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ORIGINAL ARTICLE

Viewing Angle Matters—Screen Type Does Not

Steven Bellman, Anika Schweda & Duane Varan

Interactive Television Research Institute, Murdoch University, Murdoch, WA 6150, Australia

Increasingly, television content is available to viewers across 3 different screen types: TVs, personal computers (PCs), and portable devices such as mobile phones and iPods. The purpose of this study was to see what effect physical and apparent screen size has upon ad effectiveness. Using a sample of 320 members of the Australian public, we found that TV ads can be just as effective on PCs and iPods. However, controlling for screen type, ads viewed from a closer distance (i.e. with a wider viewing angle) were more likely to be recalled the next day, and were associated with more favorable brand attitudes. Shorter programs, product relevance, and use of close-ups and detailed images made no difference to this general viewing-angle effect.

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On October 12, 2005, Apple's CEO Steve Jobs launched the video iPod, holding it up to show how it could play episodes of top-rated ABC network TV shows such as *Desperate Housewives*, which viewers could download for just $1.99 (Wingfield & Smith, 2005, B.1). Six months later, in April 2006, Disney began making many of these same TV shows downloadable for free to iPods and personal computers (PCs) by including ads inserted in the content, which viewers were unable to skip through (Fleetwood, 2006). Today, watching video on these other screens—the PC and the "third screen" (Balaji, Landers, Kates, & Moritz, 2005), mobile devices like the cell phone and the video iPod—has become an essential part of everyday life for many people (O'Hara, Mitchell, & Vorbau, 2007). In TV's new landscape, advertisers will increasingly need to follow their audiences onto these other screens to ensure they reach their target markets with effective levels of exposure. In order to plan their media schedules in a new world of multiple screens, it is important for advertisers to better understand the likely impact of TV ads when they are not seen on a TV screen. This study set out to answer the question: "Are ads seen on an iPod or a PC as effective as ads seen on a TV?"

Little is known about the different effects of TV ads when seen across PC, iPod, and smaller mobile phone screens, compared to viewing them on a normal TV screen.

Corresponding author: Steven Bellman; e-mail: S. Bellman@Murdoch.edu.au

What research has been carried out has either investigated the feasibility of showing video on these devices, rather than its effects (e.g. Heppner, Benkofske, & Moritz, 2004; Knoche & Sasse, 2008; Knoche, McCarthy, & Sasse, 2005), or the difficulties of creating content for portable devices, which vary so widely in operating systems and capabilities (Rondeau, 2005). Other research has compared the effects of different types of content, such as video versus still pictures, when seen on portable screens (e.g. Nasco & Bruner, 2007; Ravaja, 2004). Only a few studies have compared video content seen on small screens with the same content seen on larger screens, such as a domestic TV set (e.g. Bracken & Pettey, 2007; Kelley, 2007; Reeves, Lang, Kim, & Tatar, 1999). Those studies have compared programs rather than ads, specifically. The unique contribution of this study is that it is the first to compare ads and their effects across these three screens.

Another contribution is that in this study we attempt to disentangle two effects of small screens that are often confounded. Small screens tend to occupy a narrower angle of view, that is, have a smaller retinal image. But portable devices, especially, can be held at different viewing distances, so that one viewer's angle of view may be larger or smaller than another's. This means that the angle of view subtended by a PC or even an iPod screen could be wider than an average TV screen. By controlling for angle of view, we were able to test for any effects of the type of screen the viewer was watching. We found that it was viewing angle that mattered, rather than screen type, when explaining the effects of ads seen across these three screens.

We used a laboratory experiment to control for differences in viewing angle, and also the viewer's motivation for using one device instead of another, to isolate the effects of differences in screen type. For each screen, we tested a best-case (timeless) scenario rather than attempt to replicate the currently typical viewing experience. For example, a real iPod experience would entail finding the content, downloading it (potentially a very long step), and finally updating the iPod. Similarly, video quality on PCs suffers when bandwidth varies, and playing video often taxes the performance of the computer. Potentially, however, both PCs and iPods can play back video as easily as a TV screen. For that reason, we chose to display video images of equally high quality on all three screens. To ensure our results could be generalized to most TV ads, we used a variety of ads that ranged widely on execution factors thought to improve or diminish performance on small screens (e.g. using only close-up shots). The next section develops the hypotheses we tested in our experiment, based on previous research. Following that, we describe our experiment in detail, and report its results. We conclude with a discussion of some implications of our findings for advertising practitioners, and for future research.

Literature review

In this section, we develop a series of hypotheses about the effects of differences in screen size on the effectiveness of television advertising. But first, we use a model of how television messages are processed to define what we mean by effective television advertising and how it can be measured.

The limited capacity model and advertising effectiveness

The limited capacity model of motivated mediated message processing (the LC4MP) (Lang, 2000, 2006) is based on the assumption that a viewer's capacity to devote cognitive resources to the processing of mediated messages is always limited, and this limited capacity is shared among three subprocesses: selecting and encoding information, storing information, and retrieving previously stored information to make sense of new information. When the medium is television, the rate at which new information is introduced is not generally under the control of the viewer, so most of the available resources are devoted to encoding, to keep up with the flow of the content. The effectiveness of encoding can be measured by recognition of visual or verbal content from the message, and a typical finding is that people can often recognize television content, but otherwise have no memory of it, that is, they perform poorly in free recall tasks, which measure retrieval, or cued recall tasks, which measure storage (Brown & Rothschild; Lang, Bolls, Potter, & Kawahara, 1999). For many advertised products, recognition memory is enough, because the buying situation (e.g. the supermarket shelf) provides recognition cues to jog memories of the advertisement (Rossiter & Percy, 1997). In this study, however, we wanted to investigate whether differences in screen size affected ad recall (i.e. retrieval, based on successful storage). For example, ads seen on smaller screens may be less likely to be recalled.

At any time, the actual capacity available for processing a television message is the combined result of conscious allocation processes and automatic allocation processes. Resources can be consciously allocated in accordance with a situational goal, such as an instruction to concentrate hard on remembering the message, but in an advertising context, conscious allocation primarily reflects a viewer's interest in the programming surrounding the ad break, and the product category of the brand being advertised. Resources can be automatically increased as well by the kind of product being advertised. Stimuli immediately related to survival, either from instinct or learned associations, will elicit an orienting response, which is a "what is it" reaction that temporarily increases the resources devoted to attention and encoding of the stimulus. Appetitive stimuli, such as food and sex, prime a tendency to increase the resources devoted to processing the stimulus, as closer approach may not always be possible. Aversive stimuli, such as danger, also increase the capacity of the system, but this capacity will be switched rapidly to behavioral avoidance—running away or just blinking—because there may be no time for further thinking if the danger is to be avoided. Automatic orienting responses are also cued by novel stimuli, which change the environment (e.g. someone entering the room) and need to be quickly categorized as appetitive or aversive. Television messages elicit orienting responses by introducing novel stimuli visually, following cuts or camera movements, or in the soundtrack. Encoding resources, and therefore recognition performance, are both increased by higher rates of camera changes (edits and cuts) and information introduced (A. Lang, Bradley, Park, Shin, & Chung, 2006) although often by stealing resources away from storage and retrieval. At some point, however, the amount of resources required by the rate and size of these automatic orienting responses causes

cognitive overload: They exceed the amount available in the current pool devoted to message processing, and even recognition performance breaks down.

To be effective, therefore, an advertising message needs to generate attention and therefore encoding. In some cases, the advertiser can rely on the viewer supplying sufficient resources for encoding, storage, and retrieval, simply because of their interest in the advertised category. But in general, attention to ads is low and they are increasingly being avoided, especially as more homes adopt digital video recorders (DVRs), which have the capacity to fast forward through recorded or delayed television. So advertisers need to elicit orienting responses using structural features of the ad, such as the rate of camera changes and information introduced. If the aim of the campaign is to increase recall, for brands that are not available in supermarkets and which buyers need to form an intention to buy, the advertiser has to walk a fine line between attracting attention and overloading the system, to ensure that sufficient resources are available for storage and retrieval. If the viewer treats the buying decision as complex, they will pay more attention to the arguments made for buying the brand, so these will need to be strong to generate a favorable brand attitude and purchase intention. On the other hand, if the viewer treats the buying decision as simple, a positive emotional response to the ad will generate a favorable attitude toward the brand. If the brand is bought in supermarkets or convenience stores, it may not matter that the structural features of the ad cause cognitive overload, because viewers remember experiencing a high level of positive emotional arousal, and therefore have a favorable attitude toward the ad (Yoon, Bolls, & Lang, 1998), and just recognizing the brand on the shelf will trigger this positive evaluation.

The effects of screen size on recall

Screen size is likely to be another driver of the automatic allocation of processing resources. Compared to smaller screens, larger screens magnify images of objects so that they look closer, which means that the appetitive or aversive stimuli being depicted seem nearer, which increases the urgency and the size of responses to those stimuli. Responses to novel objects are likely to be increased as well, and ordinary objects can become novel simply by enlargement (Reeves et al., 1999). Onrushing or looming objects, especially, are likely to appear even more threatening on larger screens: We are more likely to duck when we watch a 3-D movie in a cinema than at home on a television set. As nearness increases the orienting responses to appetitive and aversive stimuli, more resources should be allocated to encoding these stimuli when they are seen on larger screens. And because nearness also motivates the allocation of more resources to increase the capacity available for behavioral responses to aversive stimuli, or attentive responses to appetitive stimuli, extra resources will be available for storage and retrieval to replace those stolen by the increase in resources devoted to encoding. As the threatening objects are not real, the viewer will survive this highly arousing situation, with very strong memories of it. Larger images are also likely to increase the automatic allocation of resources to attention because (a)

peripheral vision is also affected, (b) more visual processing is required, and (c) larger visual images generate larger mental images (Reeves et al., 1999).

These predictions of the limited capacity model are supported by the results of several empirical studies. Reeves et al. (1999) directly measured the size of the orienting response using heart rate deceleration (HR), which was greatest for video shown on their large (56″) television screen compared to two smaller screens: one medium-sized (13″) and one which was very small (2″). More recently, however, Codispoti and De Cesarei (2007) found no effect of screen size on HR. They speculated that this was because they used the same constant task, but another explanation is that they used the same device (a 19″ PC) for all three screen sizes (large, medium, and small), whereas Reeves et al. (1999) used a different device for each screen size.

Reeves et al. (1999) also directly measured the difference in arousal between larger and smaller screens directly, using skin conductance (SC), and found that the level of SC associated with viewing a large (56″) screen was significantly higher compared to their two smaller ones, and SC did not decline significantly from the medium to the small screen (cf. Codispoti & De Cesarei, 2007; Lombard, Reich, Grabe, Bracken, & Ditton, 2000). Pictures rated as ''high arousal'' in pretests were substantially more arousing (measured by SC) than calm pictures, when seen apparently nearer on the larger screen, but on smaller screens this contrast was more subdued, even high-arousal objects were apparently further away, and therefore also low in motivational relevance. In line with this general effect of apparently closer objects on larger screens generating larger responses, video content seen on smaller screens tends to be seen as less motivationally relevant, and generates equally small levels of SC even if the content is rated as highly appetitive or aversive in pretests (Ravaja, 2004).

In general, the more arousing the stimulus, the more likely it is to be recalled. Most studies of the effects of arousal (measured using SC) on memory have found a positive linear relationship between memory (recall or recognition) and more arousing images (Bradley, Greenwald, Petry, & P. J. Lang, 1992), sounds (Bradley & P. J. Lang, 2000), and video (A. Lang, Bolls, Potter, & Kawahara, 2004). The effects of greater arousal on memory are complicated, however, by the different effects of arousal on encoding, storage, and retrieval (Eysenck, 1976; A. Lang, 2006), so that inverse-U effects are possible (e.g. Kleinsmith, Kaplan, & Tarte, 1963; Tavassoli, Shultz, & Fitzsimons, 1995).

In line with the expectation that apparently nearer objects elicit more, and larger, orienting responses, which increase the general level of resources aroused and available for encoding, storage, and retrieval, Reeves and Nass (1996) found that a screen 16 times larger than an average television screen generated significantly higher self-reported arousal and performance in a free-recall task 1 week later. For all these reasons, we expect that delayed cued recall (a measure of storage) will be higher when television commercials are seen on a larger screen, such as a domestic television set, compared to a smaller screen, such as a video iPod:

H1: The larger screens (TV and PC) will have higher day-after cued recall than the smaller screen (the iPod).

The effects of screen size on attitude and intention

An increase in recall does not mean that an ad is more effective. Larger screens may increase memory for ads or brands that are not liked, making them more likely to be avoided. On larger screens, objects will appear closer, which increases the motivational relevance of objects, and therefore the size of viewers' emotional responses to these objects. Aversive objects will be more threatening; appetitive objects will be more desirable. This suggests that the primarily positive emotions associated with brands in ads will generate higher levels of positive emotional response when these ads are seen on larger screens. But advertisers often adopt a "carrot and stick" approach in their messages, especially when the goal of the campaign is changing an ingrained behavior (A. Lang, 2006). Showing ads on a larger screen may enhance perceptions of the aversive consequences of not changing the behavior, as well as the positive consequences of making the change. Incidentally, this line of thinking suggests that campaigns designed to divert young people away from obesity or smoking may be less effective if young people are more likely to watch them on small handheld screens. More importantly, although for some kinds of ads (transformational ads that tend not to show negative emotions; Rossiter & Percy, 1997), the end-peak and average valence of response correlates significantly with ratings of ad liking (Baumgartner, Sujan, & Padgett, 1997), for other types of ads (e.g. informational ads, including fear appeals and "problem-solution" ads; Rossiter & Percy, 1997), the relationship between the valence of emotions felt during the ad and overall evaluations of the ad is more complex. But to the extent that viewers appreciate the strength of the rewards and punishments depicted in the ad, they are likely to evaluate the ad more favorably in terms of the "claim" component of attitude toward the ad (Yoon, Bolls, & A. Lang, 1998).

Again, there is considerable evidence in line with the theory that emotional responses are greater in size when aversive or appetitive stimuli appear nearer, such as when they appear on larger screens. Codispoti and De Cesarei (2007) found a magnifying effect of screen size on valence, similar to its effect on arousal: Positive images were more positive, and negative images were more negative. Mühlberger, Neumann, Wieser, and Pauli (2008) measured startle responses, an aversive response to negative stimuli (P. J. Lang, Bradley, & Cuthbert, 1990), and found that pictures that grew in size to simulate the objects depicted getting closer generated a greater startle response compared to pictures that were reducing in size, simulating objects receding away. Mühlberger et al. speculated "that approaching stimuli activate a general action tendency" (p. 196), as even a normally friendly object can be dangerous in a collision. However, unpleasant (aversive) stimuli generated the largest startle responses when these stimuli appeared to be approaching, indicating that nearness magnifies their negative valence. At the other end of the scale, smaller pictures may make the objects depicted in them appear apparently distant, and therefore less motivationally relevant, even if they are rated as highly aversive or appetitive in pretests. Two studies provide evidence that supports this possibility. News items designed to be positive or negative did not differ significantly in valence, measured by facial electromyography (EMG) activity in the smiling muscles, when

shown on a portable screen (Ravaja, Saari, Kallinen, & Laarni, 2006). Smaller pictures also suffer the problem of being harder to comprehend, as viewers are less accurate when categorizing objects as positive or negative when they are shown at smaller sizes (De Cesarei & Codispoti, 2006). However, neither of these studies varied the type of screen used, so it is impossible to rule out the possibility that perceived differences in valence are constant across screen size.

Another consequence of objects appearing larger on larger screens is that more of them will appear to be life-sized, which will increase the sense that what is being depicted is realistic (immersive), and that viewers are "present" in the picture (Lombard & Ditton 1997; Lombard, Ditton, Grabe, & Reich, 1997; Lombard et al., 2000; Reeves & Nass, 1996). Again, emotional reactions to real objects should be faster, and potentially greater in amplitude, than reactions to imagined ones because real objects should be perceived as more motivationally relevant. Furthermore, if the average level of arousal while viewing images on larger screens is high, then viewers are more likely to spike into cognitive overload whenever there is an increase in the rate of structural or content changes. This would mean that viewers of very exciting roller coaster content on a large screen may not be able to remember what they saw, but will associate the larger screen with positive feelings. For all these reasons, content seen on larger screens tends to be liked more (Reeves & Nass, 1996), although some studies have failed to find a main effect of screen size on liking (Codispoti & De Cesarei, 2007; Detenber & Reeves, 1996).

As well as using recall to measure the impact of screen size on ad effectiveness, we also measured the impact of screen size on the ability of television ads to associate the brand with a positive attitude, and to change behavior (purchase intention). Responses to the positive emotions depicted in ads should be magnified on larger screens, which should increase the favorability of attitude toward the ad. A more positive attitude toward the ad tends to be highly correlated with a more favorable attitude toward the brand and, therefore, more favorable brand purchase intention (Brown & Stayman, 1992). Although in a previous study, Kim and Biocca (1997) found no effect of screen size on intentions, they measured intention to recommend, rather than purchase intention. If screen size affects either recall or liking, or both, then we should see an effect of screen size on purchase intention. On the other hand, if cognitive overload results from the high level of arousal associated with viewing larger screens, viewers may not remember the ad, but still associate a general positive feeling with the advertised brand, which may be sufficient to prompt purchase for convenience and supermarket products. For these reasons, we propose the following hypotheses:

H2: Larger screen sizes will be associated with more positive attitude toward the ad.

H3: Larger screen sizes will be associated with more positive attitude toward the brand.

H4: Larger screen sizes will be associated with more favorable purchase intentions.

A countervailing factor: Headphones versus speakers

One factor associated with the video iPod could make up for its small screen size—increasing ad effectiveness to levels seen on larger screens. Viewers listen to iPods through headphones rather than speakers, and Kallinen and Ravaja (2007) found that viewers prefer headphones over speakers, even though most rated them equal on sound quality. Biometric measures of attention (blood pressure) and liking (EMG) were also higher for the headphones. They argued that headphones are preferred because of their intimacy, and because they isolate the viewer from the environment, both of which increase presence, which increases motivational relevance, and overall pleasure. Kelley (2007) predicted and found no differences between small, medium, and large screens, because the small screen viewers listened to the audio through iPod-style "earbud" headphones. He argued that because the small screen was less arousing, viewers had more resources to devote to listening. Bracken and Pettey (2007) found that a video iPod, listened to through headphones, was rated as more immersive than a TV. They speculated that there were three potential reasons for the enhancing effect of watching video on an iPod. Firstly, having to hold the iPod probably stimulates bodily arousal; secondly, watching an iPod from close up is more intimate than watching a distant TV screen (cf. Ravaja, 2004); and thirdly, that listening through headphones, which eliminates distractions, increases immersion (cf. Kallinen & Ravaja, 2007). In terms of the limited capacity model, increased arousal would increase capacity, which could be devoted to enhancing encoding, storage, and retrieval. Greater intimacy and immersion would increase the motivational relevance of stimuli, thus magnifying emotional responses. For these reasons, we also may see no difference between our three screen types: TV, PC, and iPod.

Controlling for viewing angle

Another countervailing factor is viewing angle, which is determined by the type of screen and its physical size, but also by viewing distance. In most previous studies of the effects of screen size, viewing angle has been confounded with screen size, and even with screen type, such as when an iPod is compared to a TV. But the theoretical explanations for the effects of screen size on arousal, such as looming, could just as easily be applied to differences in viewing angle. More importantly, to conserve resources, our bodies quickly habituate to stressors in the environment, so the main effects of screen size on arousal and valence may be less important, over time, than changes in viewing angle compared to the viewer's baseline for the screen they are watching. Just as novel stimuli can only be novel and elicit an orienting response once, viewers may quickly adjust to the enhancing effects of a large screen, but still react with higher levels of arousal and valence if they lean forward to see a larger than usual screen. Conversely, if they lean back and see a smaller screen, their emotional responses may be diminished in comparison.

Evidence for the potential overriding effect of apparent screen size over actual screen size comes from previous experiments in which the screen type was held constant, but viewing angle was manipulated (Codispoti & De Cesarei, 2007; De

Cesarei & Codispoti, 2006; Mühlberger et al., 2008). In all of these studies, viewing angle had its expected magnifying effects on emotional responses, even though the width of the physical screen did not change. Even stronger evidence comes from two previous studies that have differentiated between the effects of viewing angle and the effects of physical screen size. The first study (Lin, Imamiya, Hu, & Omata, 2007) found that viewing angle was more important than physical size. They varied angle across two types of screen, large (49″) and small (18″). Arousal (SC) was higher for the wider angle, no matter what screen type it was seen on. On the other hand, the second study (Tan, Gergle, Scupelli, & Pausch, 2006), which varied screen size and also screen type while keeping viewing angle constant, found that performance on egocentric spatial tasks, such as navigation, was much better with a larger screen. They argued that physically larger screens are more realistic, especially when the image is life size (cf. De Cesarei & Codispotti, 2006), which encourages the egocentric strategies essential for egocentric spatial tasks. The results of this second study suggest that very large screens increase the realism, and therefore the motivational relevance of objects depicted on them, because they convey perceptions of nearness not only by single-point perspective (visual angle), but also by fooling binocular judgments of distance.

The results of the first study (Lin et al., 2007) suggest that no matter what the physical size of a screen is, it is variation in the viewing angle that matters when explaining an increase or decrease in the motivational relevance and emotional effects of the objects depicted on the screen. For these reasons, we hypothesize a main effect of viewing angle, controlling for screen type. The results of the second study (Tan et al., 2006) suggest an interesting research question. This hypothesized main effect of viewing angle may be qualified by an interaction between viewing angle and physical screen size. Over and above the general effect of larger viewing angles to enhance emotional responses, content viewed on very large screens will additionally enhance emotional responses because the illusion of nearness will be more realistic. Hence:

H5: Controlling for screen type, a wider viewing angle will increase day-after cued recall.

H6: Controlling for screen type, a wider viewing angle will be associated with more positive attitude toward the ad.

H7: Controlling for screen type, a wider viewing angle will be associated with more positive attitude toward the brand.

H8: Controlling for screen type, a wider viewing angle will be associated with more favorable purchase intentions.

RQ1: Are there any significant effects of the screen type × viewing angle interaction?

Effects of involvement

In the previous set of hypotheses, we assumed that the effects of viewing angle were automatic, that is, the effects of accidental changes in viewing posture. But what

if these changes in viewing posture were not accidental? In the limited capacity model, processing resources can be increased not only by automatic reactions, such as reactions to apparently nearer stimuli, but also by conscious allocation, such as when the viewer has greater interest in what is being shown on the screen. More interested viewers are likely to lean forward to get closer to this more interesting and desirable content. If this were the case, then any significant main effects of viewing angle, controlling for screen type, would not reflect the enhancing effects of apparent closeness, but instead reflect a prestanding interest in the advertised product category. It is well known that products with greater motivational relevance for the viewer are more likely to be recalled, and also that motivational relevance alters the route by which positive emotional responses to advertising increase the favorability of attitude toward the brand, although both central and peripheral routes can be equally effective (Petty, Schumann, Richman, & Strathman, 1993). To test this possibility, we measured the motivational relevance of the product category, controlling for differences between categories (e.g. cars are less likely to be bought than fast food), and compared the relevance of products seen in ads watched from a closer distance, with a wider viewing angle, to products seen in ads watched from further away. If there was a significant difference, then we could not rule out the possibility that our results confounded the effects of viewing angle with those of product category relevance:

H9: Controlling for screen type, a closer viewing distance, and therefore a wider viewing angle, will be associated with higher levels of product category relevance.

The following section describes the experiment we used to test our nine hypotheses about the effects of screen type and viewing angle. As far as we are aware, this is the first study that has compared the effects of these three screen devices (TV, PC, and iPod) in one experiment. This next section details the methods used to carry out the experiment and the analysis. It is followed by the results of this study and a discussion of some implications of its findings for advertisers and for future research.

Method

Sample

A sample of 320 members of the general public in Australia took part in a controlled experiment to investigate the effects of screen type and viewing angle on the effectiveness of TV ads (54% [174] were women; ages ranged from 18 to 87 years, $M = 45.83$, $SD = 17.97$). They were compensated for their time with a $20 (AUD) department store gift voucher. There were no differences between viewers of the three screen types on a range of demographics including age, gender, occupation, and education level. There were no differences in viewing comfort ($M = 5.39$ on a 7-point scale) or enjoyment ($M = 5.30$) either.

Design

The design of the study included two between-subjects factors (Screen Type and Program Duration) and one within-subjects factor (eight test ads). There were

three Screen Types (TV, PC, iPod) and two levels of Program Duration (Full Sitcom [30 minutes] versus Short Extract [6 minutes.]). To increase the generality of our results, the eight test ads were selected to vary widely on three factors that potentially affect the performance of ads seen on small screens (Appetitive Content, Close Up shots, and Fine Detail), each of which had two levels (low vs. high).

Screen type

We thought it was essential that we compared real devices, to increase the validity of our results, as recommended by Knoche et al. (2005). The video iPod was an Apple 30 GB classic, with a 2-inch diagonal screen (5.5 cm, 320 × 240 pixels [i.e. 240 lines], aspect ratio 4:3). The PC was an Apple G5 Mac, with the QuickTime movie player screen set to 10 inches wide (25 cm; 758 lines, 4:3), to subtend the same viewing angle as the TV (19°). The TV set (a Panasonic Quintrix SR) had a standard cathode-ray tube (CRT), with a diagonal width of 35 inches (88 cm; 525 lines [NTSC], 16:9). To create an equalized "best possible" experience across the three screens, we used a black TV, a black iPod, and for the PC, a black background surrounding the QuickTime player on a black LCD monitor even though, in real life, video seen on a PC might be viewed against a much busier background.

Viewing angle

A side-on camera was used to measure viewing distance, and the feed from this camera was combined, for storage, with that from an over-the-shoulder camera, so that the viewer's posture could be synchronized exactly with what they were viewing on screen. A video editor later selected key frames from each ad view, representing the minimum and maximum distance at which the ad was viewed. These distances were averaged to generate one distance measure per ad. Distance was measured by positioning a grid overlay over each key frame so that it lined up with the center of the screen being viewed, and then counting the number of grid lines between the screen and the viewer's eyes. Each grid line represented 2 inches (5 cm) of distance. The average viewing distance for the iPod was 14.5 inches (37 cm), at which the iPod screen subtended a horizontal viewing angle of 9.08° (see Table 1). The average viewing distance for the PC in the experiment (2′4″/70 cm) was actually 2 inches closer than our pilot test average, so that most PC viewers saw a wider angle ($M = 21.72°$) than the TV viewers ($M = 18.63°$). Viewing distance for the TV viewers ($M = 6′10″/209$ cm) was coded from the video recorded by a front-on camera, using three levels: (a) leaning forward (6′3″/190 cm), (b) upright (6′7″/201 cm), and (c) leaning back (8′6″/260 cm).

For each participant, we ranked the ads they viewed in ascending order of viewing angle, and averaged the dependent variables across the top and bottom halves (four ads in each half for viewers who watched the Full Sitcom, see below; two ads in each

Table 1 Cell Means and Standard Deviations

	Narrow (Far)		Wide (Close)				
	TV		PC		iPod		
Dependent Variable	Narrow (Far)	Wide (Close)	Narrow (Far)	Wide (Close)	Narrow (Far)	Wide (Close)	Test
Angle of view (degrees)	15.84^{x} ($SD = 6.36$, $n = 320$)			17.03^{x} ($SD = 6.70$, $n = 320$)			$F(1, 317) = 97.53$ $p < .001$, $\eta^2 = .24$
	18.63^{xy} ($SD = 1.26$, $n = 110$)		21.72^{xz} ($SD = 5.74$, $n = 103$)		9.08^{yz} ($SD = 2.04$, $n = 107$)		$F(2, 317) = 366.77$ $p < .001$, $\eta^2 = .70$
	18.57 ($SD =$ 1.52, $n = 110$)	18.69 ($SD =$ 1.22, $n = 110$)	20.66^{x} ($SD =$ 5.57, $n = 103$)	22.78^{x} ($SD =$ 6.37, $n = 103$)	8.38^{y} ($SD =$ 1.75, $n = 107$)	9.78^{y} ($SD =$ 2.51, $n = 107$)	$F(2, 317) = 366.77$ $p < .001$, $\eta^2 = .70$
Product category involvement (standardized)	$-.005$(SD = .71, n = 320)			$-.03$(SD = .72, n = 320)			$F(1, 317) = .34$ $p = .559$, $\eta^2 = .001$
	$.03^{x}$ ($SD = .61$, $n = 110$)		$-.15^{xy}$ ($SD = .49$, $n = 103$)		$.05^{y}$ ($SD = .58$, $n = 107$)		$F(2, 317) = 3.87$ $p = .022$, $\eta^2 = .02$
	.06 ($SD = .83$, $n = 110$)	$-.003$(SD = .72, n = 110)	$-.17$(SD = .56, n = 103)	$-.13$(SD = .66, n = 103)	.08 ($SD = .67$, $n = 107$)	.02 ($SD = .77$, $n = 107$)	$F(2, 317) = .50$ $p = .605$, $\eta^2 = .003$
Day-after recall (0 to 1)	$.48^{x}$ ($SD = .37$, $n = 282$)			$.52^{x}$ ($SD = .37$, $n = 282$)			Sign test $Z = -2.14$ exact $p = .032$, $\eta^2 = .01$
	.52 ($SD = .31$, $n = 101$)		.51 ($SD = .33$, $n = 89$)		.47 ($SD = .30$, $n = 92$)		Kruskal Wallis test $\chi^2(2) = 1.36$ $p = .506$, $\eta^2 = .004$
	.50 ($SD = .37$, $n = 101$)	.54 ($SD = .37$, $n = 101$)	$.48^{x}$ ($SD = .39$, $n = 89$)	$.55^{x}$ ($SD = .38$, $n = 89$)	.47 ($SD = .35$, $n = 92$)	.47 ($SD = .37$, $n = 92$)	$F(2, 279) = .63$ $p = .532$, $\eta^2 = .005$

(*continued overleaf*)

Table 1 (*Continued*)

	Narrow (Far)		Wide (Close)				
	TV		PC		iPod		
Dependent Variable	Narrow (Far)	Wide (Close)	Narrow (Far)	Wide (Close)	Narrow (Far)	Wide (Close)	Test
Attitude toward the ad (Aad: 1 to 7)	3.91 ($SD = 1.26$, $n = 320$)				3.97 ($SD = 1.35$, $n = 320$)		$F(1, 317) = .20$ $p = .654$, $\eta^2 = .001$
	3.96 ($SD = .74$, $n = 110$)		3.96 ($SD = .86$, $n = 103$)		3.91 ($SD = .85$, $n = 107$)		$F(2, 317) = .12$ $p = .891$, $\eta^2 = .001$
	3.83 ($SD =$ 1.30, $n = 110$)	4.08 ($SD =$ 1.22, $n = 110$)	4.13 ($SD =$ 1.29, $n = 103$)	3.79 ($SD =$ 1.42, $n = 103$)	3.79^{x} ($SD =$ 1.18, $n = 107$)	4.03^{x} ($SD =$ 1.41, $n = 107$)	$F(2, 317) = 2.92$ $p = .055$, $\eta^2 = .02$
Attitude toward the brand (Ab: 1 to 7)	5.15^{x} ($SD = 1.07$, $n = 320$)				5.28^{x} ($SD = 1.12$, $n = 320$)		$F(1, 317) = 3.98$ $p = .047$, $\eta^2 = .01$
	5.22 ($SD = .98$, $n = 110$)		5.29 ($SD = .86$, $n = 103$)		5.14 ($SD = .92$, $n = 107$)		$F(2, 317) = .73$ $p = .481$, $\eta^2 = .005$

Notes: Means with the same superscript letters in the same row are significantly different at $p < .05$ (Screen: Games-Howell test, 2-tailed; Viewing Angle: paired sign test, 1-tailed exact p); measure of effect size = partial η^2: small = .01, medium = .06, large = .14 (Cohen, 1988). Cell *ns* vary due to missing data.

half for the Short Extract) to create two repeated measures for each participant (cf. Yoon, Bolls, & Muehling, 1999): the average for ads seen with a narrow Viewing Angle (from further away) and the average for ads seen with a wider Viewing Angle (from closer in). Within subjects, there were significant differences between the average Viewing Angles for these two groups of ads on every Screen Type except the TV (Table 1), mainly because only 16% of TV viewers (18 of 110) watched ads from noticeably different distances compared to 87% of PC viewers (90 of 103) and 100% of (all 107) iPod viewers ($\chi^2(2) = 200.19, p < .001$). Including viewers who did not change their viewing angle makes our results more conservative, but more likely to be representative of typical audiences for each screen type.

Program duration

Previous research and industry practice suggested that only short content, less than 10 minutes in duration, could be viewed comfortably on a mobile device (Knoche & Sasse, 2008). The typical offering on video download sites such as iTunes and YouTube (www.youtube.com) is less than 10 minutes long (in fact YouTube prevents the uploading of videos longer than 10 minutes except by certified directors). Knoche et al. (2005) found that 10% of comments made by participants in their study were "about visual fatigue from watching such a small screen" (p. 836), as prolonged viewing at close distances creates eyestrain. For this reason, we prepared two versions of our content, an unedited half-hour *Full Sitcom*, and a *Short Extract* of this sitcom, the opening scene, which (including ads) was only 6 minutes long. We were prepared to test our hypotheses using data from only the Short Extract condition if visual fatigue affected the Full Sitcom results. The sitcom was a pilot for a show that had not previously been seen in Australia, where this study was carried out. Voting on whether or not the series should be aired in Australia provided a rationale for participation. The Full Sitcom had four ad breaks, one before, one after, and two during the show. The 20 ads shown in this condition (5 in each break) included all eight test ads. The 12 other ads were fillers chosen from similar categories, with a similar mix of execution factors (see below), to avoid highlighting the test ads. For the same reason, all the ads had been broadcast in the United States, but not in Australia, so they had equivalent production quality and unfamiliarity (Chattopadhyay & Nedungadi, 1992). The test ads appeared randomly in either the second, third, or fourth positions in each of the four pods, to minimize primacy and recency effects (see, e.g. Terry, 2005). Order of ad presentation was counterbalanced using four variations (DVDs). The Short Extract had just two ad breaks, one before the show, containing just one ad, and another during the show, with three ads. All four ads were test ads. Eight counterbalancing variations of the Short Extract were created, so that across all the participants in this condition, the eight test ads were seen an equal number of times, in all four positions.

Small screen execution factors

Knoche and Sasse (2008) describe some strategies used to adapt TV content for mobile devices, to improve small screen performance. We selected eight test ads

that varied widely on three of these small screen execution factors (each with two levels: -1 = *Low* vs. $+1$ = *High*), according to a full factorial 2^3 design. This design allowed us to test the main effects of these factors but not their interactions, which were represented by single messages, and therefore confounded with brand and execution.

The first factor was *Appetitive Content.* Messages about products that are more appetitive (food items) should be more likely to trigger automatic orienting responses (A. Lang, 2006). Four of the ads were for likely *Highly Appetitive* products (waffles, orange juice, bubble gum, and salads); the other four were for likely *Less Appetitive* products (i.e. nonfood products: two each for automobiles and insurance).

The second factor was *Close Ups* (vs. long shots: High = 80% of shots are close ups). On portable devices, close ups receive more favorable ratings than extremely long shots (Knoche, McCarthy, & Sasse, 2008), which suggests they increase ad liking on small screens. They may also increase arousal, even on small screens, through effects of novelty (enlargement) and looming (Reeves et al., 1999), although the actual amount of arousal depends on the information introduced by the shot (A. Lang et al., 2006).

The third factor was *Fine Details.* Small, illegible text is the most common cause of unacceptable video quality on small screens (Knoche & McCarthy, 2005). Text that was readable on a larger screen may not be readable on a small screen, as letters need to be at least one-sixth of a degree in height to be legible (Loftus & Harley, 2005; Seibert, Kasten, & Potter, 1959). Also, smaller screens may simply not have enough lines (pixels) to render letters, because at least five lines per letter are needed. More generally, as it is harder to discriminate fine details on small screens, identification and valence categorization tasks are more difficult (De Cesarei & Codispoti, 2006; Roring, Hines, & Charness, 2006). For these reasons, we expected that ads coded as high in Fine Details would perform poorly on the small iPod screen. Two coders (trained research assistants) were in complete (100%) agreement about whether the ads were High or Low on the two subjective factors, Close Ups and Fine Details.

Procedure

Participants were randomly assigned to conditions (and variations within conditions) using a quota system: (a) TV ($n = 110$), (b) PC ($n = 103$), and (c) iPod ($n = 107$). For the TV and iPod conditions, participants sat in a comfortable chair in one of two individual-viewing labs. These were designed to feel as much as possible like watching TV at home: They had potted plants, pictures on the wall, and a TV in one corner of the room. In the iPod condition, participants held the iPod in either hand, in any position they liked. For hygienic purposes, they listened to their iPods via over-the-ear headphones with disposable covers, rather than the iPod's standard "earbud" headphones. A separate volume control box was provided, as the functionality of the iPod was turned off (using the lock switch on top of the iPod). An over-the-shoulder camera recorded the image on the iPod screen (to time when test

ads appeared). A different lab had been specifically set up to reproduce the typical PC viewing environment. Participants sat at a work table on a straight-backed chair, and watched a flat PC screen on a head-high stand.

A welcome message advised participants about the duration of their viewing experience:

> *Today you shall be viewing a 30-minute program [6-minute excerpt of a program], after which you will be collected by a Research Assistant to complete a short questionnaire.*

Within each screen condition, approximately a third of the participants saw the Full Sitcom (total $n = 119$ [37%]): (a) TV ($n = 44$ [40%]), (b) PC ($n = 33$ [32%]), and (c) iPod ($n = 42$ [39%]). More participants were needed for the Short Extract condition, which showed only four test ads, to collect equal amounts of data for the eight test ads. There were no differences across Screen Types in the proportion viewing the Short Extract. After viewing the program, participants completed a short survey (either on a computer or on paper, according to preference), which began with the question "Do you think this program should be aired in Australia"? ($-1 = no, 1 = yes$). If they consented, they were also phoned back the next day to measure day-after recall (282 [88%] consented).

Measures

Following the program voting question, participants were asked about their overall *viewing comfort* ("How comfortable were you while viewing the TV program during your viewing session just now?" $1 =$ *very uncomfortable* to $7 =$ *very comfortable*), and *viewing enjoyment* ("How would you rate the overall enjoyment of your viewing experience just now?" $1 =$ *very unpleasant* to $7 =$ *very enjoyable*).

Next, *purchase intention* (PI) for the test brands seen by the participant (8 for the Full Sitcom, 4 for the Short Extract) was measured using Juster's (1966) 11-point scale ($1 =$ *no chance or almost no chance* [*0% chance*] to $11 =$ *certain or practically certain* [*99% chance*]), with different framings and weights applied (Rossiter & Percy, 1997) depending on whether the advertised product was a regular (food, i.e. Highly Appetitive Content) purchase (e.g. "the next time you purchase a soft drink"; 4-point scale: 6%, 40%, 76%, 99%, "don't know" = 0%) or a planned (nonfood, i.e. Low Appetitive Content) purchase (e.g. "*if* you were going to buy a new car"; if recalled, new% = [old% + 10%]/2, 0% otherwise). *Attitude toward the brand* (Ab) was measured by the average of four 7-point items ($\alpha = .96$, *bad–good, dislike quite a lot–like quite a lot, unpleasant–pleasant,* and *poor quality–good quality*, Gardner 1985). *Attitude toward the ad* (Aad) was measured by the mean of four different 7-point items ($\alpha = .95$, *agreeable–disagreeable*, *clear–imprecise*, *interesting–boring*, and *well structured–badly structured*, reverse-coded; Perrien, Dussart, & Paul, 1985). Product category involvement was measured using different items for the four regularly purchased (food, i.e. Highly Appetitive) products (8-point scale, *never–3 or more times a day*) versus the two planned purchase (nonfood, i.e. Low Appetitive)

products (6-point scale, *do not plan to purchase–within the next year*). To allow comparisons between products, these measures were standardized within the six product categories, so that values higher than zero indicate more than average interest in purchasing products from that category.

Brand-prompted *day-after ad recall* was measured by phoning participants 24 hours after their session and asking them to describe the ads they claimed to remember. The list of 11 probe brands (in random order) included all eight test brands, two fillers, and a foil ad not seen during the session. Participants had to describe these ads in sufficient detail to satisfy the interviewer that the ad was indeed recalled (1 = *recalled*, 0 = *otherwise*: Brown, 1985). As average day-after recall was not normally distributed, we analyzed this variable using nonparametric tests.

Results

Manipulation checks and tests of possible covariates

First, we tested whether Program Duration affected comparisons between the three Screen Types. The was no difference in viewer comfort, whether the Short Extract or the Full Sitcom was watched, and the Full Sitcom was actually rated as more enjoyable (5.56 vs. 5.14, $F(1, 314) = 6.22$, $p = .013$, $\eta^2 = .02$). There were no significant interactions with Screen Type, however. Using data at the level of individual ads, viewing the Short Extract significantly increased recall (because there was less to remember; $M_{\text{Short Extract}} = 56\%$ vs. $M_{\text{Full Sitcom}} = 39\%$, $F(1, 1542) = 46.42, p < .001, \eta^2 = .03$), but there was also one significant effect of the interaction between Screen Type and Program Duration, on Ab ($F(2, 1750) = 4.90, p = .008, \eta^2 = .01$). For this reason, we included the effect of Program Duration in the main analyses.

Using data from only the participants who saw all eight test ads (i.e. watched the Full Sitcom), we conducted a series of repeated analyses of variances (ANOVAs) to test for significant interactions between Screen Type and the three small screen execution factors (Appetitive Content, Close Ups, and Fine Details). All three factors had significant and large main effects on all three dependent variables. Highly Appetitive products were more likely to be purchased, but also had higher recall, although less favorable Aad and Ab. Close Ups also had positive effects on recall, Ab, and PI. Fine Details reduced recall, but increased the favorability of Aad and Ab. There was, however, only one significant interaction effect, on Aad ($F(2, 116) = 4.45, p = .014, \eta^2 = .07$). Ads featuring Close Ups tended to have *less favorable* Aad on the iPod and the PC, but the only significant difference was associated with the TV screen, on which ads featuring Close Ups were more favorably evaluated (iPod: $M_{\text{CloseUps}} = 3.68$ vs. $M_{\text{LongShots}} = 3.81$; PC: $M_{\text{CloseUps}} = 3.82$ vs. $M_{\text{LongShots}} = 4.02$; TV: $M_{\text{CloseUps}} = 4.06$ vs. $M_{\text{LongShots}} = 3.82$). We pooled data across these three execution factors for the main analyses, but this significant interaction

effect would have provided an alternative explanation for any effects of Screen Type on Aad.

Effects of screen type

Hypothesis 1 predicted that ads seen on the two larger screens, the TV and the PC, would have higher day-after recall compared to ads seen on the smaller iPod screen, but the effect of Screen Type was not significant, even without controlling for Viewing Angle (Table 1). Hypotheses 2, 3, and 4 had predicted that larger screen sizes would be associated with, respectively, more positive Aad and Ab, and more favorable PI. However, there were no significant differences between the three Screen Types on these dependent variables. An alternative explanation whenever a null result is found is that the experiment did not have a sample size sufficient enough to detect a significant effect. Brown and Rothschild (1993), faced with a similar situation, used a rule of thumb that if the null hypothesis could be rejected by doubling the sample size, the experiment was underpowered, and therefore inconclusive. Screen Type had very small effects on both Aad and PI ($\eta^2 = .001$), which means that cell sizes greater than 3,213 per screen would be needed to detect these effects (at $p < .05$) with 80% power (Cohen, 1988, Equation 8.4.1), or in other words, more than double (30.12 times) the average cell size we used. Screen Type had slightly larger effects on recall and Ab, but these were still very small ($\eta^2 \approx .0045$), which means they would also require cell sizes more than double (6.68 times) the size we used. This suggests that our experiment was not underpowered, and therefore the effects of Screen Type on these three variables are indeed small enough to be considered negligible.

Effects of angle of view

Hypothesis 5 had predicted that, controlling for Screen Type, a wider Viewing Angle would increase day-after cued recall. There was a significant increase in recall for ads seen with a wider Viewing Angle, that is, from a relatively closer than normal distance to the screen, across all three Screen Types (Table 1). Controlling for Screen Type, a wider Viewing Angle was also predicted to be associated with a more positive Aad (H6), and Ab (H7), and more favorable PI (H8). The effects of Viewing Angle on Aad and PI were in the predicted direction, but only its positive effect on Ab was significant (Table 1). These results are conservative, because they include data from all our participants, including those who did not change their viewing posture. When only the viewers who varied their viewing distance are included in the analysis, the significant effects of Viewing Angle are magnified (recall: $\eta^2 = .04$; Ab : $\eta^2 = .02$) and its effect on PI also becomes significant ($M_{\text{Narrow(Far)}} = 26.55\%$ vs. $M_{\text{Wide(Close)}} = 31.61\%, p = .028, \eta^2 = .02$).

Research question: Interactions between screen type and viewing angle

The research question we posed asked: Are there any significant effects of the Viewing Angle × Screen Type interaction? None of the two-way interactions were significant at the .05 level (Table 1), but there was a marginally significant two-way interaction

effect on Aad, reflecting a significant three-way interaction effect, between Screen Type, Viewing Angle, and Program Duration ($F(2, 314) = 3.53, p = .031, \eta^2 = .02$). The positive association between Viewing Angle and Aad (H5) for the iPod and the TV was reversed on the PC (Table 1). Ads seen from further away, with a narrower viewing angle, were more favorably evaluated, perhaps because closer inspection revealed they were being shown at NTSC resolution, rather than with the high definition possible on PC screens. This effect was only significant, however, for viewers who watched the Short Extract ($F(2, 198) = 5.37, p = .005, \eta^2 = .05$). For viewers who watched the Full Sitcom, and therefore had a longer time to habituate to the resolution of the screen, a wider Viewing Angle was associated with a more positive Aad, but the difference was not significant. We also tested for possible quadratic effects of Viewing Angle on the three dependent variables, but none were significant.

Effects of product category involvement

Hypothesis 9 had predicted that a closer viewing distance would reflect greater interest in the advertised product category, and therefore any apparent effects of Viewing Angle on recall, Aad, Ab, and PI, would in fact be the effects of product category involvement. Based on the evidence of this experiment, this hypothesis can be rejected. People who viewed ads at a closer distance with a wider Viewing Angle did not have a greater than average interest in buying the advertised product category (Table 1). There was, however, an unexpected main effect of Screen Type on product involvement, with products seen in ads on the PC having lower levels of involvement than products seen in ads on the TV or the PC. Most likely for this reason, there was actually a significant negative correlation between product category involvement and Viewing Angle at the ad level ($\rho = -.064, p = .007$). In a separate ad-level analysis, among the ads seen from a closer distance with a wider Viewing Angle, the percentage of ads for High Appetitive (regularly purchased food) products was almost identical to the percentage of ads for Low Appetitive (planned purchase nonfood) products (51% vs. 49%, $\chi^2(1) = .74, p = .417$).

Discussion

As broadband Internet applications become more widely used, TV advertisers will have to follow their target markets and buy video insertions on other screens. This study used a controlled experiment to test whether there are any differences, in terms of advertising effectiveness, between ads seen on a TV, a PC, or the new "third screen," smaller portable devices such as the video iPod. In a lab setting, we were able to equalize many of the differences between these devices that are due to their typical viewing context, such as the purpose for which they are used (e.g. work vs. entertainment, convenience when traveling, etc.), to test nine hypotheses and one research question about the effects of screen type and viewing angle on four measures

of television advertising effectiveness: ad recall, attitudes toward the ad and the brand, and purchase intentions.

Our results suggest that viewing angle matters more than the type of screen that is viewed. Unlike most previous studies of screen size effects (e.g. Codispoti & De Cesarei, 2007, who restrained movement with a chin rest), we allowed our participants the freedom to watch from as close or as far away from the screen as they felt comfortable, and measured and controlled for within-subject variation in viewing distance. We found no evidence to support any of our hypotheses about the effects of screen type, whereas viewing angle had significant positive effects on recall and attitude toward the brand. When viewers leaned forward and saw a screen with a wider viewing angle, they were more likely to recall the ad, and had more favorable attitudes toward the brand advertised in the ad. The most likely explanation for our results is that individuals habituated to the average level of arousal associated with the size of the screen they were watching, but variations from this average elicited automatic responses to the apparent additional nearness of objects, and because of this, variable viewing angle was more important than constant screen type. This effect of viewing angle was not associated with significant differences in product category relevance, which increases our confidence that automatic reactions to the apparent nearness of stimuli are the explanation for our results. However, a future experiment could remove the potential confounding of product involvement with viewing distance by randomly showing ads at different distances, across different screens.

Individual participants viewed angles that were as narrow or as wide as those used in previous experiments (minimum 6° to maximum 42°), but the fact that we could detect an effect of viewing angle using a realistic range (9° to 22°, on average), shows that the effects of viewing angle can occur during normal viewing behavior, across a range of screens, and it should be taken into account by advertisers. The troubling thing for advertisers, however, is that viewing angle is something they cannot control, whereas they can choose whether or not to advertise on different types of screen. One potential remedy might be using demographic or personality variables to segment audiences into narrow- and wide-angle viewers, for a particular screen type. We explored this possibility by halving the sample for each of our three screens, using a median split on average viewing angle (across ad views), to compare the demographics of on-average close versus on-average distant viewers. There was only one significant difference. Three-fifths (59.7%) of the on-average closer viewers were women ($\chi^2(1) = 6.63, p = .014$). Previous research into conversational distance has found that women are more comfortable being intimate (discussing personal topics) at a closer distance than men (e.g. Skotko & Langmeyer, 1977), and for this reason, women may prefer the intimacy of a closer screen. This finding potentially opens up an interesting avenue for future research, which may have important ramifications for media planning.

Our results are consistent with habituation to differences in the average level of arousal associated with our three different screen types, but because we didn't

directly measure arousal, using, for example, skin conductance, we can't rule out the possibility that our null results for the effects of screen type could also reflect the fact that these screens did not differ in arousal, even though they differed greatly in physical size. The distancing effect of seeing objects on the smaller iPod screen could have been counteracted by the immersive effect of listening to the soundtrack through headphones (Kallinen & Ravaja, 2007; Kelley, 2007), and the activation of resources due to holding the screen in the hand (Bracken & Pettey, 2007). Another factor that potentially limited variability across the three screens was their equally sharp resolution; all were close to the lower limit of human visual acuity (Knoche et al., 2008; Loftus & Harley, 2005): 48, 47, and 34 lines per degree for the TV, PC, and iPod screens, respectively (at their average viewing distance in the experiment). In focus groups run with a sample of participants from the study, many commented on the surprisingly impressive quality of the video iPod viewing experience:

> *I was actually surprised at how involved I got in it, how I forgot I was watching this tiny little thing with headphones, I actually just thought I was watching television* (female, 21).

There were also surprises, for us, in the null results we found for factors considered critical for portable video screen content, such as program duration. In line with a recent diary study of mobile video watching, we found that longer duration content was enjoyed more, and "a more accurate characterization of behavior was that viewing episodes were determined by the range of different content lengths available" (O'Hara et al. 2007, p. 859). Nevertheless, advertisers can increase recall by buying insertions in short programs, and this fact may increase the attractiveness of advertising on hand held platforms, simply because among the programs available for those platforms, short programs outnumber longer ones.

Similarly, we generally found null results when we varied three small-screen execution factors to test whether they increased the effectiveness of ads seen on smaller screens. Future research should investigate the potential enhancing effects of other execution factors advertisers could apply to small-screen ads. For example, higher rates of camera changes (edits and cuts), and the rate of information introduced by these camera changes, together and separately elicit orienting responses that focus greater attention on video content (A. Lang et al., 2006), and in combination with positive and negative emotion generate cognitive overload (A. Lang, Park, Sanders-Jackson, Wilson, & Wang, 2007). Controlling for screen type, viewing angle may interact with these three sources of overload to create overload situations, in which recall is lower, but attitude toward the brand is enhanced. On smaller screens, however, cognitive overload may be more difficult to create because of the greater difficulty viewers have in discriminating whether, for example, a camera change has in fact introduced new information (De Cesarei & Codispoti, 2006).

Limitations and other suggestions for future research

The most important limitation of this study was that it did not investigate screen types smaller than the video iPod, with lower resolution (fewer pixels), such as mobile phones. Although it is likely that on these smaller screens the effect of viewing angle on recall will follow the same linear trend we observed, future studies may find that ads on very small screens are uniquely affected by the limited number of pixels available for rendering images (Maniar, Bennett, Hand, & Allan, 2008). Another limitation is that we did not test screens larger than a typical domestic TV set. On larger screens, more objects will be seen at life size, which may increase their likelihood of generating orienting responses and other behavioral reactions (De Cesarei & Codispotti, 2006). Future studies may be able to identify the point at which the effect of a display's physical size dominates the size of its retinal image (Tan et al., 2006). Outside the lab, field studies may find that other factors are more important than viewing angle, such as the viewer's quest (their motivation for using a screen device; Barwise, 2001), although potentially even these factors could be manipulated in lab experiments.

A second limitation, and one common to all experiments conducted in a lab (Webb, 1979), is that all our participants watched the test ads with higher than normal involvement and attention, making our results more conservative than field results would be. Other researchers have tried to replicate the noisy environment in which portable devices are typically used (Kelley, 2007; Maniar et al., 2008), and future research should test whether our results apply in those situations. Although we tried to vary the differences among our test ads as much as possible, the range of ads and ad executions we could test in one experiment was limited. Future research with different ads may find significant differences that we were unable to observe.

A third limitation, related to the second, stems from our investigation of the best possible viewing conditions for each of the three screens. In particular, we did not reproduce the degraded video images associated with streaming video. For this reason, in addition to the effect of competing screen clutter, the effectiveness of PC and mobile phone ads in the field is likely to be a lot lower than we found in our lab.

Another limitation is that for most of our sample, viewing video on an iPod was a novelty. Again, this limitation makes our results conservative, and also suggests the differences between these three screen types may be greater in the field. We note, though, that novelty was also a potential explanation in Bracken and Pettey's (2007) study of iPod viewing, but they found no general halo effect of iPod novelty on viewers' immersion ratings.

A final limitation is that we tested content originally optimized for TV on PCs and iPods, instead of the other way around. It is possible that small-screen optimization, beyond the use of the three small-screen execution factors we tested, significantly improves the performance of ads on portable screens, potentially making them even more effective than ads seen on TV. Again, this would be an interesting topic for future research to explore.

Conclusion

As far as we know, this is the first study to compare, head-to-head, the effectiveness of TV advertising across normal TV screens and two typical broadband TV viewing devices—the PC and the iPod. It was also one of the first studies of screen size to allow participants to watch from as close or as far as they felt comfortable, and to measure and control for viewing distance and viewing angle. Although we generally found no differences in effectiveness, there was a tendency for ads seen at narrower viewing angles to be less memorable, and brands advertised in those ads to be less favorably evaluated, across all three types of screen. In other words, we found that viewing angle matters—screen type does not. With advertising spending on broadband video set to increase by nearly six times by 2009 (Westerfield & Salmon, 2006), this study is both timely and useful. We hope that it will help stimulate further research in this area.

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El Ángulo de la Visión Importa—El Tipo de Pantalla No

Steven Bellman, Anika Schweda & Duane Varan

Interactive Television Research Institute, Murdoch University, Murdoch, WA 6150, Australia

Resumen

Cada vez más, el contenido de la televisión está disponible para los usuarios en tres tipos de pantallas diferentes: televisores, computadoras personales (PCs), y aparatos portables tales como teléfonos móviles y iPods. El propósito de este estudio fue ver qué efecto tiene el tamaño físico y aparente de la pantalla sobre la efectividad del anuncio. Usando una muestra de 320 miembros del público Australiano, encontramos que los avisos de TV pueden ser tan efectivos como los de PCs y iPods. No obstante, controlando el tipo de pantalla, los avisos vistos desde distancias más cercanas (a saber con un ángulo de visión más amplio) fueron recordados el día siguiente con mayor probabilidad, y fueron asociados con actitudes más favorables hacia la marca. Los programas más cortos, la relevancia del producto, y el uso de primeros planos e imágenes detalladas constituyeron diferencias en el efecto de este ángulo de visión general.

L’angle de visionnement compte, le type d’écran ne compte pas

Steven Bellman & al.

Résumé
Le contenu télévisuel est de plus en plus disponible sur trois types d’écrans : les télévisions, les ordinateurs personnels et les appareils portatifs tels que les téléphones cellulaires et les baladeurs iPod. Cette étude cherchait à évaluer les effets sur l’efficacité publicitaire de la taille physique et apparente de l’écran. Nous appuyant sur un échantillon de 320 membres du grand public australien, nous avons découvert que les publicités télévisées pouvaient être tout aussi efficaces sur les ordinateurs personnels et sur les baladeurs iPod. Cependant, selon le type d’écran, les gens étaient plus susceptibles de se souvenir le lendemain des publicités vues de plus près (c.-à-d. avec un angle de visionnement plus large). Ces publicités étaient également associées à des attitudes plus favorables vis-à-vis la marque. De plus courtes émissions, la pertinence du produit et l’utilisation de gros plans ou d’images détaillées n’avaient aucune incidence sur cet effet général de l’angle de visionnement.

Viewing Angle Matters

각도 문제들을 보기

Steven Bellman, Anika Schweda & Duane Varan
Interactive Television Research Institute, Murdoch University, Murdoch, WA 6150, Australia

요약

점증적으로, 텔레비젼 콘텐츠는 시청자들에게 세가지 다른 스크린 형태를 통해 보일 수 있게된다. 그들은 텔레비젼, 개인용 컴퓨터, 그리고 모바일 전화나 아이팟과 같은 휴대용 장치들이다. 본 연구의 목적은 물리적 그리고 명백한 스크린 크기가 광고 효과성에 영향을 주는지를 조사하기 위한 것이다. 호주에서 320명의 사용자들을 대상으로 한 조사에서, 우리는 텔레비젼 광고들이 개인용 컴퓨터나 아이팟 등에서도 효과적이라는 것을 발견하였다. 그러나, 스크린 형태를 위한 통제와 보다 근접한 거리로부터 보는 광고들은 다음날 더욱 회상될 가능성이 높았으며, 더욱 좋아할 만한 상표 태도들과 연계되었다. 짧은 프로그램들, 생산 연계성, 그리고 밀접하고 세세한 이미지들의 사용은 이러한 일반적인 시청각도효과들에 있어 별 차이를 보이지 않았다.

观看视角重要——屏幕类型并不重要

Steven Bellman

Anika Schweda

Duane Varan

默多克大学交互式电视研究中心

摘要

越来越多的电视节目内容能够通过三种不同的屏幕类型提供给观众：电视，个人电脑（PC）和便携式设备，如移动电话和iPod。本研究的目的在于探究外观上的屏幕大小对广告有效性有何种影响。通过将320位澳大利亚普通市民作为样本，我们发现电视广告在电脑和iPod上都同样有效。然而，在控制了屏幕类型之后，近距离观看的广告（例如从更大的广角）比较容易在第二天被回忆起来，观众也会对品牌有更好的印象。较短节目、产品相关性、特写镜头的使用和细节图像对这种观看视角效应并无影响。