78)$

= 1.16, p = .320, and the overall task, $F(2, 78) = 1.54$, p = .221. Another one-way ANOVA found that there was also not a statistically significant difference in participants' pre-task to post-task average mood difference, $F(2, 78) = .79$, p = .456. Multitasking condition had the largest average mood difference, (M = -2.82, SD = 7.38), followed by interruption condition, (M = -1.43, SD = 6.76), and the single-tasking condition with the smallest average mood difference (M = -.52, SD = 5.85). Figure 1 illustrates the mean affect scores pre-experiment and post-experiment for the three conditions. However, there was a statistically significant difference in participants' perceived performance on the essay task, $F(2, 78) = 5.85$, p = .004, the call task, $F(2, 78) = 8.49$, $p < .001$, and the overall task, $F(2, 78) = 12.47$, $p < .001$.

Additional Analyses

Demographic information was collected from each participant at the end of the study, which included questions about their age, gender, race, major(s), minor(s), and class year. Subsequent analyses were conducted using a one-way ANOVA statistical test with multiple independent variables (IV's) to find any statistically significant difference in performance or affect based on the demographic information collected (e.g., gender difference). An alpha of 0.05 was used for all of the statistical analyses. Another analysis was conducted based on the time of day the participant completed the task, either in the morning (9:00 AM - 12:00 PM), early afternoon (12:00 PM - 3:00 PM), or late afternoon (3:00 PM - 6:00 PM) using a one-way ANOVA to see if the time of day affected the participants' performance or mood difference before and after the task. The difference between participants' perceived performance and actual performance were also analyzed to see the variability in participants' inclination to overestimate or underestimate their performance. Additionally, the average time to complete the task was

calculated across the conditions to see if there was a difference in how long it took participants to complete both tasks, up to 10 minutes.

Multiple one-way ANOVAs found that there was a main effect of condition on the participant's age, $F(2, 65) = 5.27$, $p = .008$, gender, $F(2, 75) = 10.27$, $p < .001$, race, $F(2, 66) = 4.29$, $p = .018$, and class year, $F(2, 69) = 6.77$, $p = .002$, but no main effect of condition on the participant's major, $F(2, 72) = 2.13$, $p = .127$. There was also an interaction between condition and race, $F(8, 66) = 3.42$, $p = .002$. Although it was not significant, the main effect for age was approaching significance, $F(5, 65) = 2.25$, $p = .060$. Additionally, for the time of day participants completed the experiment, the one-way ANOVA did not find a significant difference, $F(2, 78) = .74$, $p = .481$.

The one-way ANOVA found a statistically significant difference in the variation between perceived performance and actual performance, $F(2, 78) = 6.37$, $p = .003$. All conditions had positive mean differences, indicating that on average, all participants overestimated their perceived performance compared to their actual performance. Multitasking condition had the smallest mean difference, ($M = 6.51$, $SD = 18.86$), whereas the interruption condition had the largest mean difference, ($M = 21.30$, $SD = 13.17$), and the single-tasking condition in the middle, ($M = 14.81$, $SD = 13.81$). Figure 2 depicts participants' mean perceived performance ratings and actual performance ratings across the three conditions. There was also a statistically significant difference in the time it took participants to complete the task, $F(2, 78) = 8.14$, $p = .001$, with the multitasking condition finishing the earliest, ($M = 495.68$, $SD = 74.35$), followed by the single-tasking condition, ($M = 553.37$, $SD = 44.72$), and the interruption condition taking the longest ($M = 554.69$, $SD = 61.43$).

Discussion

In the present study, the first hypothesis stated that the interruption condition would a) perform worse, b) have a more negative affect, and c) rate lower on their perceived performance than those multitasking and single-tasking. The findings did not find a statistical significant difference in participants' actual performance or affect. However, there was a significant difference in perceived performance and it found that the interruption condition rated the highest in this measure compared to the multitasking and single-tasking conditions. Furthermore, although not significant, the patterns suggest that the interruption condition had the highest score in actual performance, and did not have the greatest negative affect. Therefore, all three parts of the first hypothesis were not supported.

The second hypothesis stated that the multitasking condition would a) perform worse, b) have a more positive affect, and c) rate lower on their perceived performance than those single-tasking. The results did not find a statistical significant difference in participants' actual performance or affect. However, there was a significant difference in perceived performance, and it found that the multitasking condition rated the lowest on perceived performance compared to the interruption and single-tasking conditions. Furthermore, although not significant, the trending patterns suggest that the multitasking condition had the lowest score in actual performance, and had the greatest negative affect. With these findings, the actual performance and affect parts of the second hypothesis were not supported, but the perceived performance part was supported.

Implications

Although participants' actual performance were not significantly different across the three conditions, participants' perceived performance were significantly different. However, trending patterns indicate that participants performed the worst in the multitasking condition,

while those in the interruption condition performed the best, with single-tasking following very close behind (the difference was 0.69 out of 100 points). Furthermore, the difference between their perceived performance and actual performance were also significantly different; all conditions had positive mean differences, indicating that on average, all participants significantly overestimated their perceived performance. This means that regardless if someone is multitasking, interrupted, or single-tasking, people have a tendency to overestimate their ability to do well on tasks.

Additionally, the participants' mood from pre-task to post-task was not significantly different. However, when comparing means between the conditions, the greatest mood difference was seen in the multitasking condition, with a difference of -2.82, followed by the interruption condition at -1.42, and the single-tasking condition with the smallest difference at -0.52. These differences, while not significant, suggest that framing multiple tasks as multitasking can negatively impact a person's mood more than when framing the tasks as an interruption or when asked to single-task. Conversely, the difference is so small, that the more negative affect in those who multitasked may have been one or two points off from one of the items on the scale, and in fact barely register as a slight negative mood change.

While the time of day the participants completed the experiment was collected, there was not a significant difference, suggesting that it does not matter when people are working on multiple tasks as their performance would not vary greatly between dual-tasking in the morning, early afternoon, or late afternoon. Further the participants were college students who participated before, between, or after their classes. The time of day was collected in hopes to find a moderator effect, as having been in class or not may affect a student's cognitive attention to the dual-tasks in the present experiment. However, there was not a significant difference, so it may not have

made a difference, or it was not accounted or measured in a more accurate and valid way (e.g., questions asking about a participants' class schedule or if they were in class yet or are heading to class after the study).

However, there was a significant difference in the time it took participants to complete the task. All participants, regardless of what condition they were randomly assigned to, were given up to 10 minutes to complete the task but were allowed to finish sooner. Those in the multitasking condition completed the task the fastest, on average finishing at around 495.68 seconds, or 8 minutes, 15.68 seconds. Those in the interruption condition took the longest to complete the task at 554.69 seconds, or 9 minutes, 14.69 seconds, followed by the single-tasking condition at 553.37 seconds, or 9 minutes, 13.37 seconds. These findings indicate that how someone frames a dual-task effects the time it takes someone to complete it. Participants in the multitasking condition were instructed to work on both tasks simultaneously in order to finish within the allotted 10 minutes, whereas participants in the interruption condition were instructed to work on the secondary task when interrupted with it, but that they had to finish everything within the allotted 10 minutes.

Furthermore, although participants in the multitasking condition complete the task the fastest, they rated lower on their perceived performance, and had mean scores showing that they actually performed the worst. On the other hand, participants in the interruption condition took the longest to complete the task but rated the highest on perceived performance, and had a mean score that showed they actually performed the best, followed closely by the single-tasking condition. These findings can also suggest that the framing of the dual-task, multitasking versus being interrupted, can affect an individual's perception of their performance, and can implicitly motivate them to either work on tasks faster (multitasking) or at their own pace as long as they

handle the interruption. While interruptions to the primary task have been found to negatively impact a person's performance on the initial task and interruption task (Baethge & Rigotti, 2013; Bailey & Konstan, 2006; Conard & Marsh, 2016; Tremblay et al., 2012), the present study did not find that pattern.

Applications

Dealing with multitasking and interruptions are applicable to a plethora of settings, such as at home, at work, in school, and out in public. When focused on one task or stimulus at a time, the chances of making a mistake or forgetting something important is minimal as attentional control is focused on one thing rather than exerting cognitive control to switch between tasks (Smit et al., 2016; Szumowska & Kossowska, 2016). In a personal environment, like one's home, this can include chores (e.g., cleaning) or family responsibilities (e.g., cooking dinner). When multitasking, a lot of work may be done at once which can feel great, but it may not be at optimal performance. Finishing multiple tasks at a faster rate can seem like it is a more ideal option to best utilize the time in one's day, but it does not always mean it is the best option. When one is distracted, it can lead to errors, such as forgetting to clean a certain room or area, or overcooking the meat or mismeasuring ingredients.

This is also applicable to a work setting and school setting, where working on multiple tasks at once feels great and accomplishing, but may include shortcuts that negatively affect performance. Being interrupted distracts from the main task and can become dangerous, such talking on the phone while driving, or watching a video while lifeguarding. Additionally, some tasks may vary greatly from the primary task and can cause employees or students to take longer to cognitively switch back to the main task (Trafton, Altmann, Brock, & Mintz, 2003). Although the present study had one secondary task presented at two different times, they were both for the

same amount of time (90 seconds), so we did not measure if longer or shorter interruptions, or one interruption versus multiple interruptions made a difference in performance and mood. However, being interrupted four times for shorter periods of time (compared to one interruption for a longer period of time) affects people's performance, in that it takes people longer to finish the primary task, and longer to switch and resume to the primary task from the secondary task or interruption (Conard & Marsh, 2016).

Based on the present study, it seems that when there are multiple tasks that have to be completed in a given amount of time, it is best to introduce one task at a time (i.e. single-task), or interrupt the person to complete the secondary task before letting them go back to complete the primary task. When being told that they have to multitask, their performance suffers and their perception of their performance is also indicative. Although very minimal, their mood also trends more negatively than those who are only interrupted or single-task. However, telling someone to multitask (rather than single-task) can hint that the tasks have to be completed simultaneously and can ensure that the tasks are completed faster, but will mean more errors leading to worsen performance.

Alternative Explanations

While the dual-tasks for multitasking and interruptions were presented in the same way, the framing of the instructions were different and thus affected performance and mood. In the multitasking condition, instructions included directions to complete both tasks simultaneously in order to finish within the allotted 10 minutes. This created an added mental demand that forced participants to work on both in a quick manner to ensure that they had enough time to finish both. On the other hand, the interruption condition had instructions outlining participants to work on the primary task, but to redirect their attention to the interruption and complete that task

before resuming to the primary task in order to finish within the 10 minutes. While the mental demand was not as strong as the multitasking condition, it included the same details and tasks, but was framed in a different manner that allowed participants to work through the tasks without feeling rushed to complete both in 10 minutes. The single-tasking condition had instructions that said to complete the primary task first, then to work on the secondary task after. This was presented as sequential tasks, which was almost similar to how the interruption condition participants could have interpreted their instructions - to focus on the primary task, then the secondary task when interrupted, then back to the primary task.

One of the questions that participants were asked to answer at the end of the study was what they believed the purpose of the study was. While none of the participants identified the actual purpose was to investigate how framing a dual-task may affect their performance or mood, many predicted that it had to do with stress, mental demands, and multitasking habits that people practice (similarly to students, e.g., studying while distracted on social media). More specifically, many of those in the multitasking condition mentioned that they believed the purpose of the study was to test how well students can multitask, or how well they can multitask under a stressful situation (e.g., time limit), as well as which task do people focus on more or perform better in, and the changes in mood due to the cognitively-demanding task. Many of those in the interruption condition identified how the interruption (secondary task) affects performance on the primary task, how much someone's attention span is affected when interrupted, and how being interrupted affects mood.

Limitations

While the design of this study incorporates facets of multitasking and interruptions, as well as vie for internal and external validity, there are still some limitations in this study to

consider. First, the affect measures were assessed using self-report. This may lead to self-serving bias, or can be limiting to the items and scale provided on the questionnaire. Additionally, the same items were used in the pre-experimental mood and post-experimental mood scales but in random order. This can lead the participates to possibly guess that the study is measuring something before and after the experiment, or can force the participant to try to remember their previous responses to the same items rather than how they feel at the moment. Further, it only included 20 items which covered a range of moods, but not all were relevant to the specific study.

Second, an English-proficiency level was not determined for each participant. The primary task required that participants highlight the spelling errors in the two essays, one with 17 errors and the other with 13 errors. While it is assumed that all the participants have an average to high level of English-proficiency, there may be participants whose primary language is not English. Third, the audio task consisted of basic general and trivia-like questions, covering topics such as campus-related news, basic mathematics, civics and government, and history and politics. These questions were not all general-knowledge questions that could be answered in other parts of the state, country, or world, but rather included questions that would require someone to have specific knowledge about the country and campus affairs.

Fourth, the setting was a small, generic research room with minimal to no external distractors limited observation by the researcher. While the researcher could account for no external distractions, there was no additional measures taken to ensure participants were not distracted by their own volition, such as texting or checking social media on their own phones while in the research room. Additionally, when other studies were being conducted in the other small rooms in the area or during times between classes, other sounds and voices carry over into

the research rooms, and can factor as audio distractors, which some participants experienced and some participants did not.

Fifth, participants were undergraduate students from Arcadia University, which is a small, private liberal arts university that is primarily consisted of female students, and of White ethnicity. Therefore, there is not a lot of variability in a diverse sample, covering facets of gender, age, and ethnicity. Additionally, participants were primarily recruited from Psychology courses, meaning that a majority of the participants were also Psychology majors or minors. This meant that some of these participants could have been suspicious or susceptible to what the study was about, but none identified the purpose of the study when asked during the debriefing period. Further, these participants only cover a small sample of the population, so the effects on performance and mood may vary on younger adolescents, middle-aged individuals, and the elderly.

Future Direction

For future research, a different setting for the experiment would be interesting to investigate. Instead of being in a small, generic research room, being in a larger room with more stimuli (e.g., posters, windows, people) may simulate a more realistic setting, which can determine what is externally-driven. Additionally, accounting for the individual's personality by use of personality scales may help to identify the types of people that are more likely to multitask or engage in interruption, which can determine what is internally-driven. This can also help to identify the types personality traits of people that engage in dual-tasking behaviors but perform on average better than other types personality traits of people that engage in dual-tasking behaviors but perform on average worse (Adler & Benbunan-Fich, 2012; Gillet et al., 2017). Furthermore, the dual-task manipulation can be strengthened, to ensure that the framing of the

dual-task is very obvious when comparing multitasking and interruptions, but not to where the participant may become suspicious of the purpose of the study.

Another expansion on the current study is to incorporate priming into framing of dual-tasks. In this case, the between-subjects conditions can either be primed (i.e., being told they will be multitasking, interrupted, or single-tasking; very similar to the present study) or not primed (i.e., not told in advance that they will be multitasking or interrupted). The primed versus not-primed instructions may indicate if there are perceived versus actual performance and mood differences when told in advance about multitasking or interruptions, or if they are dual-tasking without prior knowledge or warning that it will occur. Furthermore, different types of tasks can be used aside from the present study's essay and audio tasks, such as a computer simulation or real-life scenario. It can also use cognitive-demanding tasks or kinesthesia-based activities to measure for performance.

Moreover, adding additional stressors or mental demands may affect performance and mood, such as having the researcher in the same room as the participant (or a confederate acting as another researcher), having a confederate in the room acting as another participant working on the same task, or a stricter time demand. The current study gave participants up to 10 minutes to complete both tasks, but many participants finished within that time frame, so giving them less time may add more mental demand and affect their performance and mood. In addition, there can be more tasks than two (e.g., having three or more tasks to complete), and see if that affects performance and mood when framing the tasks and multitasking versus interruptions.

Conclusion

Previous researchers have conducted various studies and experiments to understand how multitasking or interruption affect performance and mood. However, none of the studies used in

this paper compared multitasking and interruption as one phenomenon of the presentation of a dual-task. The present study expanded on previous research by merging the two concepts and studying how framing the dual-task as either multitasking or an interruption affect one's perceived performance, actual performance, and mood. While the first hypothesis and most of the second hypothesis were not supported, the results found in the present study are interested and can contribute to the literature and application of multitasking and interruption. Moreover, the findings are not exclusive to understanding performance and mood; this topic can cross over into topics of split attention and cognitive abilities.

These findings, significant or not, suggest many different explanations as to how we understand and perceive dual-tasks. The research on these topics are relatively recent, and there is still a lot to learn and understand in order to optimize performance to reduce errors, as well as avoid increasing negative affect (or job satisfaction) and lower perceived performance, though it was not the case in the present study. Additionally, the findings may vary based on the demographic sample used, as age and experience may affect one's perception of dual-tasking, performance, and changes in mood. The possibilities to expand are endless and the knowledge gained from understanding this topic can help to shape how employers, families, instructors, and other superiors frame tasks, as well as help to increase performance and positive affect to all those who engage in such behavior.

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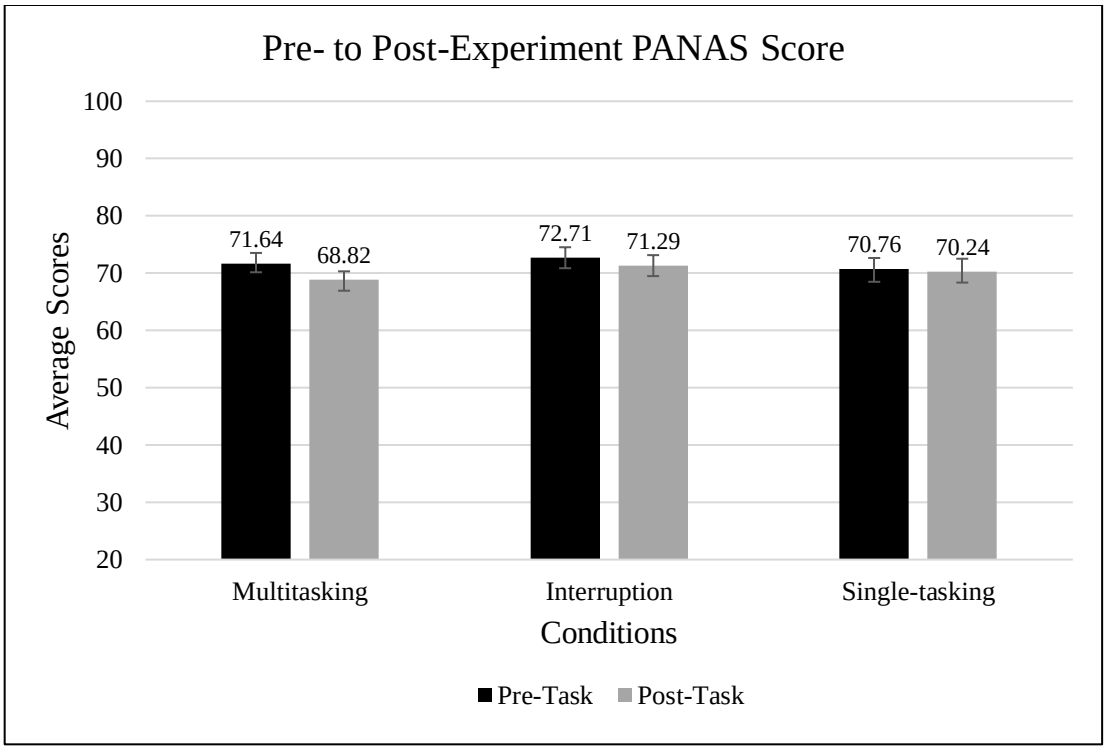

Figure 1. Participants' average Positive and Negative Affect Schedule (PANAS) score pre-experiment and post-experiment across the three conditions. Differences are not statistically significant.

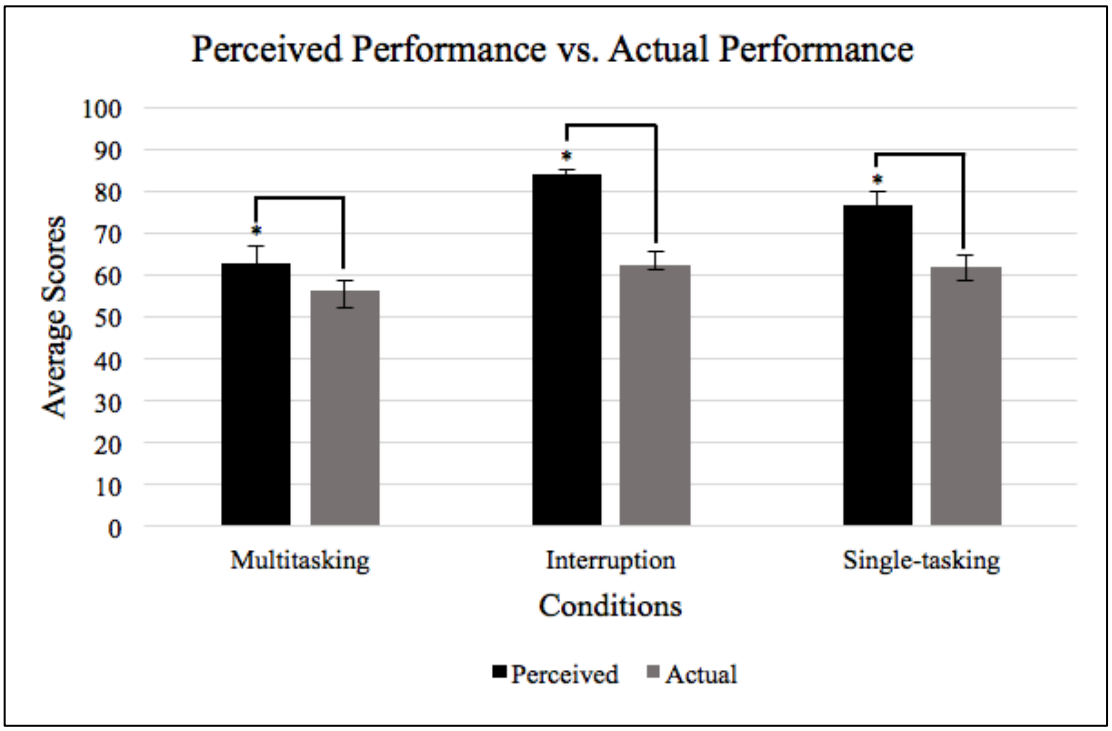

Figure 2. Participants' average scores on perceived performance and actual performance across the three conditions. The difference between perceived performance and actual performance are statistically significance, p = .003. Note: *$p < .001$, **$p = .029$.