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Media multitasking: How visual cues affect switching behavior

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ABSTRACT

As media multitasking becomes the most common form of entertainment consumption, foundational research is needed to explore actual patterns of multitasking behavior. This work uses direct observation to provide better insight into media multitasking, exploring visual cues that encourage or discourage switching. A first eyetracker study recorded consumer reactions to simultaneous television and webpage media coded on numerous content variables. Consistent with differences between peripheral and central vision, results show that lower-level visual cues (such as motion) were more effective at creating switches towards content, while higher-level perceptual cues (such as faces) were more effective at discouraging switches away. A second naturalistic study observed participants using a computer and television simultaneously, and established that media switching is rapid and constant. Breaks between show-to-commercial or commercial-to-show, or moving between webpages, led to increased switching in the seconds immediately following. Unlike lay theory, both show and commercial onsets favored towards-computer switches, further highlighting the importance of multitasking work that records and establishes baseline behavioral patterns.

1. Introduction

Recent years have seen a fundamental shift in behavior as consumers simultaneously consume multiple media sources. Multitasking is becoming the default method of media consumption; Deloitte (2016) reports that 92% of respondents simultaneously consume other media content while watching TV, and 33% "almost always" browse the web while TV viewing. Media multitasking is not confined to commercial breaks: recent research from Millward Brown (Cohen, 2014) had 73% of respondents multitasking "constantly" during television viewing. Single screen multitasking is also increasing, with larger computer monitors enabling consumers to access simultaneous media streams, tablets adding split-screen multitasking at the OS level, and larger phones offering pop-out media players that overlay video content above other applications (Yeykelis, Cummings, & Reeves, 2014).

Yet there is little research that explores how consumers directly engage in media multitasking. Most literature focuses on the effects of multitasking (Wang & Tchernev, 2012; Chang, 2017), or individual predictors of multitasking behavior (Magen, 2017; Sabonmatsu, Strayer, Medeiros-Ward, & Watson, 2013). Work exploring how consumers actually consume media simultaneously, and how media cues shape multitasking behavior, is rare (Jayasinghe & Ritson, 2013). Most multitasking research uses surveys and self-report measures rather than direct observation which forces results into a cognitive frame. This makes it difficult to form an accurate picture of behavior when actual moment-by-moment media multitasking is likely sensory, and largely nonconscious. In addition, multitasking research that was largely spurred by research in task-driven educational contexts frequently defines media multitasking as across-medium (i.e. multiple media platforms such as print-plus-television, radio-plus-video, or computer-plus-television), when a more relevant definition may focus on simultaneous content consumption for varying tasks, regardless of the number of screens employed.

The present work explores actual media multitasking behavior, contributing to an understanding of how various visual switch cues and changes in media context can encourage or discourage media switching. A first study explores how differences in central versus peripheral vision might cause certain cues to encourage switching towards, or discourage switching away from, various media sources. A second study highlights how "breaks" in media, such as moving from show to commercial, shape consumer switching.

While results are exploratory and further work is needed to

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establish the extensibility of these switching patterns to alternative media contexts, the disconnect between these observational findings and common lay theories of multitasking behavior reinforce that more research into multitasking behavior is warranted. These results provide a foundation to better understand multitasking behavior, and highlight the importance of sensory data when exploring consumer multitasking (Krishna, 2012).

2. Media multitasking theory

Most multitasking work focuses on outcomes such as education and learning (Lee, Lin, & Robertson, 2012; Loh, Tan, & Lim, 2016; Rosen, Carrier, & Cheever, 2013; Shin, An, & Kim, 2016), ad and media processing (Voorveld, 2011; Chinchanachokchai, Duff, & Sar, 2015; Oviedo, Tornquist, Cameron, & Chiappe, 2015), or cognition and task performance (Alzahabi & Becker, 2013; Kazakova, Cauberghe, Pandelaere, & DePelsmacker, 2015). Another stream has explored multitasking inputs: whether individual differences can predict who might be heavy multitaskers (Bardhi, Rohm, & Sultan, 2010; Duff, Yoon, Wang, & Anghelcev, 2014) with a common focus on how multitasking corresponds with polychronicity and self-monitoring (Srivastava, Nakazawa, & Chen, 2016; Kononova & Chang, 2015).

Prior work acknowledges that simultaneous media usage is increasing and calls out for further research (Pilotta & Schultz, 2005; Jäckel and Wollscheid, 2007), but most models of media behavior explore a single media stream in isolation (Pilotta, Schultz, Drenik, & Rist, 2004). Yet a number of multitasking effects from psychology may not map to multitasking behavior in entertainment contexts. Moment-to-moment visual attention receives little conscious direction (Belopolsky, Kramer, & Theeuwes, 2008), and media consumption is largely habitual and automatic (LaRose, 2010; Saling & Phillips, 2007). Self-report measures such as surveys and diaries can be suspect as recreational media behavior is frequently nonconscious and easily forgotten (Jordan, Trentacoste, Henderson, Manganello, & Fishbein, 2007), and observational research suggests that self-report media multitasking measures bear little relation to actual behavior (Brasel & Gips, 2011), with stated multitasking strategies not mapping onto observational data.

While research has begun to explore cognitive and affective motivations behind media multitasking (Hwang, Kim, & Jeong, 2014), consumers show little self-insight into their own multitasking ability (Ophir, Nass, & Wagner, 2009), and changes in processing mindset can affect how information such as ads are perceived in multitasking environments (Duff & Sar, 2015). Environmental variables may have large effects on what is a largely automatic behavior (Bargh & Chartrand, 1999), highlighting the need for direct observation, and suggests that cues within media might drive multitasking somewhat automatically, beyond conscious control.

2.1. Vision and content

Visual attention is selective, with top-down and bottom-up cues altering the activation potential of areas in the visual salience map (Beck & Kastner, 2009). In addition, perception differs between central and peripheral fields of vision (Hoffman, 1998). Central vision is high-resolution, colored, and capable of advanced perception (Wilson, Levi, Maffei, Rovamo, & De Valois, 1990), but encompasses less than three degrees of the visual field (about 1.25 inches diameter at computer viewing distances, and 6.5 inches at television distances). Vision beyond five-degrees off center is peripheral (Loschky, McConkie, Yang, & Miller, 2005; Rayner, 1984): low-resolution, largely colorless, and concerned with low-level visual information (Drasdo, 1989; Strasburger, Rentschler, & Juttner, 2011). Due to the preponderance of cone photoreceptors, peripheral vision especially focuses on movement, luminance shifts, and edge detection. In order for something in peripheral vision to cause an attentional shift, these low level visual cues must be activated; peripheral attentional shifts are largely automatic and outside of conscious control (Lambert, Naikar, McLachlan, & Aitken, 1999; Van der Stigchel et al., 2009).

This suggests that higher-level visual cues and cognitive strategies may not drive media switching behavior, and instead low-level cues in a non-attended media create switching as they break through the peripheral vision signal floor. In contrast, once attention is already on a media, higher-level visual cues may serve to discourage switching away. This effect may be elevated in media multitasking environments, as visual saliency biases are stronger when choices are made rapidly and under cognitive load (Milosavljevic, Navalpakkham, Koch, & Rangel, 2012).

Due to these differences between central and peripheral vision, we argue that visual cues that *encourage* switching to a different media must engage peripheral vision, as central vision will be occupied with the current media being attended to. In contrast, cues that *discourage* switching can engage central vision, as visual attention would already be on the media. The first study explores how low versus high level cues can alter switching using specific controlled stimuli that allows for frame-by-frame coding of visual information. Note that the current work focuses on visual cues; audio may certainly drive switching behavior, but a better understanding of visual factors will provide a foundation on which future work can be built.

3. Study 1

3.1. Methods

40 students (60% female, $M_{age} = 20$) were run individually in an eyetracker lab and compensated with a $10 gift certificate; three were removed due to gazepoint tracking errors. Once participants completed informed consent, they were seated at the eyetracker (an ASL6000 desktop-mounted 60hz infrared system). To utilize the eyetracking system all stimuli had to be displayed on a single 19″ widescreen monitor "splitscreen," with the television content on the left and the web browser on the right; participants were seated 22 to 26″ from the monitor. A custom program prevented participants from accidentally disabling or moving the windows.

The television content was a custom-edited version of the BBC program *The Secret Life of Birds*, condensing a 60-min episode into 24 min, with three inserted 90-s commercial breaks collected from 15 h of television (including common brands such as Pizza Hut and Toyota) to simulate a traditional American program. The web content was a Spring Break travel planning website with information on destinations in Jamaica, Cancun, the Caribbean, and Mexico, with banner advertisements displayed above and below the content. Participants were told they would be shown a website and television program, and were given no specific goal or task to accomplish. Participants were free to explore the multiple pages of the website at their own pace in any order they chose. The order of mentioning the two media in the basic instructions given was alternated across participants to prevent the chance of a consistent bias towards the first-mentioned media.

3.2. Measures

The television program was coded frame-by-frame on a series of variables. Hundreds of possible visual cues were present due to the natural stimuli. Four low-level cues (left/right motion, motion towards camera, camera cut, strong luminance shift) and four high-

level cues (human present, animal present, human face present, text present) were selected. Once individual frames were coded, it was collapsed into 3-s blocks for analysis (3 s being previously used in research such as Anderson, Alwitt, Lorche, & Levin, 1979); for each block the presence or absence of each of the variables was recorded. For "point-event" cues such as camera cuts that do not have a temporal component the block containing them was marked; for "over-time" cues such as motion or the presence of a face the sequence of blocks containing the cue was marked. Then, each participant's eyetracker data was examined to see whether they were attending to the television content, web content, or whether a web-to-television or a television-to-web switch had occurred.

3.3. Results

3.3.1. Television versus web attention

A map of attention supports two clear dispersions for television and web gazepoints, reinforcing that the media were treated separately even though they shared one screen (see Fig. 1). The clear "trough" in visual attention between the two media supports that the media not currently being attended to would lie in peripheral vision; participants were not centering their vision on the screen and attempting to use central or parafoveal processing to attend to both media simultaneously. The web content captured 63.3% of visual attention on average while occupying 56.3% of the visual space, the television content captured 36.7% of visual attention while covering 43.8% of the visual space. This reinforces prior work that suggests that web content can frequently serve as the primary medium in multitasking scenarios.

3.3.2. Overall switching rate

Participants switched between the media an average of 224 times across the 24 min. This is higher than prior dual-screen multitasking data (Brasel & Gips, 2011); monitoring glances may be easier in single-screen multitasking and the close proximity of the two media may make peripheral switch cues easier to detect. Switching rates in minutes containing commercials were not significantly different than switching rates during minutes containing show programming, and switching did not significantly increase or decrease in a linear, quadratic, or cubic fashion over the duration of the program.

Most switches represented short "glances" of attention; 75.3% of web-to-television switches and 83.6% of television-to-web switches occurred within 2 s of a prior switch. Indeed, extended duration attention was rare, with only 4% of television looks and 11% of web looks lasting over 30 s. This suggests that in this media scenario the majority of visual attention in multitasking environments were "orienting" and "monitoring" looks (Hawkins et al., 2005), with few "engaged" looks (>5sec) that are necessary for deeper semantic processing. Still, even if all "glance" switches are removed, participants averaged 2.5 switches per minute.

3.3.3. Content switch cues

To explore how media cues drive switching, the incidence of 3 s blocks containing a cue within the overall program was compared to the number of blocks containing switches both towards and away from the television for each cue. So, for example, "motion-towards-camera" may occur in 5.6% of all blocks, but be present in 17% of blocks with switches from web-to-television (i.e. over-represented), and only 2% of blocks with switches from television-to-web (i.e. underrepresented). Chi-Squares suggests a significant difference between the distribution of blocks and the distribution of switches in either direction (ChiSquares > 100, *ps* < 0.01 for both), with absolute adjusted standardized residuals greater than 2 for all 4 low-level cues in the web-to-television switches and all 4 high-level cues in the television-to-web switches. A pattern quickly emerges (see Table 1):

Consistent with peripheral vision, low-level visual cues create switches towards the television when the participant is on the web content, featuring two to four times as many switches as their occurrence in the show would predict. These low-level cues, however, are not as strong in their ability to hold attention if it is already on the television. In contrast, higher-level cues show

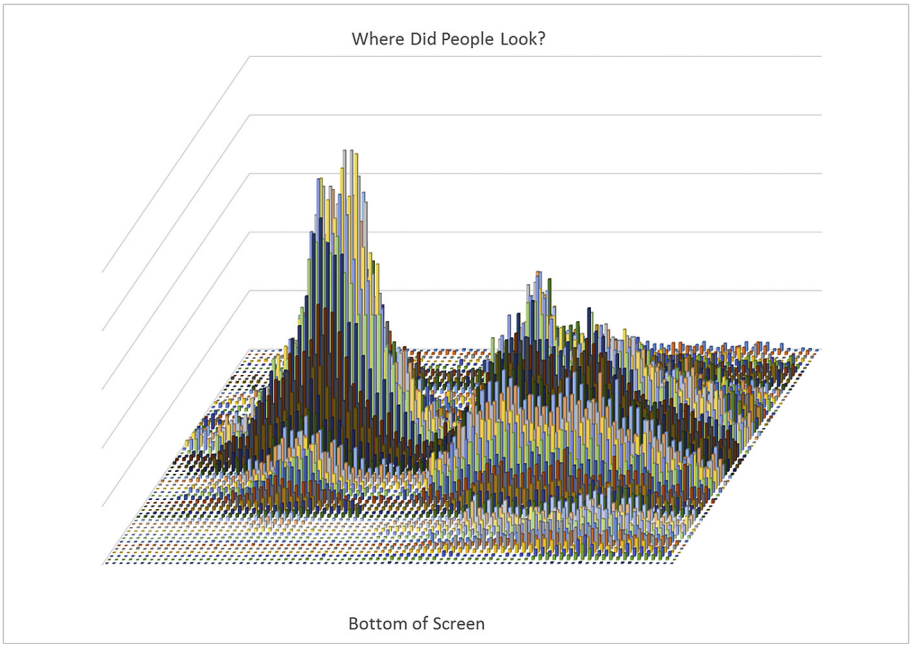

Fig. 1. Overall Gaze Distribution for Study 1. Note: Television content was displayed centered vertically on the left part of the monitor, while web content was presented on the right. The vertical trough in the visual distribution represents the border between the television and web content.

Table 1
Study 1: Visual cues as drivers of media switching behavior.

Cues in 3 Second Blocks of Television Show	Ratio of Web-to-Television Switch Blocks to Blocks Containing Cue	Ratio of Television-to-Web Switch Blocks to Blocks Containing Cue
Low-Level		
Motion Left or Right	2.10	1.05
Motion Towards Camera	3.03	0.46
Cut to Black or White	3.52	1.47
Color Brightness Shift	2.84	1.11
High-Level		
Human	1.61	0.45
Animal	1.16	0.70
Face	1.50	0.53
Text	1.29	0.85

Note: Values higher (lower) than 1 indicate conditions where switching is more (less) frequent than normal. Logistic regression supports that Low-Level cues are significant positive predictors of web-to-television switches, while High-Level cues are significant negative predictors of television-to-web switches.

reduced ability to trigger switching towards the television in comparison to the low-level cues, but consistently suppress switches away from the television, with half the switch-away rate as their occurrence in the show would predict.

This is reinforced in binary logistic regressions for web-to-television switches and television-to-web switches. In both cases, the model significantly outperforms the cue-free baseline model (hit rate increase of 22% for web-to-television and 16% for television-to-web over baseline, ChiSquare $df_{(7)} > 16$ $p < 0.05$ for both). In the web-to-television switch model, the four low-level predictors all have significant and positive betas, in addition to the high-level face cues ($\beta s > 0.21$, Wald $ps < 0.05$). In the television-to-web switch model, the four high-level predictors all have significant and negative betas, in addition to the motion-towards-camera low-level cue ($\beta s < -0.16$, $ps < 0.05$).

4. Show-versus-commercial multitasking and media break points

This pattern of results reinforces that low-level visual cues are effective at encouraging switches towards a media while high-level visual cues inhibit switching away. This is consistent with differences between central and peripheral vision, and confirms that peripheral cues serve as strong multitasking triggers. Yet Study 1 used a single television program and a single webpage sharing a single screen, which suggests more research is needed to explore multitasking patterns in more flexible and naturalistic settings. Two findings from Study 1 seem especially relevant to explore further as the focal lens moves to one where participants can choose their programming at will while multitasking. The low level visual cue of a cut to black or white (most commonly seen at a break between content such as going from show-to-commercial or vice versa) had a very strong effect on multitasking behavior, suggesting that media breaks deserve further exploration. Also, the finding that the minutes with commercial content did not have significantly different switching patterns than the minutes containing show content seems to run counter to conventional wisdom, and deserves further follow-up.

First, structural factors and situational variables may explain more of media behavior than stable individual audience factors (Webster & Wakshlag, 1983; Hawkins, Pingree, Bruce, & Tapper, 2005); even contextual variables such as genre and time of day influence multitasking frequency (Voorveld & Viswanathan, 2015). A critical factor is scene changes (Geiger & Reeves, 1993); scene changes break attentional inertia (Anderson & Burns, 1991), and camera/scene cuts or the onset of various media types elicit arousal (Lang, 1990). These “break points” signal to re-establish the visual salience map and re-focus attentional resources, so breaks between show and commercial or vice versa may serve as key contextual multitasking triggers. But break-points in media are not limited to television; website usage often moves through a series of pages (Wang & Day, 2007). Each page change within a website, as well as changes between websites, can serve as a break-point similar to a television context change, and might encourage switches in a similar manner.

Second, a common assumption is that switching is elevated during commercial breaks as consumers shift attention off the television to avoid having to process commercials (Bardhi et al., 2010); consumers are more motivated to watch the show in comparison to advertising (Gupta & Lord, 1998; Thorson & Zhao, 1997; Van Reijmersdal, 2009). Indeed, knowledge that media is attempting to persuade the viewer (such as commercials) can affect third-perception perceptions and change persuasion knowledge (Ham & Nelson, 2016). As scene changes have been shown to stimulate alpha brainwaves analogous to increased attention (Reeves et al., 1985), switching during commercials may also increase due to the elevated number of camera cuts when compared to show programming (MacLachlan & Logan, 1993). Prior work has established that vision moves away from the screen during commercial breaks (Krugman, Cameron, & White, 1995), and work on second-screen applications suggest higher engagement with secondary media during commercials (Holmes, Josephson, & Carney, 2012).

To explore the effects of show-versus-commercial on the television and the effects of break-points in both media, a re-analysis was conducted of a study using unobtrusive video observation (Brasel & Gips, 2011). The only overlap in analysis (noted below) is the exploration of overall switching rates and whether television- or web-dominant individuals differed in switching patterns. This further allowed for a naturalistic study environment where web and television could utilize separate screens, and also allowed a test of the lay theory that the onset of commercials triggers switches towards the web, while returning to the show triggers switches back to the television.

5. Study 2

5.1. Methods and measures

Forty-two participants ($M_{age} = 34$, 55% female) were recruited on campus; both students ($N = 20$) and staff ($N = 22$) were included to obtain a wider range of age and multitasking experience (age does not have significant effects in the analyses presented here so is not discussed further). Students were compensated with a $10 gift

certificate, staff with a $20 certificate or a charity donation. Each participant was run individually. After completing informed consent and a pre-survey on media habits and demographics, the participant was seated at a table with a laptop, web browser already open. A 36-inch HDTV was five feet in front of the computer on a raised stand; the television was on and connected to cable TV. Participants were told they would have 30 min to use the computer and television however they wanted, and they would be recorded on multiple video cameras. The participant was free to visit any website and could use the remote to change television channels as they wished.

Two video cameras recorded participant behavior. A camera located beneath the television recorded the participant's face, revealing whether attention was on the computer or television. A second camera behind the participant recorded both screens. The feeds were synchronized and analyzed frame-by-frame (30fps); the record was truncated to 27.5min to control for participant behavioral changes that might result from anticipating the study ending. Each frame was coded as to whether the participant was looking at the laptop, the television, or "other," and whether the television was displaying show or commercial content. Visual switches between media were recorded on the frame they began, and frames where media "breaks" such as channel changes, website changes (either new pages within a website or changing to a new website), and program changes (show to commercial, commercial to commercial, or commercial to show), were marked. In addition, 5 s following each of these media changes were also marked, as many media signals may have a time-lag before consumers react.

5.2. Results

5.2.1. Overall visual attention

Consistent with Study 1, participants spent an average of 68% of their time attending to the laptop and 32% on the television. This is reflected in participant-driven breakpoints, with an average of 12.4 website changes and 5 television channel changes. As shown in Brasel and Gips (2011), switching between media was rapid, averaging of 120 switches across 27.5min. Similar to Study 1, when "glances" are removed 73 switches on average remain, nearly three switches per minute. This switch rate is slightly higher, but in the same general range as, the 2.5-per-minute switch average found by Segijn, Voorveld, Vandeberg, and Smit (2017). Switch incidence was not significantly different between television dominant (>65% of attention on television), web dominant (>65% attention on web), and balanced participants. Histograms of switch duration support a similar pattern to study 1, with extended gazes on both media being quite uncommon, and the majority of gazes lasting less than 5 s (see Figs. 2 and 3).

To explore the effect of context and media changes on switching, the distribution of switches across context states was compared to the distribution of frames (for example, the "first 5 s of commercial" context contains 0.78% of frames, but 1.66% of switches, see Table 2). A significant mismatch occurred for both television and web contexts for switches versus frames (Chi-Square$_{(6)}$ = 905.54 $p < 0.001$ for television, Chi-Square$_{(5)}$ = 255.46, $p < 0.001$ for computer, see Table 2). Residuals reveal that the first 5 s of show, first 5 s of commercial, and first 5 s of a new webpage have far more switches than would be expected from a distribution that followed the frame distribution.

To explore further, frame-by-frame data was grouped into 5-s blocks across the duration, recording which media the participant was attending to, the media context, break points that occurred, the amount of switches (if any), and switch directions (if any) during the block.

5.2.2. Break points and switch prediction

39% of blocks at the beginning of a show segment (when a show returns from a commercial break) contained a switch compared to 24% of blocks after the first 5 s (t = 3.87, $p < 0.01$). Similar to the beginning of a show segment, 40% of blocks at the beginning of a commercial segment generated switching (versus 15% in other blocks, t = 6.79, $p < 0.001$). New webpages also generate switches: 28% of blocks following a new webpage contain switching while only 18% of other blocks do (t = 2.83, $p < 0.01$).

When media context and break point presence is used as predictors in a pair of logistic regressions for switching behavior (one for switches to television, one for switches to computer), both models significantly outperform the cue-free baseline model (hit rate increase of 19% for web-to-television and 21% for television-to-web). In the web-to-television switch model, both show and commercial television break points have significant and highly positive betas (βs > 0.24, Wald ps < 0.05), showing that the onset of either show or commercial creates switching towards the television if the participant was on the web, while new webpage break points have no significant effect on web-to-television switches. Both television break points are significant switch predictors in the television-to-web model as well (βs > 0.36, ps < 0.01), and new webpage breakpoints are also a significant positive predictor ($\beta = 0.42$, $p < 0.01$). So show-to-commercial breaks, commercial-to-show breaks, or new webpages *all* create switching behavior toward the web if the participant was on the television.

These results suggest that lay theory of "people switch away from the television when commercials start, then switch back when the show returns," does not map well to actual behavior. Breaks from both show-to-commercial and commercial-to-show create switches towards the television if the person is on the computer, and both create switches towards the computer if the person is on the television. For further exploration of these switches, see Table 3.

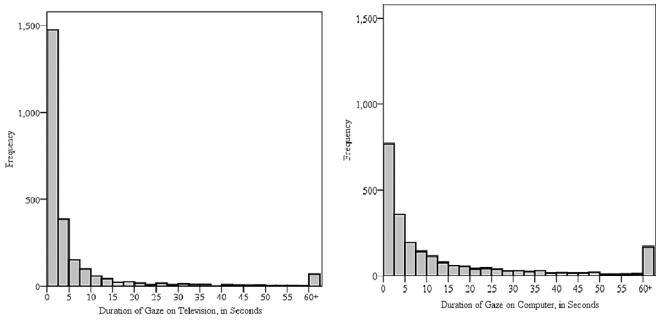

Fig. 2. Gaze duration distributions for television and webpage media.

6. General discussion

The results of two studies using direct observation of media multitasking behavior highlight the potential role of visual switching cues. A first study uses eyetracker analysis on preselected video and web stimuli in a multitasking environment to explore how visual signals affect multitasking switching. Results showed that low-level visual cues such as motion and luminance encouraged switching towards a media due to their ability to capture attention in peripheral vision, while higher-level visual cues such as faces or animals that need central visual attention discouraged switching away from a media when attention is already on it. A second study using video recording of consumer behavior where participants were allowed to freely choose television shows and websites across two screens showed that switching

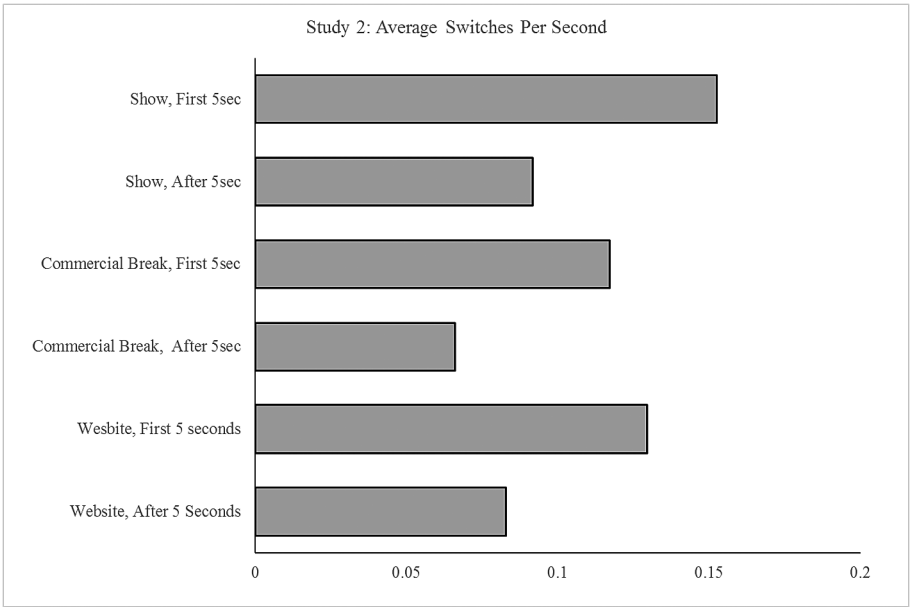

Fig. 3. Study 2 Switch Incidence by Media Context. Note: Participants averaged 120 switches across 27.5 min, or over 4 switches per minute between the two screens.

Table 2
Study 2 ratio of switches in either direction to frames, for varying television and computer contexts.

Show First 5sec	1.71
Show After 5sec	1.03
Commercial First 5sec	2.12
Commercial After 5sec	0.75
Webpage, First 5sec	1.26
Webpage, After 5sec	0.84

Note: values higher than 1 indicate conditions where switching is higher than normal, and values lower than 1 where switching is lower than normal. Logistic regression supports that the first 5 s of show, first 5 s of commercial, or first 5 s of website context generate significantly elevated switching behavior.

is constantly occurring between television and computer media. "Breakpoints" within either media such as new webpages loading or the switch between show and commercial segments (or vice versa) served as strong cues of switching behavior. In contrast to lay theory, going from show-to-commercial and commercial-to-show both encouraged switches towards the computer, rather than the "people watch show programming, then switch their gaze to the computer during commercial breaks" pattern commonly predicted.

This work offers a preliminary understanding of moment-by-moment multitasking behavior across simultaneous media, and presents ground-level insight that can be built on in exploring media-driven and participant-driven effects in multitasking. Future studies can begin to explore how manipulations and psychological drivers can alter these behavioral patterns, or how switching patterns might affect downstream marketing outcomes. It also grounds multitasking behavior in sensory processing (Krishna, 2012), supporting that much of multitasking behavior may be habitual and automatic. The results of these two studies show the potential for direct observational research in media multitasking, and call out for more research that does not rely on diaries or post-hoc survey accounts of media consumption.

6.1. Limitations

It is important to note, however, that the current studies used laboratory environments and somewhat artificial media scenarios, and results may not map onto all content environs. The eyetracker

Table 3
Study 2: Overall switching patterns by 5-second block.

Media Context	No Switch	Switch	One Switch vs Two or More Switches	Gaze Ends Block on Media Opposite From Start
Begins 5sec Block on Television				
Show, First 5sec	41%	59%	44%, 15%	50%
Show, After 5sec	70%	30%	17%, 13%	20%
Commercial, First 5sec	22%	78%	47%, 31%	47%
Commercial, After 5sec	54%	46%	29%, 17%	38%
New Webpage, First 5sec	13%	87%	60%, 27%	74%
New Webpage, After 5sec	70%	30%	17%, 13%	19%
Begins 5sec Block on Computer				
Show, First 5sec	72%	28%	5, 23%	14%
Show, After 5sec	77%	23%	9, 14%	11%
Commercial, First 5sec	70%	30%	14, 16%	20%
Commercial, After 5sec	89%	11%	4, 7%	5%
New Webpage, First 5sec	82%	18%	6, 12%	8%
New Webpage, After 5sec	86%	14%	6, 8%	7%

implications from Study 1 were obtained on a specific show and website combination on a single-screen set-up, where study participants could not change the channel or leave the website: follow-up work would need to explore whether changes in genre or viewing method alter the pattern of attention. Study 2 used a task-free environment that may map on to purely recreational media consumption, but not replicate in more task driven environments or scenarios where one media is clearly positioned as dominant. Also, when the data for Study 2 was collected less interactive websites were the norm, with lesser amounts of animation and interactive elements. Future work could explore how the pervasive nature of webpage video, animation, audio, and other interactive elements might alter multitasking behavior in a television-plus-computer environment. There remains much research to be done in the area.

6.2. Future directions

There could be value in exploring how television-to-web and web-to-television switches differ in cues and cognitive consequences. The video nature of television suggests that it will have advantages in creating low-level cues such as motion that attract web-to-television switches; perhaps cognitive top-down switching pressures are stronger on television-to-web switches in comparison? If so, moderators such as cognitive load may have biasing effects on one switching behavior versus the other. Website changes may also be consistently more user-driven in comparison to the media-driven breaks between show and commercial; there could be value in exploring whether this difference leads to consistent changes in switching. In addition, the central-versus-peripheral aspect of visual switch cues suggests that future work could explore physical or implied boundaries between screens. For example, would a website that uses white-space near the top create a conceptual border that discourages switching?

It is important to note that while the current work focuses on visual cues of media multitasking behavior, we are not suggesting that multitasking is never cognitive or driven by top-down strategies. This represents a strong area for future research; manipulation of strategies or mindsets may yield interesting effects. Future work could also explore how goal-driven behavior shapes multitasking. Does switching look similar for recreational media consumption versus scenarios where goals make one media dominant and one secondary (for example, see Shin et al., 2016)? In addition, future work might explore how levels of interest in content might alter multitasking between media: how does material that is more or less personally interesting or engaging change multitasking tendencies, especially in task-driven environments?

Another area that could yield insight is exploring visual processing in single-media versus simultaneous media multitasking environments. What does visual processing of a particular media look like when media multitasking, versus attending to that same media in isolation? Is there a wider dispersion of fixations and visual eccentricity within media? Does saccadic speed and distance change? Do consumers create similar salience maps for a particular piece of media in mono- and multi-tasking environments? If not, what does it mean for comprehension and memory?

Finally, future work may also explore the interplay of audio and visual cues in multitasking behavior. Audio cues likely influence switching behavior, as numerous crossmodal correspondences can guide attention (Spence, 2012). At the same time, audio cues may present a way to attend to non-visually focused media without actual visual switching; how is audio information from non-attended media integrated? Is there interference from the visual channel? Work exploring how consumers process television audio while attending to the computer, and when they feel “forced” to switch their visual focus to match, may illuminate cognitive effects and processing insights driven by multitasking environments.

6.3. Conclusion

In conclusion, a series of two studies explores media multitasking behavior and how visual cues in media can drive switching behavior. A first study used an eyetracker to record visual attention across webpage and television content displayed side-by-side, and shows that switching behavior is frequent and rapid. Content analysis supports that lower-level visual cues such a motion or luminance changes can drive switching towards a medium as these cues engage peripheral vision, while higher level visual cues such as faces can discourage switching away as they engage central vision. A second study uses separate televisions and computers to reinforce that switching is constant and rapid in a more naturalistic context, and provides initial evidence that switching patterns during show and commercial content look similar. It also supports that break-points in both television and digital media can serve as strong switching signals. The present work offers exploratory direct behavioral evidence of media multitasking behavior; much future work is needed to establish a more nuanced picture of what is a pervasive and complex media consumption behavior.

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