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The Power of Social Television: Can Social Media Build Viewer Engagement? A New Approach to Brain Imaging of Viewer Immersion

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Management slant

- The authors believe this is the first study measuring social television interactivity; previous research focused only on the incidence of second-screen usage.
- Television and social media interaction can be highly complementary in terms of building engagement over the short and long term during a program.

- For advertisers, this means that programs that encourage social engagement can be more effective than originally thought, particularly brands that sponsor these programs and have various levels of branded content throughout.
- For content makers and broadcasters, social media activities can be seen as building program engagement and broadening their promotional net for additional viewers. Consideration into how social media could be further developed in and around program content may prove to be an effective way to build viewer loyalty and drive ratings growth.

INTRODUCTION

The rise of digital technology has seen a fundamental shift in the way media are consumed. Although television traditionally has been a mainstay of home entertainment, the more recent shift in media consumption—coupled with the rise in the availability of Internet-enabled devices—has meant that time spent in front of the television now is shared with smartphones, tablets, and laptops (Deloitte, 2012; Google, 2012).

There is much industry-driven quantitative research examining the incidence of multi-screening or viewing and interacting with more than one screen. Current industry studies have reported that anywhere from 31 percent (Thinkbox, 2012) to 77 percent (Google, 2012) of television viewers interact with a second screen even as they watch television. Comparable findings also show that up to half of television viewers between the ages 18 and 24 report using a second-screen device for messaging, e-mail, Facebook, or Twitter to discuss what they are viewing on television (Deloitte, 2012; Thinkbox, 2012). This statistic is of particular importance as it foreshadows the potential behavior of future television audiences.

In line with the findings of these reports, one question that has not been answered clearly is the level of interactivity between the two screens. Specifically, is the second screen a distraction to the first screen? Or does it prove to be a complementary influence?

This is of particular significance to the advertisers, as this relationship may have a direct impact on advertising effectiveness. Research has found that multi-screen interaction does not significantly affect advertisement recognition (Thinkbox, 2012). In addition, qualitative analyses indicate that individuals feel more connected to television sets and are more likely to stay in the room they have access to a second screen (Thinkbox, 2012). Though this point is important in the study of how consumers consume content, it is still unclear what impact this interaction has on viewer engagement.

Although the aforementioned body of research has helped highlight the significance of multi-screen behavior, Nielsen has taken the analysis one step further by linking Twitter activity with prime-time ratings (Nielsen, 2013). Specifically, this research found a correlational link between the two:[1]

- increased Twitter activity increased television ratings, and
- television shows with higher ratings attracted more Twitter engagement.

In line with this group of findings, the authors of the current paper sought to further explore the impact of the second screen using a neuroscience-based methodology. This approach was chosen for two main reasons:

- The authors' approach—using steady state topography (SST)—enabled the research team to continuously track cognitive states throughout the entire testing session in real time, thereby capturing any changes that could have occurred during the interaction with the second screen; and
- the authors sought to capture these data during a live broadcast and under natural user-driven conditions—a new research dimension that other methodologies had not been able to capture.

In fact, the authors of the current paper believe that no prior attitudinal or recall research could accurately gauge these effects and that no similar neuroscience project has been conducted.

NEUROSCIENCE METHODOLOGY

This investigation utilized a brain-imaging methodology known as steady state topography (SST). In this section, the authors provide a brief description of the methodology, as the reader may be unfamiliar with this approach.

SST is an event-related potential-based approach that was first described in research more than two decades ago (Silberstein *et al.*, 1990). The main feature of SST is the presence of a dim oscillating visual stimulus that is presented in the peripheral visual field while the participant is performing a cognitive task (or, in this instance, is watching a television program and using a second screen). In SST, the oscillating stimulus is present during the entire session and elicits a small brain rhythmic sinusoidal response at the stimulus frequency. This response is termed the "steady-state visually evoked potential" (SSVEP). The SSVEP response is characterized by the amplitude and the phase difference between the stimulus signal and the SSVEP, which frequently is represented as a complex number.

Variations in the SSVEP phase difference reflect changes in latency or delay between the SSVEP signal and the visual stimulus. In particular, a reduction in latency is considered to reflect an increase in post-synaptic excitation, whereas an increase in latency is considered to reflect the opposite (or, rather, an increase in synaptic inhibition; Silberstein, 1995; Silberstein, Line, Pipingas, Copolov, and Harris, 2000).

Three specific features of the SST methodology make it a useful technique in cognitive neuroscience research and neuroscience-based advertising research:

- High temporal resolution: The SST technique is able to continuously track rapid changes in brain function (Silberstein, 1995). This is an important feature as many changes in brain function associated with television viewing and social-media interaction can occur over very short periods of time (less than a second).
- High signal strength (or high signal-to-noise ratio) and resistance to interference and "noise": The mathematical technique used to estimate the SST activity means that it is possible to tolerate very high levels of noise (or interference) due to such things as head movement, muscle tension, blinks, and eye movements (Silberstein, 1995). This makes SST well suited to cognitive studies wherein eye, head, and body movements occur as a matter of course.
- High signal to signal-to-noise ratio: Using the SST, it is possible to work with data based on a single trial per individual (Silberstein *et al.*, 1990), as opposed to the typical situation encountered in event-related potential or event-related functional magnetic resonance imaging (fMRI) studies, where there is a need to average multiple trials recorded from each individual to achieve adequate signal-to-noise ratio levels.

In summary, SST is an established methodology being used in numerous studies of both normal brain function, such as visual attention (Silberstein *et al.*, 1990); working memory (Ellis, Silberstein, and Nathan, 2006; Silberstein, Nunez, Pipingas, Harris, and Danieli, 2001); visual imagery (Silberstein, Danieli, and Nunez, 2003); and decision making (Silberstein, Ciorciari, and Pipingas, 1995); and changes associated with emotional processes (Gray, Kemp, Silberstein, and Nathan, 2003; Kemp, Gray, Eide, Silberstein, and Nathan, 2002; Kemp, Gray, Silberstein, Armstrong, and Nathan, 2004). SST also has been used to study disturbed brain function such as attention deficit hyperactivity disorder (Silberstein *et al.*, 1998) and schizophrenia (Line, Silberstein, Wright, and Copolov, 1998; Silberstein *et al.*, 1990).

THE METRIC: ENGAGEMENT

A Sense of Personal Relevance

Engagement is a term that frequently is used in the media. In the field of cognitive neuroscience, however, the term can be operationally defined as "when a stimulus elicits a sense of personal relevance." In the current study, the authors believed the nature of the current paradigm meant that "engagement" would be the most appropriate metric in measuring responses to social-media interaction.

Neuroimaging research using fMRI suggests that a region of the brain within Brodmann area 10 (BA10) is associated with personal relevance. BA10 is located within the front-most region of brain, situated at the forehead. In one fMRI study (Phan *et al.*, 2004), participants were asked to rate pictures in terms of how personally relevant they were—that is, whether the pictures had personal meaning for them. It was found that the higher the "personal relevance" rating, the higher the brain activity in BA10.

The authors of another study asked their participants to think of either a friend or a famous person and found increased activity within anterior medial prefrontal cortex (Abraham and von Cramon, 2009). This region was more active when participants thought of their friends—a condition that can be argued is more personally relevant to the participant.

A similar study also reported increased activity within BA10 when participants were asked to evaluate a series of adjectives that either described themselves or a close friend, or state whether the adjective was printed in uppercase (Heatherton *et al.*, 2006). The authors reported increased signal change (increased brain activity) within the region when responding to statements that described themselves. By contrast, there was reduced brain activity in conditions where the participants were required to evaluate adjectives that did not personally relate to them but instead pertained to a friend or the case of the adjective.

The investigations reviewed here are a few of many recently published research articles that show a relationship between personal relevance and brain activity within the prefrontal regions. The authors derive the SST measures of engagement from recording sites that are the closest to BA10.

ADVERTISING EFFECTIVENESS AND NEUROSCIENCE

Long-term Memory Encoding as a Key Measure

In terms of advertising effectiveness, the authors, in prior research, had identified long-term memory (LTM) encoding as a key neuroscience measure in predicting future consumer behavior (Silberstein and Nield, 2008).

LTM can be described as information that is stored in the brain from a period of more than one hour to decades. There is one crucial distinction between LTM and the short-term memory known as *working memory*: In working memory, information is stored in the form of specific patterns of ongoing neural activity; in LTM, information is stored in the form of changes in the strength of synaptic contacts.

LTM is a complex set of processes that have been variously categorized as procedural memories and declarative memories comprising episodic (memories of experiences) and semantic (memories of facts).

In the section that follows, the authors briefly will overview the literature surrounding this concept and restrict the authors' review to declarative memories.

LITERATURE REVIEW

On Prefrontal Cortex and Encoding Processes

Functional imaging of cortical activity has implied that the lateral prefrontal cortex (PFC) is strongly linked to encoding processes. The lateral PFC is situated toward the front and side of the head and sits diagonally from the earlobes. The link between lateral PFC activity and encoding has been demonstrated across a variety of experimental paradigms, which have revealed a number of noteworthy features of the PFC response. Specifically, PFC activations

- have been reported to be related to the meaning rather than the surface features of stimuli (Fletcher, Frith, and Rugg, 1997; Fletcher, Shallice, and Dolan, 1998; Fletcher, Shallice, and Dolan, 2000);
- occur independently of the intention to memorize material (Demb *et al*., 1995; Wagner *et al*., 1998); and
- are linked with encoding success (Wagner *et al*., 1998).

Based on these findings, the lateral PFC has been proposed to be involved intimately in the process by which LTM encoding occurs.

In support of this view, converging evidence from ERP and functional brain-imaging studies suggested that cortical activity at posterior regions of the frontal cortex and PFC predicted the strength of LTM traces (Brewer, Zhao, Desmond, Glover, and Gabrieli, 1998; Buckner, Kelley, and Petersen, 1999). Additional research also has demonstrated that SST measures of brain activity at recording sites overlying the lateral PFC robustly were correlated with the strength of LTM encoding for scenes appearing in television advertisements (Silberstein, Harris *et al*., 2000; Rossiter, Silberstein, Harris, and Nield, 2001).

On SST Correlates of Advertising Effectiveness

SST indicators of LTM encoding of advertising and change in consumer brand preference were demonstrated (Silberstein and Nield, 2008). In this study, the authors examined the relationship between LTM encoding of branding segments in a television advertisement and the subsequent change in consumer preference for the advertised brand. Participants were invited to make a series of product choices before and after viewing advertisements. Proportional changes in the number of participants choosing the advertised product were said to reflect the “persuasion shift” and, hence, the likely commercial effectiveness of the advertisement.

The study demonstrated that participants who changed their original preference after viewing the advertisements had higher levels of LTM encoding at the time of branding as compared to participants who had not changed their original preference. The authors believe this was the first time that research demonstrated the relationship between brain activity during television advertising branding and changes in consumer brand preference.

On Long-term Memory Encoding and Engagement

LTM encoding and engagement are two brain processes that are closely linked to each other. When one considers the sheer amount of information, experiences, and perceptions to which an individual is exposed each day, it is clear that only a small fraction of these events are encoded into LTM. What are the factors that determine whether an experience is committed to memory or when it is forgotten? The authors of the current study would argue that one of the main factors that could mediate the strength of these encoding processes are those experiences that are the most relevant to the individual. For example, taking an evolutionary approach, it is fair to say that the experiences that have survival or reproductive significance are the most valuable to the individual (LaBar and Cabeza, 2006).

The current study's authors note that LTM encoding is an indication that the "encoded experience" is of personal relevance to the individual, irrespective of whether the source of this personal relevance is consciously recognized. With respect to advertising, high levels of memory encoding indicate that the "message" of the advertisement is considered relevant and/or important by the brain, which in turn drives new or reinforces existing behavior. Furthermore, the encoding of specific information contained within an advertisement, such as the brand, allows the brain to incorporate this information into subsequent future behaviors. In summary, it should be noted that the authors of the current study are not stating that memory encoding drives behavior but rather that memory encoding reveals the factors that may drive behavior.

In exploring the relationship between the SST measures of LTM encoding and engagement, data from a Neuro-Insight analysis—conducted in July 2013—has shown that the two measures are strongly correlated with each other, with engagement accounting for 48 percent and 43 percent, respectively, of the variance with LTM in left and right hemisphere, respectively ($p < 0.001$).

METHODOLOGY

Participants

Thirty-six participants (10 male and 26 female) volunteered to participate in the current study. Participants were recruited by a professional recruitment firm and were paid for their participation. To participate in the study, participants had to be regular viewers of the target television program ("X Factor") and had to be frequent users of the social-media application Twitter or the interactive-television application, Fango ("Seven Network"). Participant ages ranged from 18 to 32 years (M = 21.5 years).

SST Recording

Brain electrical activity was collected using a custom-designed electrode cap containing 24 electrodes positioned according to the international 10–20 system. The SSVEP was elicited by a peripheral sinusoidal visual flicker present during the entire recording session.[2] During acquisition, participants sat approximately one meter from a 22-inch LCD monitor presenting the television program and used their cell phones or tablets in their usual manners.

Procedure

Participants watched 35 minutes of the live television show "X-Factor" across four different nights (Seven Network, Australia, under license from FremantleMedia Enterprises) and were free to interact on social-media platforms via their mobile phones and tablet devices during the course of the program. This particular program was chosen for two reasons:

- The format of the show was consistent, providing a great deal of program homogeneity across the four-day testing period.
- The program encouraged a high degree of social interactivity in which selected viewers' tweets are displayed within the program.

During the session, each viewer's social-media interactions were recorded using a camera system synchronized (time-locked) to their brain activity data (SSVEP responses), allowing each viewer's behavior (Screen 1 or Screen 2) to be subsequently classified with a high degree of temporal resolution.

Viewing behavior was classified into "pre-," "during-," and "post-" social-media usage. Specifically,

- the "pre-" condition was defined as any period of time where the sole focus was directed towards the television show (Screen 1);
- the "during" condition was defined as any period of time where the television show was still screening but attention was directed toward the second screen (Screen 2); and
- the "post-" condition was defined as any period of time after second screen interaction had ended and attention was redirected towards the television show (Screen 1) once again.

To keep the viewing experience as naturalistic as possible, participants were not restricted in their Screen-2 interactions. Consequently, it was possible that the Screen-2 condition could include periods during advertisement breaks (as opposed to the television program). Second-screen interactions were analyzed to understand this behavior—from which it was established that the majority (76 percent) of Screen-2 interactions occurred during the program itself.

RESULTS: BEHAVIORAL ANALYSIS

Across all participants, there were 153 Screen-2 interactions over the course of the study (an average of 4.25 Screen-2 interactions per participant, with a range from 0 to 28 Screen-2 interactions per participant; 4 participants did not experience any Screen-2 interactions). These interactions were distributed throughout the entire broadcast; 76 percent occurred exclusively during the program itself, and 24 percent extended into advertising-break content (See Figure 1).

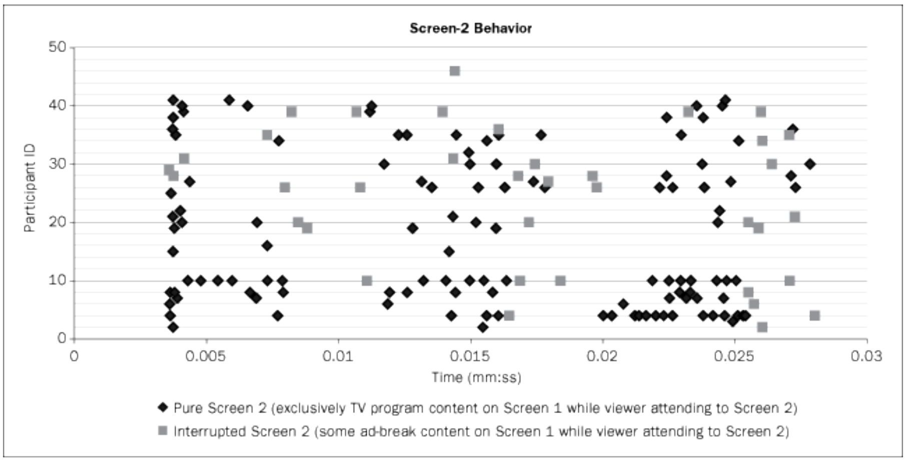

Figure 1 Distribution of Screen-2 Activity across the Live TV Broadcast

SST Brain Activity Measures of Engagement

The authors considered changes in the SST brain activity measure of engagement from two perspectives:

- The authors examined the immediate effect of Screen-2 events on engagement by evaluating:
  - the 2-minute period preceding the Screen-2 event, during the Screen-2 event itself, and
  - the 2-minute period following the Screen-2 event.
- The authors then examined the cumulative effect of the Screen-2 events on Engagement over the entire 35-minute

program period.

Immediate Effects of Screen-2 Events on Viewer Engagement

The behavioral analysis revealed participants made 153 Screen-2 interactions with an average duration of 45.3 seconds (*SD* 88 sec). To determine the typical SST engagement measure during the period leading up to, including, and then following Screen-2 events, the authors concatenated

- a 142.5-second epoch comprising a two-minute (120-sec) period preceding a Screen-2 event and the first 22.5 seconds of a Screen-2 event, with
- another 142.5-second epoch comprising the last 22.5 seconds of the Screen-2 event and the following 120-second period.

Each occurrence of the 285-second epoch comprising 120 seconds of “Preceding Screen-1 event” (“Pre-Period”), 45 seconds of “Screen 2” and 120 seconds of “Post Screen-1 event” (“Post-Period”) was averaged for each individual and then averaged across all participants.

Analysis comparing these findings to the 60 seconds immediately preceding the Screen-2 event revealed a robust 35-percent increase in engagement during the Screen-2 event (<0.005 based on confidence interval [CI] data).

Effect of Screen-2 Event on Subsequent Screen-1 Engagement

To examine the changes in viewer engagement in more detail, the authors calculated the mean engagement during the first- and second-minute period in both the Pre-Period and the Post-Period and the 45-second Screen-2 Event (See Figure 3).

The mean engagement in the first Post-Period minute was not significantly different from that in the Pre-Period minute immediately preceding the Screen-2 event.

The engagement time series (See Figure 2) dropped below the mean of the first Post-Period minute, following the end of the Screen-2 event (See Figure 3).[3]

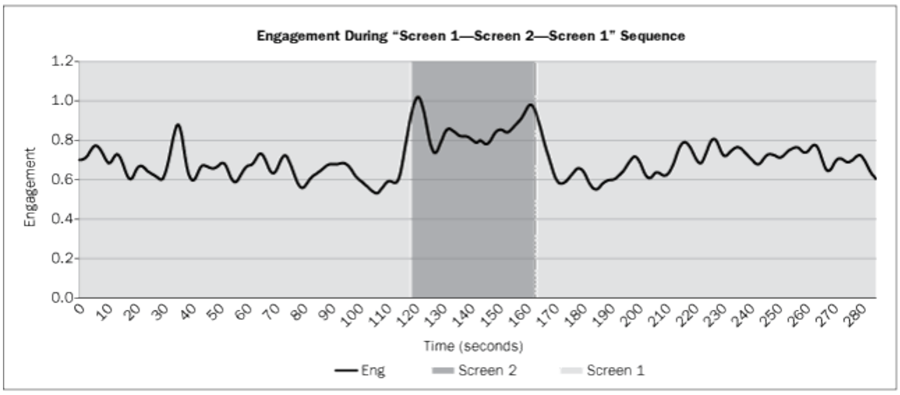

Figure 2 Time Series Illustrating SST Responses for the Screen-1 “Pre Period” (1–120 Seconds), Screen-2 “During Period” (120–165 Seconds), and Return to Screen-1 “Post Period” (165–285 Seconds) Sequence

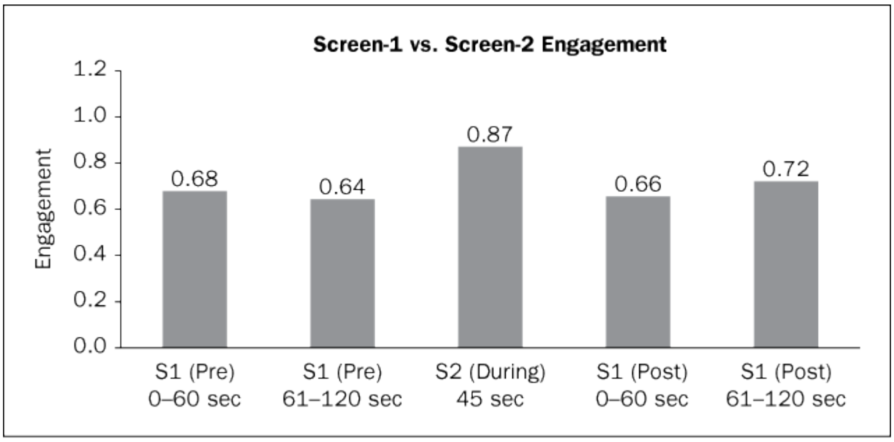

Figure 3 Averaged Brain Activity Corresponding to the Different Time Periods within the Broadcast

Such a brief undershoot frequently was observed immediately after periods of increased brain activity.

The longer-term impact of a Screen-2 event on viewer engagement was observed during the second minute of the Post-Period. In this instance, the authors witnessed a more sustained engagement increase:

- When compared to the entire 120-second Pre-Period, the second Post-Period exhibited a 9 percent increase in engagement (0.72 compared with 0.66, CI $p < 0.05$).
- Screen-2 events not only were associated with a large increase in engagement during the Screen-2 event but also a more sustained increase in engagement when viewers redirected their attention to Screen 1.

Longer-Term Impact of Screen-2 Events on Screen-1 Engagement

Screen-2 events had a dramatic short-term impact on viewers during a television program, significantly increasing their engagement. There also was evidence of increasing engagement with Screen 1 following a Screen-2 event.

The authors were interested in understanding the implications of the short-term effect. To that end, they asked: "Did the transient [over the course of a few minutes] increase in Screen-1 engagement surrounding Screen-2 events give rise to a more enduring effect over the duration of the program [approximately 35 minutes]?" To answer this question, the authors drew on a Neuro-Insight database of 150 prime-time television programs where typical viewing durations were 30 minutes or more.

When examining the level of engagement over the total duration, the authors found that, irrespective of genre, engagement would generally reduce after the first three minutes of the program. The nature of this reduction typically followed a linear trend and resembled the physiological process of "habituation." A characteristic feature of habituation consists of elevated responses at the start of a period of sustained sensory stimuli followed by a reduction to a lower sustained value.

The authors termed this effect *program habituation.* Consistent with the authors' database observation, the current program also exhibited evidence of program habituation in the Pre-Period, and there was a gradual reduction in engagement levels leading into Screen-2 period (See Figure 3).

To examine the long-term effects of second-screen events, the authors compensated for the effect of program habituation by subtracting the expected change in engagement over the viewing period. This enabled the authors to examine the impact of Screen-2 events over the duration of the program. The authors found that Screen-2 events had a sustained positive effect on viewer engagement during the entire program. In other words,

- Screen-2 events reduced program habituation and maintained engagement levels at a higher level throughout the program, although this was most apparent at the end of the program, and
- Screen-2 events led to viewer engagement's being some 26 percent higher than would be expected from a prime-time program and some 23 percent higher than would be expected from reality genre programs.

The figure of 26 percent is likely to be an underestimate of the positive effects of Screen-2 events. This is because it is based on the assumption that the program habituation was equal to the average program habituation observed in the authors' database.

In reality, the level of program habituation that was estimated from the Pre-Period was some 15 percent larger than the authors' database value. Thus, though the positive effects of Screen-2 events on viewer engagement were likely to have been larger than the level reported, the authors favored a conservative approach in describing these effects.

DISCUSSION

The authors believe this study represents the first neuroscience-based investigation that demonstrates the effect of second-screen interaction in real time. Although previous qualitative reports had suggested potential benefits of the second screen, it has been difficult to quantify the impact of this interaction.

The findings from the current study largely echo the results of these earlier reports, but this paper goes one step further in quantifying the positive nature of this interaction. The authors chose this methodology as it afforded the ability to continuously track and measure the impact of these interactions during a live broadcast and under user-driven responses. Such analysis realistically could not have been conducted using other neuroscience and traditional methodologies.

The principal findings of the current study were as follows:

- When interacting with Screen 2, engagement was significantly higher for that period of time when compared to Screen-1 viewing.
- Engagement rose by an average of 9 percent after this interaction period on returning back to the first screen. This finding was important because leading into the Screen-2 behavior, the authors' data demonstrated that engagement habituated during the course of the program.
- When Screen 2 was initiated, there was an arrest to this behavior, and engagement increased during the Screen-2 period. After the Screen-2 interaction had finished, engagement returned to the same level at pre-Screen 2; however, there was a reversal in the habituation process. Specifically, engagement returned to a level that was 9 percent higher than it had been before the Screen-2 interaction.
- This effect was cumulative and built up over the entire program, leading to more sustained, and ultimately higher, levels of viewer engagement over the longer term.
- The net effect: a 26-percent increase in engagement (23 percent higher when benchmarked against primetime programs in the reality genre).

The authors' observation of a cumulative increase in engagement also was consistent with other findings, such as Neilsen's report of a positive correlation between Twitter volumes and television ratings (Neilsen, 2013), which provides further evidence of a positive relationship between the two screens. The authors' data imply a similar relationship with programs that actively encourage viewer participation (*e.g.*, voting, sharing comments).

Higher levels of program engagement also bode well for advertisers, with advertising spots also likely to receive boosts in performance. As mentioned earlier, engagement and LTM encoding are linked closely, with nearly 50 percent of the variance in LTM encoding being accounted for by engagement. Although the authors specifically did not test this hypothesis, they would also expect that multi-screening would have a positive influence on advertising effectiveness: specifically, increased levels of LTM encoding during the broadcast.

CONCLUSION

The findings of the current study identify multi-screen interactivity as a new opportunity for marketers, with increased levels of engagement correlating with increased commercial effectiveness. Sponsors who make greater use of verbally and visually branded integration within such programs also would benefit from the higher engagement and long-term memory encoding. For broadcasters and content producers, these findings offer actionable insights into the complementary nature of multi-screening. Rather than being simplistically viewed as a distraction, this interaction can be a powerful, complementary mechanism to galvanize viewer engagement in broadcast television.

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[1] *Though statistically significant, the specific effect sizes had not yet been released at the time of preparation of this manuscript, so the authors were not able to determine the magnitude of this effect. Nonetheless, though these results are not causal, they do add further evidence to industry observations regarding multi-screening behavior.*

[2] *For more technical details on how SST was measured, please see Silberstein and Nield, 2008.*

[3] *The engagement drop (undershoot) is based on comparing the time series data (Figure 2) approximately 20–30 seconds post Screen-2 event, with the mean engagement over the first 60 seconds after Screen 2 (Figure 3).*

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