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Media Multitasking Behavior: Concurrent Television and Computer Usage

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Abstract

Changes in the media landscape have made simultaneous usage of the computer and television increasingly commonplace, but little research has explored how individuals navigate this media multitasking environment. Prior work suggests that self-insight may be limited in media consumption and multitasking environments, reinforcing a rising need for direct observational research. A laboratory experiment recorded both younger and older individuals as they used a computer and television concurrently, multitasking across television and Internet content. Results show that individuals are attending primarily to the computer during media multitasking. Although gazes last longer on the computer when compared to the television, the overall distribution of gazes is strongly skewed toward very short gazes only a few seconds in duration. People switched between media at an extreme rate, averaging more than 4 switches per min and 120 switches over the 27.5-minute study exposure. Participants had little insight into their switching activity and recalled their switching behavior at an average of only 12 percent of their actual switching rate revealed in the objective data. Younger individuals switched more often than older individuals, but other individual differences such as stated multitasking preference and polychronicity had little effect on switching patterns or gaze duration. This overall pattern of results highlights the importance of exploring new media environments, such as the current drive toward media multitasking, and reinforces that self-monitoring, *post hoc* surveying, and lay theory may offer only limited insight into how individuals interact with media.

Introduction

RECENT YEARS HAVE SEEN a fundamental shift in how individuals are choosing to use and consume their media. Current media studies suggest that nearly 59 percent of Americans watch television while also using their computers to access the Internet at least once per month, and the amount of time spent media multitasking in the home grew 35 percent in 2009 alone.[1] Media multitasking is rapidly becoming the modal form of television and computer consumption for children under 18[2]; individuals under 30 already estimate that over 40 percent of their Internet and television usage occurs simultaneously.[3]

As the move from desktop to laptop computers has made it easier for individuals to use both computer and television simultaneously, media multitasking is becoming an increasingly greater issue for computer usage. A large-scale ethnographic study conducted in 2008[4] showed that computers have recently outpaced print and radio media as the second most common medium consumed daily (in terms of duration) after television. Although individuals in the Nielsen Company study spent only 3.1 percent of their time watching television while also using the Internet on a computer, 34 percent of their Internet usage time was spent simultaneously consuming television, an increase of 5 percent from 2008 to 2009. These changes in media consumption are growing increasingly pervasive, and a better understanding of how people consume and interact with media can offer contribution to the media industry, advertisers, and consumer psychology.

Yet even with these growing incidence numbers, current insight into actual consumer media multitasking remains limited outside of self-report studies, with little objective data to illuminate how consumers attend to multiple screens. Although prior academic work has called for further research in the area of simultaneous media consumption,[5,6] most current models of media behavior have been criticized for being monomedia-focused in design,[7] and there remains a strong need for foundational experimental work in this area.[8] As stated in D'Alessio and Allen,[9] "if we want to know what media do to people, it behooves us to figure out what people do with media."

In light of calls in the literature to use observational methods to explore media multitasking behavior, the present

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article uses a laboratory study combining analysis of frame-by-frame video records of naturalistic media multitasking behavior with traditional survey measures to explore how individuals manage simultaneous media consumption. Results address five main questions. First, how do people allocate their attention across multiple screens? Second, does their visual attention differ for computer versus television media? Third, how often do people switch between media? Fourth, do people have good immediate recall of or insight into their media multitasking behavior? Finally, do age or other individual difference variables play a role in driving patterns of media multitasking?

Given the increasing importance of understanding how people multitask in their media consumption, this area has been little explored within the literature. The limited prior media multitasking attention research suffers from methodological limitations of using either using *post hoc* memory based measures on realistic stimuli or real-time measures on abstract and truncated media stimuli. Our real-time video records of visual attention with natural stimuli provide a grounded exploration into media visual attention in multitasking environments that are becoming the modal form of media usage. Our work also illustrates a number of disconnects in media consumption between what individuals are actually doing and what they believe or remember that they are doing.

Background

Work exploring gaze duration suggests that switching between media may be more rapid and frequent than expected. In a study of gaze duration during television viewing, Hawkins et al.[10] showed a strong peak of gazes lasting around 1.5 seconds, with a median gaze duration of under 2 seconds. This would place the majority of gazes into their monitoring (defined as quick glances of 1.5 seconds or less, to confirm prior schematic expectations) and orienting (defined as establishing gazes of 1.5 to 5 seconds, to identify characters and action) categories, both of which feature little active cognition, conscious insight, or depth of processing. This prior work focused on television viewing, however, and it is unclear whether this distribution of gaze durations transfers to computer environments. Media differences can play a large role in shaping media attention; differing genres of television content had stronger effects on gaze duration distributions than individual psychological differences,[11] and prior work has shown how different physical screen sizes generate different levels of attention and arousal.[12] Therefore, previous television findings may not map well onto an entirely different medium such as the computer, much less a multitasking media environment of television and computer.

Prior work also has suggested that direct observation of individuals engaging in multitasking is necessary, as *ad hoc* theories, self-insight, and *post hoc* survey design have shown limited ability to accurately represent multitasking behavior. Work in visual psychology has highlighted that conscious involvement in moment-to-moment visual attention is highly limited,[13] as is conscious insight into perception overall.[14] Research has shown that much of our media consumption is also habitual, automatic, and nonconscious in nature,[15] and many newer models of media selection and consumption raise habit and schema to a level equal to that of conscious thought and choice in driving media behavior.[16] Indeed, individuals keeping real-time diaries of their media consumption underreported their media multitasking behavior by 50 percent[17] when compared with electronic records of their behavior. Self-reports of multitasking expertise also appear to offer little insight into actual multitasking skill or ability, with high multitaskers exhibiting increased distraction by irrelevant stimuli, increased difficulty refocusing after changing locus of attention, and increased difficulty maintaining an organizational structure.[18] Likewise, measures of polychronicity versus monochronicity (i.e., whether one views time as fluid and continuous with a preference for parallel activities or as rigid and segmented with a preference for serial activities) and measures of Type A behavioral patterns (displaying traits such as aggressiveness, impatience, and time urgency) have led to inconsistent findings when applied to multitasking environments.[19,20]

Age, as a particular individual difference variable, is a popular topic in multitasking research, with articles exploring how the brain becomes less flexible with age.[21] Numerous studies[22,23] have established that younger generations are more likely to multitask and use multiple media simultaneously than older generations. At the same time, it is unclear whether generational differences in media multitasking are driven by age-related changes in perception and cognition, or whether they reflect varying adoption rates of different technologies. Recent work suggests the gap between generations may be closing. A European study[24] showed a 75 percent growth in media multitaskers over the age of 55 from 2006 to 2009, and an American study showed that 20 percent of computer usage occurred simultaneously with television usage for people ages 55–64. This, coupled with the mounting evidence that increased multitasking among younger consumers has not led to increases in multitasking ability,[25] suggests that although younger generations may exhibit more frequent multitasking behavior and preference for multitasking, general styles of cross-media multitasking behavior may look similar across generational groups.[26]

Study: Exploring Media Multitasking

To explore media multitasking behavior, an in-depth laboratory study was conducted at a large East Coast university. A naturalistic media environment with a television and a laptop computer was provided for participants, who were recorded with two video cameras. These video records were then analyzed frame by frame for location of participant visual attention to create an objective record of media multitasking behavior. The results were combined with *post hoc* survey responses to explore the five research questions outlined above.

Method

Participants. Forty-two participants (M age = 33.8 years, $SD = 16$; 23 women, 19 men) were recruited on campus. To obtain a wider variance of ages, both students ($n = 20$) and college staff ($n = 22$) were recruited through various campus e-mail distribution lists (student age $M = 19.5$ years SD 1.47, age range 18–22; staff age $M = 46.9$ years $SD = 10.22$, age range 28–65). Participating staff included library workers, administrative assistants, and faculty; participating students were drawn from numerous majors. Students were com-

pensated for their participation with a $10 gift certificate to the campus bookstore or to a major online retailer, and staff were compensated with a $20 gift certificate to either of the same choices.

Protocol. Each participant was run individually through the protocol by two laboratory assistants; the protocol took roughly 45 minutes to complete. Upon entering the lab, participants provided informed consent and completed a presurvey on media habits and demographic information. Participants were then seated at a table with a Windows laptop computer that was turned on and connected to the Internet with a Mozilla Firefox Web browser already open. A 36-in. high-definition television was roughly 5 feet in front of the participant; the television was already turned on and connected to the university cable system. The participants were instructed that they would spend 30 minutes using the computer and television and were notified that they were being recorded on video. They were told to use the computer and television however they wished. The participants were told they had freedom to visit any Web site they wanted or to use any program available on the laptop. Likewise, the television remote was available on the table and the participants could change channels as they wished among the 59 network and cable channels offered. Participants were not, however, allowed to introduce other forms of media to the study, such as cell phones or print media.

The behavior of the participants was recorded at 30 frames per second with two unobtrusive video cameras. One of these cameras was focused on the head and eyes of the participants; because the television was located in a raised position (roughly 5 feet off the ground) relative to the laptop screen (which was at desk level), head and eye movement revealed the locus of participants' attention between the two screens. The second video camera was located behind and to the side of the participant to record the television and Internet content chosen. After the 30 minutes of media usage, the television and laptop were shut down, and the participants completed a postsurvey on the experience.

Video measures. Research assistants transformed the raw videos of participant behavior into data files suitable for analysis. Each frame from the video was coded as to whether the participant was looking at the television, the computer, or (rarely) somewhere else. Switches between these states were also coded. From these, participants' gaze durations were computed. Opening new Web pages on the computer and changing channels on the television were also noted. Although stimulus exposure lasted 30 minutes, video records were truncated at 27.5 minutes to eliminate changes in behavior that might result from the anticipated end of the stimulus presentation.

Survey measures. The presurvey included various estimates of daily media consumption (in hours) and media equipment ownership (in yes/no and counts), as well as demographic questions, and took <5 minutes to complete. The postsurvey included a mixture of Likert scale questions and categorical response questions and took 10 to 15 minutes to complete. Participants were first asked how interesting, exciting, informative, educational, and visually appealing they found the television content and the computer content (7-point Likert scales from Strongly Disagree to Strongly Agree for each attribute). This was followed by estimations of multitasking switching rate (open-ended numerical). Preference for multitasking was measured using a 5-item Likert scale battery adapted from Waller[27] featuring expressions such as, "I am comfortable doing several things at the same time." Measures of Type A personality (adapted from Bortner[28]) and monochronicity–polychronicity (adapted from Lindquist[29]) were also included, as prior work has shown partial support for correlations between these constructs and multitasking behavior. Finally, a battery of questions explored participants' estimates of multitasking behavior in their everyday life (for example, "How often do you listen to music while reading?" as a 7-point scale from Never to Always). For specific survey measure wording, see the survey measures Supplementary Material available online at www.liebertonline.com/cyber.

Results

How do people allocate their attention across multiple screens?

Although respondents did not rate the computer and television content as significantly different on the Interesting (4.28 vs. 5.15), Exciting (3.21 vs. 3.80), or Visually Appealing scales (4.13 vs. 4.56, all ns, $p > .19$), the video record revealed that the computer dominated the television for visual attention. Participants spent 68.4 percent of their time attending to the computer (on average) and 30.6 percent of their time attending to the television (see Table 1, binomial probability test versus 50/50 attentional split significant at $p < 0.0001$); 78.6 percent of participants spent more than half of their time on the computer. This is echoed in their presurvey measures of everyday media consumption, with participants estimating 4.15 hours spent online per day versus only 1.64 hours spent watching television, paired-samples $t(41) = 6.36$, $p < 0.001$. This is also echoed in the amount of direct interaction with the media observed: participants visited an

Table 1. Participant Media Attention Summary

	n	*Mean age*	*Mean time on computer, minutes*	*Mean time on television, minutes*	*Standard deviation*[a]	*Percent of participant time on computer*	*Percent of participants computer dominant*
All participants	42	33.8	18.8	8.4	7.2	68.4	78.6
Students	20	19.5	18.6	8.6	6.7	67.6	75.0
Staff	22	46.9	19.0	8.3	7.8	69.2	81.8

[a]As time on computer and time on television represents over 99 percent of visual attention during the study, standard deviations for the two measures are essentially identical.

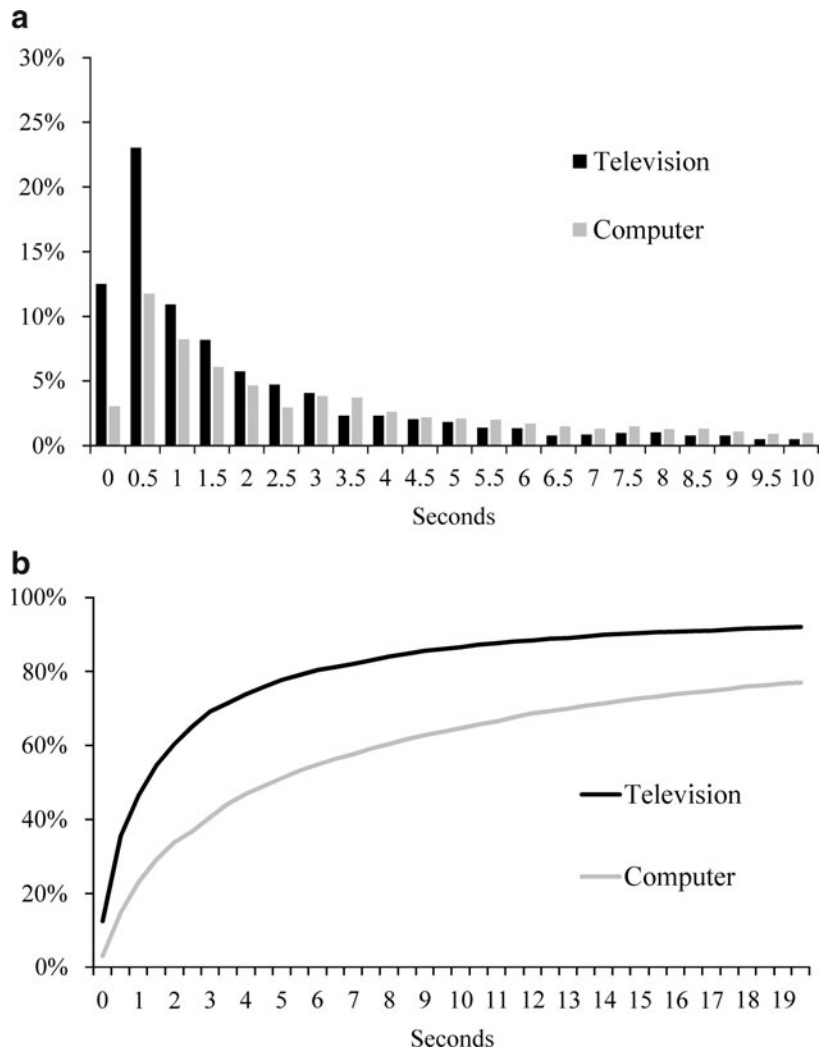

FIG. 1. **(a)** Distribution of gaze durations. **(b)** Cumulative distribution of gaze durations.

average of more than 12 new Web sites (and 29 new Web pages) during the study but engaged in only five channel-changing episodes, paired-samples $t(41) = 6.85$, $p < 0.001$.

Does visual attention differ for the computer versus the television?

The nature of gazes is different between the television and computer, with television capturing considerably shorter gazes than the computer (see Fig. 1a, b). Although both gaze length distributions followed a roughly log-normal pattern (matching the television findings of Burns & Anderson[30]), the distributions were significantly different (Mann-Whitney $Z = 18.91$, $p < 0.001$; Kolmogorov-Smirnov $Z = 8.07$, $p < 0.001$). The computer gaze distribution was considerably stretched out in comparison to the television gaze distribution. For the television, 46.2 percent of gazes were <1.5 seconds, with 75.8 percent of gazes lasting <5 seconds and 86 percent lasting <10 seconds. These numbers match quite closely with the short gaze benchmarks established for television content in Hawkins et al.[10,11] Although gazes on the computer were also heavily biased toward shorter looks, their distribution was more dispersed: 22.6 percent of computer gazes were <1.5 seconds, 49 percent were <5 seconds, and 64.5 percent were <10 seconds. Compared to television, computer attention also had a larger portion of extended gazes: 7.4 percent of gazes to the computer lasted longer than 60 seconds, whereas only 2.9 percent of television gazes broke the 1-minute barrier. Although these extended gazes were few in number, they constituted a significant portion of actual time spent on media, with 54.9 percent of computer time versus 47.9 percent of television time spent in gazes of longer than a minute.

How often do people switch between media?

Video records reveal that participants switched between media at an extremely high rate, averaging 120 switches in 27.5 minutes. This is reflected in a median gaze length of only 1.77 seconds for television gazes and 5.3 seconds for computer gazes. Media dominance, defined as whether the participant spent more time on the computer or the television, had little effect on switching frequency; there was no significant difference in the overall amount of switching behavior exhibited by television-dominant participants ($M = 109$

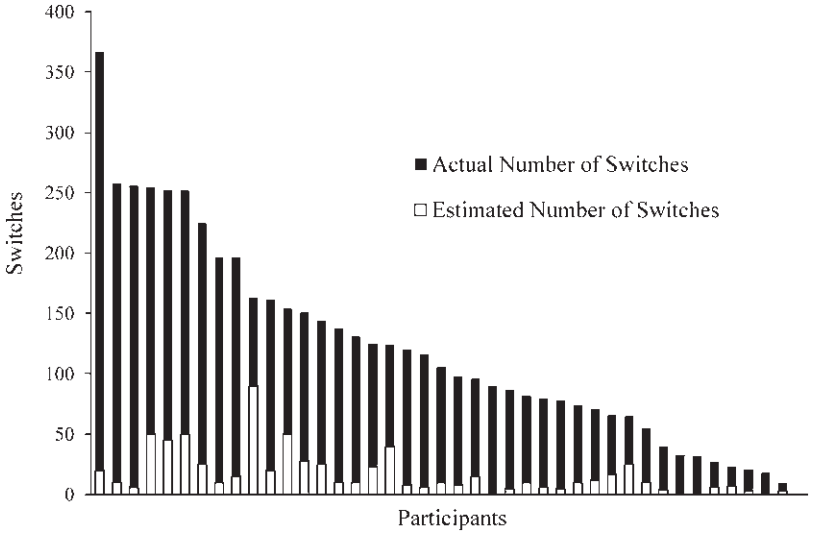

FIG. 2. Actual switches of gaze versus estimated switches of gaze.

switches) versus computer-dominant participants ($M = 123$ switches), $t(40) = 0.438$, $p > 0.60$. Examining the number of frames spent on the computer versus the television also yielded no significant predictive effect on the total number of switches (regression $F = 1.35$, $p > 0.25$). This high number of switches was only partially explained by quick "monitoring" glances toward the other medium; when switches that happen within 1.5 seconds of other switches are removed, participants still average 73 switches. Surprisingly, participants' switch rates and gaze durations did not change over the course of the study; regressing gaze duration on the timecode for that gaze yielded no significant effect, and breaking the study duration into 10 equal-length blocks of 2.75 minutes showed no significant difference in amount of switches, mean, or median gaze duration across the blocks.

Do people have good insight into their own media multitasking behavior?

Participants significantly underestimated the amount of switching that they do (Wilcoxon Signed Ranks Test $Z = 5.58$, $p < 0.001$). The mean number of survey-reported switches was 14.8, which is 12.3 percent of the actual amount of switching taking place (see Fig. 2 for a comparison of estimated to actual switches across participants). Although estimated switches were a significant predictor of the actual number of switches (regression $F = 13.254$, $p < 0.01$), the R^2 was not strong at 0.235, and the average individual underestimated his or her switching behavior by 103 switches. Indeed, out of the pooled 5,082 gazes across all participants, only 98 gazes (1 percent of television gazes and 3 percent of computer gazes) lasted longer than 2 minutes, the mean duration of gaze that would be necessary to make the participant estimated switching rate of 14.8 per 30 minutes feasible.

Personal recollections of everyday media usage also had little bearing on the observational measures of media consumption. Estimated hours spent watching television per day, estimated hours spent on the computer per day, estimated percentage of computer use while watching television and television use while using the computer, and estimated percentage of truly mixed media usage had no significant predictive effect on the number of switches between media, pattern of gaze duration, or the ratio of computer to television viewing observed in the study (all three regression Fs < 1.5, ps > 0.30).

Do age or other individual difference variables impact media multitasking behavior?

Comparing student to staff participants can provide insight into age-based differences in multitasking behavior. Students reported enjoying multitasking in general more than staff (5.68 vs. 4.50), $t(40) = 2.18$, $p < 0.05$, and also reported that they felt more effective at multitasking in general (5.10 vs. 4.01), $t(40) = 2.06$, $p < 0.05$. In addition, students scored higher on both the Type A measure (5.03 vs. 3.64) and the polychronicity measure (5.00 vs. 3.94, both differences significant at $p < 0.05$). Survey results indicated that students estimate 46.28 percent of their media is consumed simultaneously with a second media source, whereas staff estimate only 22.73 percent of their media is simultaneously consumed [$t(40) = 2.91$ $p < 0.01$]. Do these differences in general media preferences result in differences within the study environment?

Comparing gaze length distributions revealed significant differences between students and staff (Mann-Whitney $Z = 6.74$, $p < 0.001$; Kolmogorov-Smirnov $Z = 2.93$, $p < 0.001$). Students switched significantly more often than staff between the media (144 vs. 98), $t(40) = 2.26$, $p < 0.05$ (see Fig. 3), and had shorter gazes overall than staff, with a median gaze duration of 2.3 seconds versus 3.1 seconds for staff. The difference between students and staff was strongest for short-duration gazes, with 40 percent of student gazes lasting <1.5 seconds compared to 32.6 percent for staff gazes ($Z = 5.72$, $p < 0.001$); this difference decreased steadily across time. Although both students and staff strongly underestimated the amount of switching taking place, regressing actual switches on estimated switches appeared stronger for students ($R^2 = 0.32$, $F = 9.489$, $p < 0.01$) than for staff ($R^2 = 0.21$, $F = 6.23$, $p < 0.05$). Other measures, however, showed few differences between age groups. Students and staff exhibited similar levels of computer attention within the study (67.6

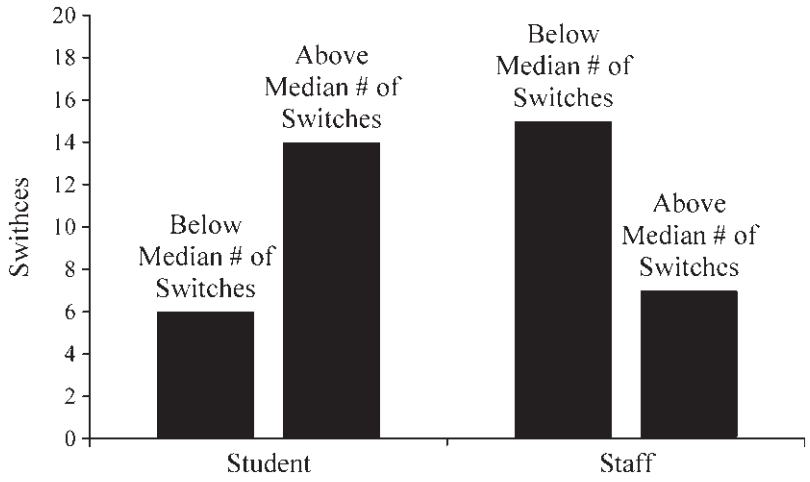

FIG. 3. Age and switching behavior.

percent vs. 69.2 percent, *ns* $p > 0.55$), and students and staff did not significantly differ on the number of channels changed (4.55 vs. 5.36, $p > 0.70$) or the number of Web sites opened (12.35 vs. 12.41, $p > 0.75$). These results suggest that switching rates may decrease with age, but interaction within a particular media and the overall allocation of attention across media might not vary highly across age groups.

Echoing the mixed results of their use in prior multitasking studies, neither the Monochronicity-Polychronicity index nor the Type A Personality index had any effect on the amount of switching taking place, media dominance, or accuracy of switch rate recollection. Gender also had little effect on the overall amount of switching taking place (male = 116 vs. female = 123; $t = 0.251$, $p > 0.75$). Participants' Preference for Multitasking index weakly but significantly predicted their actual number of switches ($R^2 = .115$, $F = 6.309$, $p < 0.05$) as well as their reported number of switches ($R^2 = .085$, $F = 4.73$, $p < 0.05$) but did not significantly predict the accuracy of their switching prediction or their level of computer dominance.

Discussion

Results of an experimental study recording media multitasking behavior show that individuals switch their attention between media at a high rate, averaging 120 switches per 27.5 minutes of media multitasking. Participants spent roughly two-thirds of their time attending to the computer rather than the television, and the average duration of a gaze on the computer was far longer than the average gaze on the television. The majority of gazes for both media, however, were quite short, with 78 percent of television gazes and 49 percent of computer gazes lasting <5 seconds.

Comparing participants' survey record of their behavior with the objective behavior revealed large differences and a drastic underestimation of media switching behavior, suggesting that individuals lack the ability to recall much of their media multitasking behavior. Even when very short glances were removed from the analysis, participants still underestimated their switching behavior by a factor of five. Younger participants switched more frequently than older participants, but beyond an increased switching rate, age or other individual difference variables had little effect on the patterns of results.

Limitations

While the present study uses real-world media stimuli for a realistic study environment, the experimental design also places a number of necessary limitations on the implications and extensibility of the results. Note that the current study limits participants to the computer and television; they were not allowed to use their cell phones or consume printed material. Media multitasking is certainly not limited to binary consumption environments, and switching patterns and gaze durations could appear quite different with further degrees of media splintering. Participants also completed the study alone, whereas much of modern media consumption takes place in social contexts. Further work must be undertaken to explore how the role of others and social settings might change media multitasking consumption patterns. Also, while the current study provides insight into the allocation of visual attention, we cannot immediately extrapolate to higher-order cognitive structures, and future work is needed to build predictive causal models based on content or explore the effects of multitasking onto subsequent content memory.

Implications and Future Directions

The brevity of gaze durations on both computer and television content in this multitasking environment suggests a fracturing of attention with rapid attentional shifts and reorientation; both media seem to have limited ability to "hook" a participant into extended runs of attention. Television attention is especially composed of very quick gazes overall, supporting the contention that much of television viewing is automatic and involves little cognitive effort or attention.[31] While this may be partially due to the distracting nature of the highly interactive Internet media that is simultaneously presented, it is interesting how closely attention to television in this current multitasking study matched the distributions and hazard rates of gaze durations found in the Hawkins et al.[11] work exploring television attention in a natural setting without the Internet present. Although computer content received longer gazes compared to television content, computer attention was still heavily biased toward very short gazes, with nearly 50 percent of gazes lasting <5 seconds and with only 7.4 percent of gazes lasting longer than 1 minute.

This suggests we need to further examine the common assumption that the more interactive and involving nature of Internet media can more effectively capture attention:[32] An individual's gaze leaves the computer screen quite frequently, and extended gazes are rare.

That participants underreported their switching behavior so drastically echoes recent work in the applied multitasking field that illustrates how individuals tend to overestimate their multitasking ability and how heavy multitaskers are more prone to distraction. Participants have little ability to recall their moment-to-moment visual attention in multimedia environments, and indeed much of their visual attention is confined to short monitoring and orienting looks involving little conscious involvement or deep processing. The results of this study indicate that even surveys taken immediately following multitasking behavior can be unreliable indicators of actual switching behavior and that *post hoc* or reflective data methods must be used with care when studying media attention or multitasking issues. This reinforces prior work suggesting that people have little self-insight into multitasking behavior, and it also highlights the nonconscious, and habitual nature of much of media consumption.

One area for future work would be to explore the interplay between internally driven media switching, created by the participant's cognition, affect, or behavioral impulses, and externally driven media switching, created by stimuli and cues in the media environment. Does the mere presence of media alternatives create a "pressure" to switch attention? Are there any inherent rhythms to this internal pressure to switch if it exists? Are there characteristics of certain users or media programming that might consistently inspire increased attentional capture or extended gaze durations? Our preliminary explorations using Fast-Fourier Transform analysis to uncover underlying frequencies of switching across participants independent of media content did not yield significant results, but future work might isolate and explore internal versus external switching triggers and drivers of gaze duration.

The current study simulated a common home scenario where one is engaging in general Internet behavior while watching television. It would also be of interest to explore how behavior may change in more explicitly goal-driven environments, or environments where media can be explicitly categorized as primary and secondary. Does someone working on a specific task, such as a homework assignment, exhibit similar media-switching patterns as an exploratory media multitasker? Likewise, would the pattern of results change for someone watching a particularly cherished television show versus casual television viewing? The role of goals within media multitasking could yield fruitful insight into media multitasking behavior.

Finally, future work might create an experimenter-controlled subset of content choices for each medium, to explore how switching between media affects comprehension and retention for stimuli presented. Given that prior work exploring single-screen multitasking has shown large impacts on completion time but not comprehension for self-paced media,[33] how severely do switching costs and the attentional bottleneck across multiple screens impact overall media comprehension? And does television audio information help overall retention of television content while interfering with retention of simultaneously consumed computer-based media?

Conclusion

This work provides an initial objective exploration into media multitasking behavior and how individuals split their attention across computer and television media content. Video results of an experiment where participants used computer and television media simultaneously showed that the computer screen received the majority of attention during media multitasking, averaging nearly two-thirds of visual attention. Gazes on computer content trended longer than gazes on television content, but gazes on both media were very short overall. Only half of visual attention took place during media gazes longer than 1 minute, and more than 75 percent of television and 49 percent of computer gazes lasted <5 seconds. Switching between media was rapid and frequent, with individuals averaging 120 switches per 27.5 minutes. Individuals have little awareness or memory of their switching behavior, underestimating their switching behavior by 88 percent. Although younger participants switched more often and featured somewhat shorter gazes overall, other individual differences presented few effects in multitasking behavior. These findings highlight the importance of direct observation and exploration of media multitasking behavior and illustrate the changing ways consumers are using and consuming media in their lives.

Disclosure Statement

No competing financial interests exist.

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