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Not All Media Multitasking Is the Same: The Frequency of Media Multitasking Depends on Cognitive and Affective Characteristics of Media Combinations

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Media multitasking comprises a variety of different behaviors, ranging from watching TV while sending a text message to listening to music while gaming. However, we still know little about which media multitasking behaviors are selected more frequently and whether specific characteristics of the media activities determine this choice. Therefore, the present study examined to what extent media multitasking is predicted by 4 cognitive dimensions (Wang et al., 2015) and by instant emotional gratification. We reanalyzed 15 data sets that assessed between 36 and 144 media multitasking combinations each. The findings show that media multitasking occurs more frequently among media combinations that are characterized by a high control over task switching, do not present information in a transient manner, do not access the same sensory modality, and do not require a behavioral response. Moreover, media multitasking occurs more frequently among media combinations that provide instant emotional gratification. These findings further illuminate media multitasking by unraveling the cognitive and emotional characteristics of media multitasking. The findings demonstrate that in addition to cognitive resources and demands, media multitasking is predicted by instant emotional gratification.

Public Policy Relevance Statement

Media multitasking has become a common form of media use. The present study shows that media multitasking selection occurs in an adaptive manner: Individuals tend to pair those media combinations that result in lower cognitive demands. However, findings also show that individuals might choose nonadaptive media combinations if these promise immediate gratification.

Keywords: media multitasking, media selection, cognitive predictors, distractions, instant gratification

Media multitasking has been commonly defined as the simultaneous use of two types of media within a specific time frame (Foehr, 2006). Owing to this rather broad definition, media multitasking may comprise a variety of different combinations of media activities. It is thus not surprising that media multitasking has typically been measured using composite measures that encompass a wide range of media types. The most widely used measure of media multitasking, namely, the Media Multitasking Index (MMI; Ophir et al., 2009), includes 144 media multitasking combinations ranging from listening to music while reading to playing video games while having a phone conversation. These combinations are then composed into a single index that indicates the average amount of media used simultaneously in a typical media-consumption hour.

Because of the composite nature of the MMI, studies based on the MMI typically treat media multitasking as a unidimensional construct, namely, as the base for determining the general amount of media multitasking someone engages in. For example, studies have shown that individuals with high levels of sensation-seeking and impulsivity engage in media multitasking more frequently (Duff et al., 2014; Sanbonmatsu et al., 2013; see Wiradhany & Koerts, 2019 for a meta-analysis). Similarly, studies have focused on the overall effects of media multitasking on various cognitive functions and well-being (for reviews, see Uncapher & Wagner, 2018; van der Schuur et al., 2015).

However, treating media multitasking as a unidimensional construct disregards the variety of media multitasking behaviors and ignores the possibility that media multitasking combinations differ from each other (Wiradhany & Baumgartner, 2019). For example, Wang et al. (2015) argued that every media multitasking behavior can be classified based on a range of cognitive dimensions and that based on these cognitive dimensions, individuals tend to select media multitasking combinations in a way that conserves mental resources.

If media multitasking combinations indeed differ in cognitive characteristics and individuals seek out combinations that are less

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cognitively effortful, this might have consequences not only for our theoretical understanding of media multitasking but also for its measurement. From a theoretical point of view, understanding the characteristics of media multitasking combinations will help us to understand which combinations are chosen more frequently than others and whether the choice of some combinations in comparison to others is less or more detrimental for cognitive functioning. Moreover, concerning its measurement, it is important to know which characteristics of media multitasking determine choice because it might help to develop more tailored and specific measures in the future and to adapt to changes in a fast-changing media landscape.

Some of the predictions of the theoretical model posed by Wang et al. (2015) have been initially supported (Wang et al., 2015) and highlight the notion that specific characteristics of the media multitasking combination itself determine why someone chooses these combinations over others. However, only a limited number of cognitive dimensions and a limited amount of media multitasking behaviors were tested in the study by Wang et al. (2015). A more comprehensive and rigorous test of how the identified dimensions predict a variety of different media multitasking behaviors is thus still missing. In addition, Wang et al.'s (2015) approach focuses entirely on cognitive underpinnings of media multitasking. In the present study, we extend the framework by theoretically deriving and testing an additional dimension that plausibly predicts media multitasking selection, namely, instant emotional gratification.

The aim of the present study therefore was to test to what extent the frequency of media multitasking is predicted by specific cognitive and affective characteristics of the respective media multitasking combinations. By dissecting the characteristics of media multitasking combinations, the present approach differs from previous attempts that predicted media multitasking solely based on characteristics of the user (e.g., personality traits that predict how much someone multitasks) or on characteristics of the situation (e.g., in which situations does media multitasking occur?). The present approach identifies characteristics inherent to the media multitasking behavior itself and examines whether these characteristics predict the frequency of media multitasking. For this means, we reanalyzed a large pool of existing data based on the MMI (15 data sets that assessed between 36 and 144 media multitasking combinations each).

Cognitive Resources as Predictors of Media Multitasking

Based on central bottleneck theories and cognitive resource theories, the multidimensional media multitasking framework posits that media multitasking behaviors are cognitively demanding, as they draw on multiple cognitive resources (Salvucci & Taatgen, 2008; 2011; Wang et al., 2015). It has been frequently shown that cognitive performance decreases when engaging in several tasks simultaneously (Salvucci & Taatgen, 2011; for reviews see Carrier et al., 2015; Jeong & Hwang, 2016; Van der Schuur et al., 2015). It has been argued, however, that media multitasking behaviors highly differ in their cognitive demands. To classify media multitasking behaviors based on their cognitive demands, Wang et al. (2015) identified 11 cognitive dimensions. The main prediction of the framework is that in daily life, individuals tend to select media multitasking behaviors in a cognitively adaptive way; that is, they choose media multitasking combinations that are less cognitively demanding and thus can be more easily combined.

These predictions have been initially tested with two self-report studies in which a total of 12 media multitasking combinations were classified by two cognitive dimensions (Wang et al., 2015). Overall, the findings of these studies suggest that media multitasking behaviors with lower levels of shared modalities were preferred over those combinations with higher levels of shared modalities. Moreover, media multitasking behaviors that were classified according to the dimensions of behavioral response, task relevance, or task contiguity were selected according to the predictions of the model. However, in testing their framework, Wang et al. (2015) only considered a limited set of media multitasking combinations. For instance, in testing the effects of shared modality and control over information flow, only a combination of four media (TV, print materials, radio, and web browsing) was considered. Thus, it remains unclear whether the findings are due to the assigned cognitive dimensions or whether they are based on the specific types of media multitasking combinations that have been chosen. Arguably, it cannot be fully ruled out that the findings are due to the specific behaviors that were selected and are thus not generalizable to other media multitasking combinations with similar cognitive requirements. To further test the predictions of the model, it is thus necessary to investigate a larger amount of media multitasking behaviors.

Because self-reports of media multitasking typically only provide limited information about the particular context in which the behavior occurred, it is impossible to classify these behaviors derived from self-reports based on all dimensions. For instance, when asking how frequently someone watches TV while browsing the Internet, it remains unclear whether this person acts under time pressure (with time pressure being one of the dimensions). In the present study, we therefore focus on only those cognitive dimensions that can be inferred from large-scale survey data of everyday media multitasking, namely, (a) the number of shared modalities, (b) the extent of control people have over task switches, (c) the type of information flow, and (d) whether a behavioral response is required.

Shared Modalities

Media activities can draw on one or more sensory modalities (i.e., visual, auditory, and motor modality; Wang et al., 2015). Based on cognitive resource-based theories, such as threaded cognition (Salvucci & Taatgen, 2008; 2011), it has been assumed that human information-processing relies on multiple cognitive, perceptual, and motor resources. Each resource constitutes a "thread" that has to process incoming information in a serial manner. Consequently, processing more than one stream of information in a similar thread (e.g., processing two streams of visual stimuli) may result in inefficient task performance. Under this assumption, media activities that draw on different cognitive resources can thus be more easily processed than media activities that compete for the same resources (Brünken et al., 2004; Wang et al., 2015). For example, listening to music—an activity that engages only the auditory senses—may be readily combined with reading (as reading only engages the visual senses). In contrast, listening to music is more difficult to be combined with watching TV because the auditory information from both sources cannot be processed simultaneously. Thus, media multitasking combinations that require shared modalities should be less frequently selected than those activities that do not draw on the same sensory modalities (Hypothesis 1).

It is, however, yet unknown whether the likelihood of sharing a specific sensory modality differs. For example, are people equally likely to select media multitasking combinations that both draw on the auditory modality in comparison to combinations that both draw on the visual modality? We therefore examine exploratively whether combinations with shared visual, auditory, or motor modality are more frequently selected (Research Question 1).

Task Switching

Media multitasking combinations can be distinguished based on the extent of control people have over switching between media activities. Some media activities such as text messaging or reading allow users to stop the task in between, switch to a different task, and resume the initial media activity later. In contrast, switching between tasks is more difficult for activities that require an immediate response, such as talking with someone on the phone or while playing a video game. In line with the predictions made by Wang et al. (2015), we expect that media multitasking combinations with greater control over task switches will be more frequently selected than combinations in which one or both tasks are characterized by a low amount of task switch control (Hypothesis 2).

Information Flow

The dimension of "information flow" is related to the task-switching dimension. This dimension addresses how information is transmitted during a task. Information can either be transmitted in a static or transitory way. Written content for example is static, whereas music is transmitted transitorily. This means that the user cannot decide on the pace of information flow. Static content can be paused and returned to at a later moment. Tasks with static content are thus more easily combined than tasks with transient information because transient information always implies a loss of information when drawing attention away from the task. Moreover, Wang et al. (2015) assumed that media activities with transient information cause cognitive overload more easily and are therefore less frequently selected. In line with these assumptions, Wang et al. (2015) found that media multitasking behaviors with static information flow were more frequently selected than those with transient ones. We thus also expect that media multitasking combinations in which the information flow of both activities is static are more frequently chosen than those combinations in which one or both activities are characterized by a transient information flow (Hypothesis 3).

Behavioral Response Requirement

Media activities also vary in the requirement of a behavioral response. Interactive media, such as video games, social media, and talking on the phone are media activities that necessitate a behavioral response. In contrast, watching TV and listening to music are activities that are typically characterized by a more passive reception mode. Wang et al. (2015) predicted that combinations that do not require a behavioral response are more likely selected than those that do require a behavioral response. To test this assumption, they identified the media multitasking combination of web browsing while chatting as high in behavioral response requirement and the behavior of web browsing while e-mailing as low in behavioral response requirement (Wang et al., 2015). This distinction might be somewhat problematic, as both combinations clearly require a behavioral response. To further test these predictions, we therefore compare a wider variety of media multitasking behaviors that can be clearly characterized as either requiring a behavioral response (e.g., browsing the Internet while gaming) or requiring no behavioral response (e.g., watching TV while listening to music).

In a media multitasking situation with two types of media, either none, one, or both of the media activities may require a behavioral response. As a behavioral response always draws on the motor modality, it is likely to assume that two media activities that both require a behavioral response are less likely selected than those combinations in which none or only one requires a behavioral response. This is based on the idea that multitasking combinations that draw on the same sensory modality are not combined. We thus expect media multitasking combinations in which both require a behavioral response to be less frequently selected than combinations in which only one or none of the activities requires a behavioral response (Hypothesis 4).

Extending the Theoretical Framework—Instant Gratification

The 11 dimensions identified by Wang et al. (2015) are based upon cognitive resource theories with the main idea that media multitasking selection is based on decisions that are driven by cognitive demands. Although these dimensions constitute a useful starting point, they might not be exhaustive for explaining media multitasking choices in daily life (Wang et al., 2015), as these decisions might not only be driven by cognitive resources and demands.

As Wang and Tchernev (2012) argued, media multitasking behaviors typically also gratify emotional needs. The emotionality of the media content is included as one of the dimensions in the framework. However, predictions concerning the choice of emotional media content within the cognitive framework remain somewhat vague, except for the prediction that emotionally pleasant media activities are preferred. Entertainment media are typically regarded as emotionally gratifying (Bartsch & Viehoff, 2010). However, we argue that some media activities provide emotional gratifications more instantaneously than other media activities and that those activities are more likely to be used during media multitasking.

Particularly, social media have been shown to elicit strong automatic affective reactions and are believed to promise immediate gratifications (Brailovskaia & Teichert, 2020; Turel & Serenko, 2020; van Koningsbruggen et al., 2017). For example, social media notifications or just the sight of a smartphone or social media image have been shown to provoke automatic pleasure responses (Brailovskaia & Teichert, 2020; Panek, 2014; van Koningsbruggen et al., 2017). If users experience these pleasure rushes, they learn to associate these with a specific type of media, which makes it increasingly difficult to resist these media technologies in the future (Johannes et al., 2019).

Next to social media, we argue that other types of media can also lead to immediate gratifications. This is particularly so if these media can be consumed in short time periods and can provide short breaks from other activities, such as online videos or other online content (Calderwood et al., 2016; Judd, 2014). Although the immediacy of the pleasure response may heavily depend on the specific content that someone consumes, we assume that overall, some media technologies lent themselves better to provide these instant gratifications than others. For example, although reading or gaming may also be experienced as emotionally gratifying, these might require more effort before gratifications are achieved. For example, when reading a story, it might take some time before the reader is immersed in the narrative and pleasure arises.

Recent research has shown that immediately gratifying media content is chosen more frequently particularly when users have many choices available (Panek, 2014) and that immediately gratifying media activities are more difficult to resist (Hofmann et al., 2012; Panek, 2014; van Koningsbruggen et al., 2017). This implies that individuals might find it difficult to resist immediately gratifying media when already engaging in another media activity. Interestingly, it has also been shown that individuals with a higher tendency for immediate reward multitask with media more frequently, providing evidence for the potentially rewarding nature of media multitasking (Schutten et al., 2017). Thus, we expect that media multitasking behaviors including one or two immediately gratifying activities are more likely to be selected than those that are not characterized by immediate gratifications (Hypothesis 5).

Method

Data Sets

The MMI (Ophir et al., 2009; Pea et al., 2012) is the most used measure of media multitasking to date (Baumgartner et al., 2017). The original MMI assesses a combination of 12 different media activities, comprising a total of 144 media pairings. Over the years, different variations of the MMI have been developed (Baumgartner et al., 2017; Loh & Kanai, 2014; Moisala et al., 2016), by adding or removing media multitasking combinations to be up-to-date with current media developments. In order to test the dimensions across a variety of media multitasking behaviors and from a diversity of samples, we contacted 15 authors in the period between February and March 2017 who have published articles using the MMI. Of the contacted authors, five contributed their data sets, providing 12 data sets (Alzahabi & Becker, 2013; Loh & Kanai, 2014; Loh et al., 2016; Moisala et al., 2016; Ralph & Smilek, 2017; Ralph et al., 2014; Ralph et al., 2015; Uncapher et al., 2016). In addition, three of our own data sets were used (Baumgartner et al., 2014; Wiradhany & Nieuwenstein, 2017).

In total, the MMI responses of 15 data sets were combined and analyzed. The samples were quite heterogeneous. The sample sizes ranged from 58 to 523 respondents. Two of the data sets included adolescents with age ranges of 11 to 15 and 13 to 16 years; eight data sets were collected from university students, with average ages ranging from 19.6 to 24.6 years; and six data sets were collected from the general population, with age ranges from 19 to 82 years. Data sets originated from Canada, Finland, Indonesia, Singapore, the Netherlands, the United States, and unspecified origin (i.e., MTurk samples). The number of media multitasking combinations ranged from 25 to 144. In total, 746 media pairs were assessed, comprising a total of 118 unique pairs (see Table 1 for an overview of all media activities).

Coding the Dimensions

As a first step for the coding, we compared the descriptions of activities related to one particular media in the different MMI questionnaires. Across studies, slightly different versions of the MMI questionnaires were used. For example, watching TV may

Table 1
Overview of the Coding for the Individual Media Activities in the Data Sets

	Dimensions and coding value						
Media	Likelihood visual modality (1 = high; 0 = low)	Likelihood auditory modality (1 = high; 0 = low)	Likelihood motor modality (1 = high; 0 = low)	Likelihood control over task switching (1 = high; 0 = low)	Level of information flow (1 = rather transient; 0 = rather static)	Likelihood requiring behavior response (1 = high; 0 = low)	Likelihood providing instant gratification (1 = high; 0 = low)
Reading	1	0	0	1	0	0	0
TV	1	1	0	1	1	0	1
Online video	1	1	0	1	1	0	1
Music	0	1	0	1	1	0	1
Nonmusic	0	1	0	1	1	0	0
Gaming	1	1	1	0	1	1	0
Phone calling	0	1	1	0	1	1	1
Instant messaging	1	0	1	1	0	1	1
SMS	1	0	1	1	0	1	1
E-mail	1	0	1	1	0	1	0
Browsing	1	0	1	1	0	1	1
Other computer activities	1	0	1	1	0	1	0
Social media	1	0	1	1	0	1	1

Note. To assess media multitasking, each media activity is paired with all other media activities. In the table, we express the likelihood of the visual, auditory, and motor modalities to be used for each media. However, in the analysis pertaining to these modalities, we coded the likelihood for the modality to be *shared* between two media.

include watching short videos on YouTube in one version, watching DVDs in another, and remained unspecified in another. The MMI responses also do neither provide any information about the specific context in which media multitasking combinations are chosen nor about the subjective experiences of engaging in these activities. It is therefore important to note that the coding of each media activity remains partly subjective.

In a second step, both authors individually coded all media activities according to the dimensions. In a third step, the coding was compared among the two authors, and a few disagreements were resolved by weighing arguments for the specific decisions. To ensure the reliability of our coding, we further invited two additional independent raters to provide their coding for the media activities. The first and second additional ratings agreed with 96% and 92% with the original coding, respectively, resulting in a high intercoder reliability (Krippendorff's $\alpha = .88$). There was full agreement between all raters for five out of the seven dimensions. The only discrepancies occurred for the dimensions "control over task switching" and "instant gratification." Nevertheless, also for these dimensions, most media types were rated in agreement among all raters. In contrast to our original rating, both raters argued, however, that nonmusic audio should be coded as having high control for task switching and that TV is high in instant gratification. After weighing the arguments for these decisions, we agreed with their coding. It is, however, important to note that the general patterns of findings did not differ from the findings resulting from the original coding. The final coding can be found in Table 1. A score of 0 was assigned to media activities with a low likelihood for the specific dimension, and a score of 1 was assigned to media activities with a high likelihood for each dimension (for a similar coding, see Wang et al., 2015, pp. 107–108).

Shared Visual Modality

The media activities of reading, watching TV, watching online videos, gaming, IM, text messaging, social media, e-mail, and other computer activities were coded as being likely to provide visual input. Listening to music or other nonmusic audio as well as talking on the phone were coded as not providing visual input. Concerning the coding for the media multitasking pairs, all combinations for which none (e.g., listening to music while talking on the phone) or only one media activity (watching TV while listening to music) was likely to provide visual input were coded as not sharing the visual modality (i.e., a score of 0). When both media activities were coded as drawing on the visual modality (e.g., watching TV while gaming), this pair was coded as 1 (i.e., shared visual modality).

Shared Audio Modality

We coded the activities watching TV or online video, listening to music or nonmusic audio, and calling as media activities that are likely to provide auditory input. Moreover, we categorized gaming as drawing on the audio modality because music and sounds are frequently used in games. All other media activities, such as reading, text messaging, and e-mailing were coded as zero. All media pairs of which none or only one activity was likely to provide auditory input were coded as 0. When both activities were likely to provide auditory information, this pair was coded as 1 (e.g., listening to music while watching TV).

Shared Motor Modality

The media activities of gaming, phone-calling, IM, SMS, other computer activities, and social media were coded as being likely to draw on the motor modality. The activities of reading, listening to music or nonmusic audio, and watching TV and online videos were coded as being less likely to require a motor response. Although also watching TV and online videos may sporadically draw on the motor modality, such as when someone engages in zapping, changing channels, or searching for a specific video, we chose to assign them to the category of no motor response in line with the coding used by Wang et al. (2015; Table 1). The motor modality was coded as shared (i.e., 1) if both media activities in a pair were likely to require a motor response (e.g., text messaging while gaming). If none or only one activity required a motor response, the media pairs were coded as 0 (i.e., no shared motor modality).

Behavioral Response Requirement

The same media activities that draw on the motor modality were coded as requiring a behavioral response. All media pairs for which both activities did not require a behavioral response were assigned a value of 0. Media pairs in which one or both activities required a behavioral response were assigned values of 1 and 2, respectively. Therefore, although the coding for behavioral response requirement and motor modality was the same for the individual activities, the coding for the media pairs differed. For instance, the media multitasking combination of texting while watching TV received a value of 1 for behavioral response requirement (i.e., only texting requires a behavioral response), but a value of 0 for the shared motor modality dimension (i.e., no shared motor modality as only one of the media activities requires a behavioral response).

Task Switching

All media activities were coded as allowing for task switching (i.e., value of 1), except for the media activities of gaming and phone calling. When in a conversation with someone on the phone, it is mostly not possible or impolite to stop the conversation in between to switch to another media activity. Although video games can typically be stopped and resumed later, in many cases, gaming involves multiple players and a specific urgency to react quickly to situations, which makes it less likely for people to switch tasks in between. TV typically is characterized by a stream of information that requires continued awareness, for example, when following the news. However, because the item descriptions in most versions of the MMI included on-demand and short online videos, we coded this as 1. All media pairs for which both activities allowed for switching were coded as 2 (e.g., text messaging while e-mailing), whereas pairs for which no activity or only one allowed for switching were coded as 0 and 1, respectively.

Information Flow

The following media activities were coded as providing mostly static content (i.e., score of 0): reading, IM and text messaging, e-mailing, social media, and other computer activities. All other activities were coded as mostly transient (i.e., score of 1), such as audio, TV, and calling on the phone. Although also all of these types of media can potentially be paused and therefore can take on a static form (e.g., pausing an audio podcast or interrupting a phone call), we argue that they are more transient than the other types of abovementioned media and that in many situations when people decide to use other media while listening to audio or while watching TV, they do not pause the audio/TV the moment they start using other media (e.g., write a text, or start reading a message). We believe it is more likely that they keep listening to the audio simultaneously while engaging in other types of media. We also reason that the MMI items are phrased in a way that suggest to the respondents that audio is continued in these situations. For example, the items are typically phrased like this: "While listening to music or other audio, how often do you simultaneously write a text message." We believe that people when responding to this item think about situations in which they indeed do both at the same time. For the media pairs, the respective scores of the individual activities were added, with 0 indicating that both activities provided static content, a value of 1 indicating that one media activity was characterized by transient content, and 2 indicating that both activities were likely to have a transient flow of information.

Instant Gratification

As mentioned earlier, and in line with previous literature we coded the following activities as being more likely to provide instant gratifications: social media, including text messaging and IM, and listening to music. Moreover, we also coded watching TV and online videos as providing instant gratifications, as online videos are typically short, highly entertaining, and sought out for providing enjoyment (Khan, 2017). Although reading, listening to nonmusic audio, and gaming may in some cases also elicit immediate pleasure responses, we argue that for these media activities, the pleasure response typically evolves slower. For example, while gaming or reading, it typically takes some time to get immersed into the narrative. Thus, when reading a book, users may not feel a pleasure response the moment they start but only after some time during the course of the narrative. E-mails and other computer activities are frequently used for nonentertainment reasons, such as work and homework, and may thus not provide instant gratifications. Activities that are likely to provide instant gratification were assigned a value of 1, whereas activities that are not likely to provide instant gratification were assigned a value of 0. For the media multitasking pairs, the values for the single activities were added, with a value of 0 indicating that both activities were unlikely to provide instant gratification and values of 1 and 2 indicating that one or both activities were likely to provide instant gratification, respectively.

Analysis

To assess whether media multitasking combinations were selected in line with our hypotheses, we first combined the data sets from the different authors. For each of the dimensions, a multiple linear regression model was constructed with the z-standardized media multitasking frequency as the outcome variable and the codings for each media multitasking pair for the respective dimension as the predictors. For each dimension, we tested if the change of intercept for each respective coding value, indicated by the distance between beta and zero, was statistically significant. A positive beta indicates that for a specific coding value of one dimension (e.g., shared audio = 0), a higher frequency occurred. A negative beta indicates that for a specific coding value, a lower frequency of media multitasking occurred. In addition, to assess if the findings were consistent across different data sets, a moderator analysis was performed by creating interaction terms between each coding value and different data sets. Thus, if the model with the interaction (i.e., different intercepts for each data set) explained more variance (i.e., higher R^2) than the original model, it indicates that different data sets show different patterns. All analyses were conducted in R Version 3.4.1 using RStudio. Graphs were rendered using the ggplot2 package Version 2.2.1.

Results

Figure 1 provides an overview of the findings of the regression models for all dimensions. The means and standard deviations for the z-standardized frequencies for all media pairs are depicted in Table A1 in the Appendix.

Shared Modalities

In line with Hypothesis 1, the number of shared modalities predicted media multitasking selection, $F(3, 742) = 73.14$, $p < .001$ with $R^2 = .23$. All predictors were significantly different from 0, with $\beta = .52$, $t = 8.47$, $p < .001$ for no shared modalities; $\beta = -1.16$, $t = -14.53$, $p < .001$ for shared audio modality; $\beta = -.20$, $t = -2.86$, $p = .004$ for shared visual modality; and $\beta = -.32$, $t = -4.78$, $p < .001$ for shared motor modality. As predicted, participants multitasked more often with media activities that were likely to involve no shared modalities in comparison to media multitasking combinations that were likely to involve either shared audio, visual, or motor modality. Answering Research Question 1, media multitasking combinations involving shared audio modality were the least likely selected media multitasking combinations. The moderator analysis showed that the model with different intercepts for different data sets did not explain significantly more variance, R^2 change = .03, $F = .82$, $p = .78$, indicating that the findings were consistent across data sets.

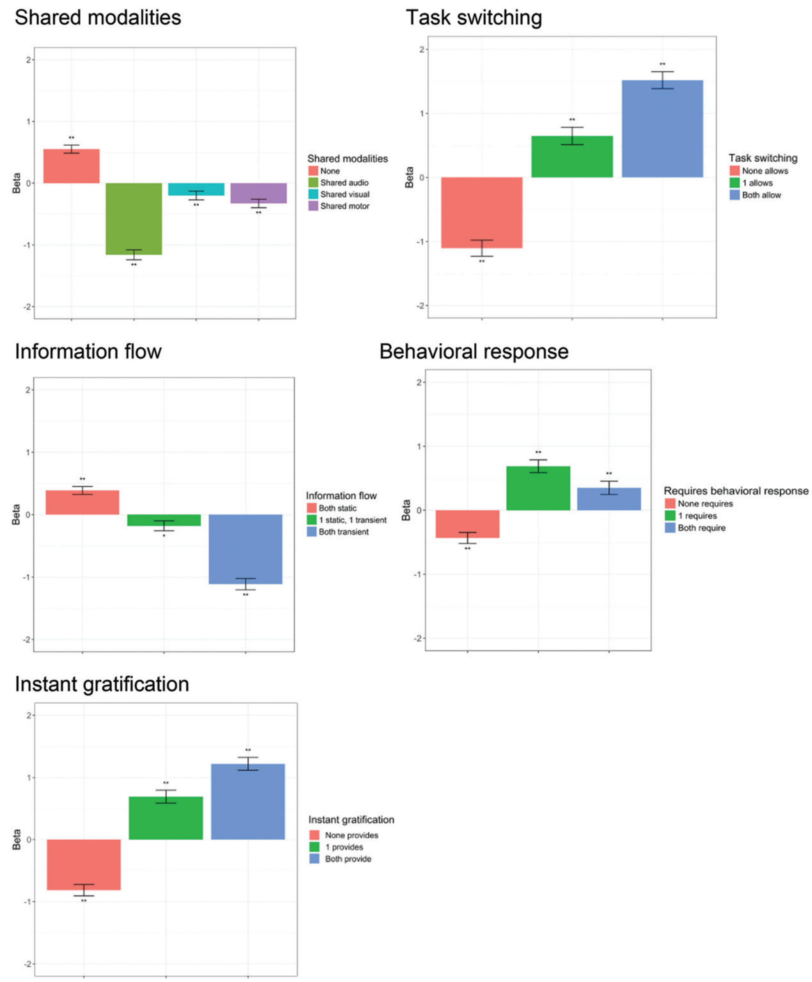
Task Switching

Supporting Hypothesis 2, control over task switches predicted how often participants media multitasked, $F(2, 743) = 126.1$, $p < .001$ with $R^2 = .25$. All predictors were significantly different from 0. Participants multitasked more often if one ($\beta = .64$, $t = 4.77$, $p < .001$) or two activities ($\beta = 1.52$, $t = 11.58$, $p < .001$) were likely to allow them to switch. In contrast, participants multitasked less often when none of the activities were likely to allow for task switching ($\beta = -1.11$, $t = -8.88$, $p < .001$). The moderator analysis showed that the model with different intercepts for different data sets did not explain significantly more variance, R^2 change = .03, $F = .76$, $p = .859$, indicating that the findings were consistent across different data sets.

Information Flow

Supporting Hypothesis 3, information flow predicted how often participants media multitasked, $F(2, 743) = 91.49$, $p < .001$, with an explained variance of 19% ($R^2 = .19$). All predictors were significantly different from 0. Participants multitasked more often in

Figure 1
Media Multitasking Frequency Predicted by the Five Dimensions



Note. Asterisks indicate that the intercepts are significantly different from 0, with * $p < .05$ and ** $p < .01$. Bars indicate the standard errors of the regression coefficients. See the online article for the color version of this figure.

cases in which two activities were like to have a static information flow (β = .38, t = 6.10, $p < .001$). In contrast, multitasking occurred less often in cases in which both activities were likely to present information in a transient manner (β = −1.11, t = −12.30, $p < .001$), or when one activity was transient and the other static (β = −.18, t = −2.27, p = .02). The moderator analysis showed that the model with different intercepts for different data sets did not explain significantly more variance, R^2 change = .05, F = 1.22, p = .17, indicating that the findings were consistent across data sets.

Behavioral Response

The requirement for behavioral responses predicted how often respondents media multitasked significantly, $F(2, 743)$ = 25.8, $p < .001$, with R^2 = .06. All predictors were significantly different from 0. Participants multitasked more often with media activities that were likely to involve a behavioral response (β = .68, t = 6.87, $p < .001$) in comparison to media combinations that both were not likely to require a behavioral response (β = −.43, t = −5.06). However, in line with the predictions on shared modalities, media multitasking combinations in which both media required a behavioral response were less often selected (β = .35, t = 3.37, $p < .001$) than combinations in which only one activity was likely to require a behavioral response. Overall, these findings do not support Hypothesis 4, as media multitasking combinations that require no behavioral response were least likely to be chosen. An additional moderator analysis showed that the model with different intercepts for different data sets did not explain significantly more variance, R^2 change = .02, F = .45, p = .999, indicating that the findings were consistent across data sets.

Instant Gratification

Supporting Hypothesis 5, instant gratification predicted the frequency of media multitasking, $F(2, 743)$ = 75.94, $p < .001$ with

R^2 = .17. All predictors were significantly different than 0. In line with Hypothesis 5, participants multitasked less often if none of the activities was likely to offer instant gratification ($\beta = -.81$, $t = -9.01$, $p < .001$). Participants multitasked more often if one activity was likely to offer instant gratification ($p < .001$; $\beta = .69$, $t = 6.64$) and most often if both activities were likely to offer instant gratification ($\beta = 1.21$, $t = 11.79$, $p < .001$). The moderator analysis showed that the model with different intercepts for different data sets did not explain significantly more variance, R^2 change = .03, $F = .54$, $p = .992$, indicating that the findings were consistent across data sets.

Comparing the Dimensions

In a final step, a hierarchical multiple regression analysis was conducted to examine the predictive power of the combined dimensions and to test whether the dimension of instant gratification explained additional variance above the cognitive resource dimensions. In the first step, all cognitive resource-related dimensions were entered. Thereby the shared audio, motor, and visual modalities were entered as separate factors (not as one combined shared modality variable). In the second step, instant gratification was entered as an additional predictor. The *z*-standardized frequency of media multitasking responses for each media pair was included as the outcome variable.

The hierarchical multiple regression showed that the cognitive resource dimensions contributed significantly to the model, $F(6, 745) = 74.27$, $p < .001$, and explained 37% of the variance in media multitasking selection. When instant gratification was included, an additional 14% of the variance was explained, amounting to a total of 51% (adjusted R^2) explained variance in media multitasking selection. In the final model, the dimensions of shared audio modality ($\beta = -.23$, $p < .001$), shared visual modality ($\beta = -.11$, $p < .001$), shared motor modality ($\beta = -.38$, $p < .001$), behavioral response requirement ($\beta = .32$, $p < .001$), flow of information ($\beta = -.18$, $p = .006$), task switching ($\beta = .27$, $p < .001$), and instant gratification ($\beta = .41$, $p < .001$) all predicted media multitasking significantly.

Discussion

In this study, we empirically tested four cognitive dimensions that influence media multitasking selection (Wang et al., 2015). To extend the theoretical framework beyond cognitive resources and demands, we included instant gratification as an additional factor which might influence media selection. To this end, we reanalyzed MMI responses from 15 media multitasking data sets. Overall, our findings suggest that, in line with the predictions of the framework, media multitasking selection occurs in a cognitively adaptive manner: Individuals tend to pair those media combinations that result in lower cognitive demands. This can be considered cognitively adaptive, as these combinations may allow to engage in two media types simultaneously without leading to cognitive overload.

With regard to shared modalities, media combinations that were likely to result in a lower number of shared modalities were less frequently selected. This is in line with the predictions of theories of compartmentalized working memory systems (Baddeley, 1992) and with contemporary views of multiple resources for cognition (Salvucci & Taatgen, 2008). However, next to the basic prediction that media multitasking combinations that draw on the same sensory modality are less frequently combined, we further examined which shared modalities are least frequently selected. Our findings indicate that particularly those media multitasking combinations are less frequently selected in which both activities draw on the auditory modality.

From an adaptive view, the abovementioned finding is intriguing. Previous research has shown that the simultaneous processing of two auditory streams of information requires a high cognitive load and that the combination of two auditory streams is related to lower task performance (Brünken et al., 2004). Moreover, the combination of two media activities including auditory information might be less likely because the dimension of shared auditory modality interacts with the dimension of information flow. Indeed, with regard to information flow and control over task switches, media combinations that are characterized by a static flow of information were preferred over transient media combinations and those combinations that allowed for greater control over task switches were more frequently selected. Auditory information in media activities, such as listening to music, or auditory information as presented on TV, is almost always transient and therefore requires continued awareness to be processed. As shown in this study, media multitasking behaviors that are both characterized by a transient flow of information were less likely selected. In contrast, visual information in the media is frequently static, such as printed information or webpages. Static information is easier to switch back and forth to without losing too much information. It is thus likely that two media activities with auditory information are less frequently combined not only because they draw on the same sensory modality but also because auditory information is frequently characterized by transient information flow.

Concerning the dimension of behavioral response requirement, the present findings were only partly in line with expectations. We predicted that media combinations that require none or only one behavioral response would be most frequently selected. However, we found that combinations that required one behavioral response were the most frequently selected, followed by combinations requiring two behavioral responses. These results are in line with the predictions of contemporary models of cognition. Specifically, the threaded cognition model (Borst & Taatgen, 2007; Salvucci & Taatgen, 2008) posits that in multitasking, different activities (called threads) might require resources from a common module (e.g., the visual modality). When this happens, resources are shared in a greedy, but polite manner: If a module is not in use by one thread, another thread may claim it (greedy). However, resources are released immediately once the thread is finished using it (polite). This greedy/polite policy explains why media multitasking combinations that require a behavioral response might be chosen more frequently but not if both activities draw on the motor modality: If the behavioral response module is unoccupied, resources are available to be used for another media activity.

The findings of the present study extend the theoretical framework in multiple respects. First, we tested the multidimensional framework of media multitasking over a large data set that includes a broad variety of media combinations (i.e., between 36 and 144 combinations in total) and different samples that varied in age as well as in country of origin. Together, our findings provide strong support for and a higher generalizability of the theoretical framework. Second, the present findings provide further insights into how some of the multitasking dimensions might interact with one another, that is, the auditory modality with information flow and the visual modality with task switching.

Third and lastly, the present study provides empirical support for the notion that cognitive demands are not the sole factor determining media multitasking selection. Specifically, we found that media combinations that were likely to provide instant gratification were more frequently selected. The dimension of instant gratification predicted media multitasking selection above the purely cognitive dimensions and explained a substantial additional amount of variance in media multitasking. This finding further corroborates the idea that media multitasking is not only driven by cognitive considerations but also by emotional ones (see also, Wang & Tchernev, 2012). This finding is in line with previous research suggesting that media activities are frequently emotionally gratifying and that it can be difficult to resist these media temptations in everyday life (Hofmann et al., 2012; Panek, 2014). Thus, when engaging in a media activity, other available media options might be difficult to resist, and, therefore, individuals might engage in an additional media activity simultaneously.

This finding is important because it suggests that media multitasking selection does not always follow an adaptive pattern from a purely cognitive perspective. Based on cognitive processing theories, choosing media multitasking combinations that are cognitively less demanding are adaptive, as they do not lead to cognitive overload. Cognitive overload is problematic, as it may lead to insufficient message processing (e.g., Lang, 2000) and to stress responses (Matthews & Campbell, 2009). However, individuals might also choose cognitively nonadaptive media combinations if these promise immediate emotional gratification. In the presence of constant media distractions, individuals may fail to control their behavior and engage in media multitasking behaviors that might be cognitively highly demanding but emotionally gratifying. This may explain why individuals often engage in media multitasking at the expense of cognitive performance. For example, individuals frequently use media while studying or doing homework (Rosen et al., 2013). Although individuals may intuitively understand that multitasking does not improve their performance, they may still do so, as it is experienced as pleasurable.

Although these choices may not be considered cognitively adaptive, they may still be emotionally adaptive. Research on the uses and gratifications of entertainment media has repeatedly shown that media are predominantly selected to gratify hedonic pleasures (Bartsch & Viehoff, 2010) and that media use can have positive effects on well-being (Rieger et al., 2014). Thus, even if media multitasking may not be beneficial for task performance, or for the effective processing of media content, it may gratify emotional needs. This idea is supported by Wang and Tchernev (2012) showing that although people choose to media multitasking for cognitive reasons, their emotional needs rather than their cognitive needs are gratified by media multitasking. Thus, the instant gratifications derived from media multitasking might be considered adaptive, as it fulfills important emotional functions. Further research, however, is needed to better understand these positive effects of media multitasking.

Limitations and Directions for Future Research

It is of key importance for future research to establish whether different media multitasking behaviors vary in their consequences. A large number of studies has indicated that media multitasking is related to various problems in cognitive control (Ophir et al., 2009; Wiradhany & Nieuwenstein, 2017; van der Schuur et al., 2015). Because these studies typically used overall scores of media multitasking, it is yet unknown whether engaging in specific combinations is particularly detrimental for cognitive performance. It thus needs to be tested whether the dimensions indeed do categorize media multitasking behaviors according to their cognitive adaptiveness. More specifically, it remains to be examined whether engaging in multitasking behaviors that are characterized by low cognitive demands are indeed less detrimental for cognitive processes than those combinations that require more cognitive resources.

In the present study, we investigated only a selection of the cognitive dimensions proposed by Wang et al. (2015). The selection of dimensions was limited due to the choice of self-reported data for this study. Self-reported data only provides limited information about the actual context in which a media multitasking behavior occurs. Thus, this data only allowed us to classify the present behaviors on a limited number of dimensions. The advantage of this approach was that it allowed us to classify a total of more than 118 media multitasking combinations from a wide variety of previous studies. This permitted us to test the theoretical predictions with a large variety of media multitasking behaviors and a variety of different samples. For future research, it would be desirable to test more of the cognitive dimensions using a broad range of behaviors.

The limited amount of information provided by the data used in this study also had consequences for the coding of the cognitive dimensions. As information about the context and content of media multitasking is missing, the coding of the media activities remained somewhat subjective. Without knowing the exact situation in which someone engages in media multitasking, it is difficult to assess, for example, the actual control someone has over task switches. For instance, we assumed that when engaging in instant messaging while using social network sites, individuals have a high control over switching between these tasks. However, there might be situations in which even for these media activities, the control over task switches is limited (e.g., if someone engages in a lively conversation with someone via WhatsApp). Similarly, we coded the use of audio media and TV as transient types of media because we believe that in many situations they are used in a transient manner. Nevertheless, in some situations these media types might also be rather static (e.g., when people stop the TV series they are just watching to send a text message or to make a call). To understand in more detail in which situations people engage in which types of media multitasking, observational or experience sampling studies would be desirable that assess media multitasking choices in the daily lives of individuals.

We introduced a new dimension, instant gratification, and showed that this dimension explains why individuals engage more frequently in some specific media multitasking combinations than others. We argued, based on previous research (Panek, 2014; van Koningsbruggen et al., 2017), that instant gratification is inherent to specific media activities, such as social media. However, it is important to acknowledge that the content of a specific medium is at least as important. For example, a badly produced or uninteresting online video can be slow in gratification or not deliver any gratifications at all, whereas an important e-mail from a friend might lead to an immediate pleasure response. Because all MMI items are based on technologies and not on the content provided by those media technologies, it is impossible to test assumptions based on content. Therefore, it is an important endeavor for future research to further establish whether individuals assign expectations about the immediacy of a gratification to a specific media technology and whether this in turn predicts their media multitasking engagement.

The present study adds to our understanding of media multitasking because it shows that media multitasking choice is not only dependent on personality characteristics but also on characteristics of the media activity itself. Thus, when trying to explain the frequency of media multitasking, it is important to not only understand characteristics of the person but also of the medium. An important next step would be to examine potential interactions between personality and media characteristics. For example, the media multitasking choices of individuals high in self-control might be less influenced by the dimension of instant gratification, as these individuals might be able to better resist immediate temptations (Panek, 2014; Schutten et al., 2017). Future research may thus benefit from investigating how individual differences interact with these dimensions in explaining media multitasking choice.

Research Transparency Statement

The authors are willing to share their data, analytics methods, and study materials with other researchers. The material will be available upon request.

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(*Appendix follows*)

Appendix

Table A1

Means and Standard Deviations of the z Scores for Each Media Multitasking Pair (Ordered by Size)

Media multitasking pairs	*M*	*SD*
Music–Social media	2.04	0.59
Music–SMS	1.9	0.39
Social media–music	1.82	0.71
TV–SMS	1.81	0.86
Music–browsing	1.78	0.91
SMS–music	1.56	0.67
SMS–TV	1.48	0.44
Music–IM	1.37	0.67
IM–IM	1.36	0.4
Reading–music	1.35	0.67
Social media–TV	1.33	0.66
Social media–e-mail	1.28	0
Online videos–SMS	1.23	0.37
Music–e-mail	1.21	1.06
Browsing–music	1.18	0.84
SMS–SMS	1.11	0.8
SMS–Social media	1.09	0.52
Music–other computer activities	1.03	0.58
Social media–IM	0.96	0
TV–Social media	0.96	0.83
Online videos–Social media	0.93	0
TV–IM	0.79	0.74
IM–browsing	0.79	0.2
Social media–Social media	0.78	0.53
Online videos–IM	0.78	0.78
Social media–SMS	0.77	0
Other computer activities–other computer activities	0.72	0.47
IM–SMS	0.68	0.59
TV–browsing	0.67	0.82
Browsing–browsing	0.67	0.62
E-mail–browsing	0.61	0.72
Reading–SMS	0.59	0.91
SMS–browsing	0.55	0.56
SMS–e-mail	0.55	0.33
E-mail–calling	0.5	0
TV–e-mail	0.49	0.44
Browsing–TV	0.48	0.78
Social media–browsing	0.42	0.65
IM–e-mail	0.42	0.27
SMS–Online videos	0.41	0
TV–calling	0.38	0.42
Browsing–other computer activities	0.37	0.71
Reading–IM	0.34	0.76
Reading–TV	0.28	0.53
E-mail–e-mail	0.27	0.67
Social media–calling	0.17	0.39
YouTube–reading	0.17	0
Music–Online videos	0.17	0
Online videos–browsing	0.17	0.77
SMS–other computer activities	0.15	0.69
Online videos–e-mail	0.13	0.37
Reading–Social media	0.11	0.7
IM–other computer activities	0.08	0.62
Music–reading	0.05	0
Social media–Online videos	−0.02	0
Calling–browsing	−0.02	0.48
Nonmusic–SMS	−0.03	0.62
Music–gaming	−0.05	0.55
SMS–calling	−0.06	0.28
E-mail–other computer activities	−0.06	0.55
Calling–TV	−0.11	0.62
Calling–e-mail	−0.11	0.31
Music–calling	−0.12	0.31
Gaming–SMS	−0.14	0.48
Other computer activities–reading	−0.18	0
Reading–browsing	−0.18	0.52
Online videos–calling	−0.18	0.15
Reading–other computer activities	−0.21	0.74
Reading–Online videos	−0.21	0.51
TV–Online videos	−0.22	0.61
Calling–IM	−0.23	0.34
Nonmusic–IM	−0.23	0.79
TV–other computer activities	−0.27	0.6
Calling–SMS	−0.29	0.26
Reading–e-mail	−0.3	0.56
TV–music	−0.31	0.69
Browsing–calling	−0.33	0.45
Calling–Social media	−0.36	0
Online videos–music	−0.36	0.38
Nonmusic–browsing	−0.37	0.53
Calling–music	−0.39	0.48
SMS–gaming	−0.41	0.39
Online videos–other computer activities	−0.48	0.56
Reading–reading	−0.48	0.3
IM–calling	−0.52	0
Nonmusic–e-mail	−0.52	0.42
Gamen–IM	−0.53	0.41
Reading–calling	−0.54	0.35
Calling–other computer activities	−0.55	0.39
Social media–other computer activities	−0.63	0
Calling–Online videos	−0.68	0
TV–gaming	−0.72	0.53
Nonmusic–other computer activities	−0.72	0.43
Social media–gaming	−0.73	0.32
TV–reading	−0.8	0
Calling–gaming	−0.85	0.27
Online videos–YouTube	−0.86	0.36
Gaming–calling	−0.87	0.3
Reading–nonmusic	−0.89	0.44
Music–TV	−0.95	0.3
Browsing–gaming	−0.96	0.32
Nonmusic–calling	−0.97	0.29
Online videos–gaming	−1.01	0.48
TV–TV	−1.05	0.37
Calling–calling	−1.09	0.29
Gaming–browsing	−1.11	0.4
Browsing–gaming	−1.13	0
E-mail–IM	−1.15	0
Music–music	−1.16	0.44
Nonmusic–gaming	−1.19	0.38
Gaming–e-mail	−1.24	0.24
TV–nonmusic	−1.29	0.24
Online videos–nonmusic	−1.29	0.12
Music–nonmusic	−1.3	0.14
Reading–gaming	−1.31	0.18
Nonmusic–nonmusic	−1.45	0.13
Gaming–other computer activities	−1.48	0.15
Gaming–gaming	−1.57	0.17

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