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# Media Multitasking and Memory: The Role of Message Modalities

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Media Multitasking and Memory: The Role of Message Modalities

by

Le Nguyen

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
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and Mass Communications  
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University of South Florida

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## **ABSTRACT**

This study explored the relationship between message modalities and memory performance in a media environment. In order to examine the role of message modalities in media multitasking activity, this research investigated the memory performance of participants after their exposure with the news stories and the commercials between same and different modalities. The research employed a 2 X 3 experiment using two independent variables: Modality of news broadcast (audio news vs. audio-visual news) and modality of commercials (audio commercials vs. visual commercials vs. audio-visual commercials). The research questionnaire was intended to reveal the influence of modality on participant performance by recalling the content of news stories, brand names of the commercials and product types of the commercials. Although the results indicate that there is no significant interaction effect of news modality and commercial modality on news recall, the majority of hypothesized interaction effect received support in this study. Finally, this research reinforces the school of human cognitive capacities are domain-specific.



## **CHAPTER ONE: INTRODUCTION**

The word multitasking has been used for decades to describe the parallel processing abilities of computers. Nowadays, multitasking is known as a human attempt to do as many things as possible at the same time. Multitasking has become so popular that people multitask with things such as using cell phones to talk and text while driving, walking or crossing the streets. For example, according to Rideout, Foehr, and Roberts (2010), teenagers are the most common group to do a second task while they are listening to music, or watching TV. The amount of people who are multitasking has increased substantially each year (Koolstra, et al., 2009) and not only young people but also older people are multitaskers (Allen, Lien, Ruthruff, & Voss, 2014). Likewise, media multitasking is not a new phenomenon. The great progress of modern communication technologies from telephones and radios, through televisions, to the networked computers and especially the mobile phones has allowed users to do many things simultaneously. This engagement with two or more communication media at once is called media multitasking (Bardhi et al., 2010). Multitasking, or media multitasking, has been studied for decades; it was first studied in cognitive psychology studies that aimed to understand cognitive activities in dual-task experiments (Solomons & Stein, 1896), and are now being studied in other fields such as marketing and education, making media multitasking a truly multidisciplinary inquiry. However, most of these studies investigated the negative impacts of media multitasking such as the relationships between heavy media multitasking and impaired social well-being or psychosocial functioning (Moody, 2001; Kraut, et al., 1998), media multitasking's influence on student learning and comprehension (Prensky, 2001), and media

multitasking and driving safety (Hatfield and Murphy, 2007; Nasar et al., 2008). Relatively little research attention has been given to one of the main characteristics of media multitasking: message modalities. By definition, media multitasking involves the exposure and processing of interlacing textural, aural, linguistic, spatial and visual content presented through images, words, layouts, speeches and videos. The extent to which message modalities affect information processing remains largely an unexamined topic. The goal of this study is to step toward a better understanding of the role of message modalities in media multitasking. In what follows, I first review the relevant literature in psychology and mass communication, with greater emphasis on the cognitive resource limitations and the potential interference resulting from message modalities as well as mention the hypothesis in chapter two. An experiment is presented which allows for the testing of a general hypothesis derived from the literature in chapter three. Chapter four reveals the results, which were further discussed in chapter five along with the limitations and recommendations for future research, and the conclusion.

## CHAPTER TWO: LITERATURE REVIEW

### **Multitasking and Its Consequences**

One of the most impressive aspects of the human cognitive system is the ability to manage and execute multiple concurrent tasks (Salvucci & Taatgen, 2008). For example, in 2009, 60 percent of TV viewers used the Internet and watched TV at the same time (Nielsen, 2009). In 2010, in a similar analysis, Nielsen also showed that Americans were using TV and Internet together 35 percent more than the year before (Nielsen, 2010). Furthermore, a study conducted by American Life Project (2001) reflected that approximately 61% of young IM users multitasked with different levels of involvement. Additionally, the project showed that one of the most frequently combined media tasks was listening to music; 91% of the sample combined music with web surfing, 87% with offline computer task, and 90% with e-mailing (American Life Project, 2001). People are convinced that multitasking is a great way to work. They think they can do two or three tasks simultaneously and they claim that it will not compromise the quality of what they produce. Thus, nearly everyone from mothers to musical conductors multitask at some level; lawyers have deadlines to meet, so they multitask; people want to get more done, so they multitask. Technology connects us to the office and clients 24/7, so we multitask. We even receive a call or message from our friends while we are walking or crossing the street.

Indeed, there is a growth in multitasking and there is increasing research evidence proving its effects on task performance. For example, Paridon and Kaufmann (2010) revealed

that multitasking decreases task performance, while increasing levels of subjective strain. Further, Spink (2008) saw that multitasking causes a negative impact on human cognition. Kahneman (1973) and Hatfield & Murphy (2007) agreed that multitasking causes attention to and performance on one or both tasks to decrease. This dividing attention across multiple activities is taxing on our brain and can result in low productivity (Cho & Proctor 2003). All of this evidence proves that human beings are limited in their abilities to distribute their limited cognitive resources in multitasking; because when we switch focus from one task to another, there is a lag time during which our brain has to draw itself from the initial task in order to attach to the new task (Weaver & Arrington, 2013). Therefore, when we multitask to save time, we actually slow down the process since performance is slower and more prone to error when shifting tasks (Weaver & Arrington, 2013).

The effects of multitasking are shown not only in task performance but also in academic learning. For example, Wang and Tchernev (2012) found that students who were chatting via text while reading a passage from a textbook took 21% more time compared to those who were not multitasking. Multitasking junkies are losing the desire to concentrate and the more plugged in we are, the less time we have to just sit and think (Holmes, 2008). Moreover, multitasking is likely to reduce comprehension and cause distraction (Jeong & Hwang, 2012). Similarly, Armstrong, Boiarsky, & Mares, (1991); and Pool, Koolstra, & van der Voort, (2003) proposed that watching television while doing academic work harmed performance of both comprehension and memory (as cited in Wang & Tchernev, 2012). Multitasking has been shown to challenge the brain. Switching between tasks leads to time lost as the brain determines which task to perform. It means that when it comes to handling two things at once, the brain, while fast, is not that fast.

## **Media Multitasking**

The advances in media technology allow people to frequently engage in multiple mediated tasks concurrently (Chinchanachokchai, 2015). Specifically, ninety-nine percent of adults spend an average of 2 hours per day to conduct two or more media activities at the same time (Ofcom, 2015). Likewise, studies by Keiser Family Foundation (KFF) (2005) stated that eighty percent of young people engage in media multitasking. It is noticed that people tend to multitask between smartphones and computers connected with the Internet, and are less likely to pair a TV time with another medium (Ofcom, 2015; KFF, 2005). Besides, text communication is another likely activity to be conducted simultaneously with another media or communication activity. Conversely, listening to radio is the least likely activity to be carried out simultaneously since this activity is usually conducted while traveling (Ofcom, 2015).

The benefits and costs of media multitasking remain controversial in research. Some authors claim that media multitasking could enhance the effects of advertising in general and cross-media advertising in particular (Pilotta and Shultz, 2005). For example, media multitasking increases overall task enjoyment and increases advertising evaluations, an effect that is mediated by the perception of how quickly time is passing while the advertising is playing (Chinchanachokchai, 2015). In addition, because of the extensive experience in integrating information from different modalities, people who are heavy in media multitasking performed better in a multisensory integration task than would others (Liu and Wong, 2012). However, other researchers argued that media multitasking is detrimental for advertising effects, because it may prevent attention to and processing of advertising messages (Jeong et al., 2010). While Dehl and Karmasin (2013) indicated that there was little empirical evidence for the positive effects of media multitasking, Duff (2015) demonstrated the negative effects of media multitasking on

advertising memory due to competition for cognitive resources and division of attention. Voorveld (2011) also shows that when using computers people increasingly engage in more than one type of media activity at a time, which might influence how they respond to what they encounter in these media. Bolls and Muehling (2007) demonstrated in their experiments that recall of radio ads deteriorated when participants simultaneously performed a visual-processing task by viewing a series of pictures unrelated to the ads. More recent work by Jeong, Fishbein and Zhang (2010) suggested that the negative effects of multitasking may be minimal when media use is the primary activity and the non-media task is secondary. Moreover, the negative effects of multitasking significantly decreased when media use was the main or exclusive activity.

We may conclude from existing studies that multitasking in general or media multitasking in particular has negative consequences. In the next section, we review the dominant psychological explanations of the negative impact of multitasking or media multitasking.

## **Psychological Explanations of Multitasking**

### **General Theories on Capacity Limitations**

Most psychological studies on multitasking have focused on how and why interference occurs when people multitask (Borst, Taatgen & Van Rijn, 2010). In one of the first psychological refractory period (PRP) experiments, Telford (1931) demonstrated that when participants had to perform two overlapping stimulus tasks, their reaction time was slower as compared to their reaction time when performing a single task. Telford's PRP paradigm was adopted by other researchers in their studies of what was referred to as the single processing

bottleneck. For example, Broadbent (1958), Craik (1948), Keele (1973), Pashler (1994), and Welford (1952) conducted dual-task experiments and asserted that the bottleneck in the processing stream is the reason why the second task had to wait for the first task to be completed. These and other studies led by Wicken (1984) conclude that the bottleneck in human information processing limited the ability to perform two or more tasks together. Subsequent research, however, showed that the single bottleneck account was insufficient in explaining the interference observed in multitasking performance (e.g., Meyer & Kiera, 1997).

In 1973, Kahneman introduced his unitary-resource theory that prescribed that all cognitive tasks would call on a central resource that could be allocated and shared between tasks. Because the central resource is limited, interference occurs during performing multiple tasks (Borst, Taatgen & Van Rijn, 2010). However, noting the possibility of perfect time-sharing in which no interference occurred between tasks in a multitasking setting, Wicken (1984) challenged the unitary-resource theory that all tasks must tap into the same basic cognitive resource. Multiple-resource theories were thus introduced to deal with the issue (Navon & Gopher, 1979; Wicken, 1984, 2002). The multiple-resource theories posited human beings possess multiple processing resources that can be shared between tasks. This explains why perfect time-sharing is possible and there would be no interference among tasks that tap different resources. The multiple-resource theories were later criticized for being too unconstrained (Meyer & Kieras, 1997), although they were able to explain a variety of experimental results.

In order to establish more constrained theories and to explain how people can actually perform multiple tasks simultaneously, in recent years researchers began to focus on computational models of multitasking (e.g., Anderson, Taatgen, & Byrne, 2005; Salvucci, 2005; Taatgen, 2005). These models attempt to describe in depth how tasks are performed, how they

are interleaved, and how the executive control functions (Borst, Taatgen & Van Rijn, 2010). Several accounts of executive control were proposed. Kieras, Meyer, Ballas and Lauber (2000), for example, discussed domain-dependent supervisory control structures under which a new control strategy for every new combination of tasks was required. However, some researchers claimed that it would be impossible for humans to develop a new control strategy for every new combination of tasks (Borst, Taatgen & Van Rijn, 2010).

In light of the weaknesses of these theories, Salvucci and Taatgen (2008) avoided using any type of higher order executive control in their Threaded Cognition Theory. According to these authors, “humans have a basic ability to perform multiple concurrent tasks and that this ability does not require supervisory or executive processes” (Salvucci & Taatgen, 2008, p.2). Threaded Cognition theory allows for parallel processing of tasks, also called threads, with multiple shared processing resources (Borst, Taatgen & Van Rijn, 2010). When multiple threads need a resource at a same time, those resources immediately can act like a bottleneck (Borst et al., 2010). Implemented within the ACT-R model, Threaded Cognition Theory proposes that a cognitive thread includes the goal of a task and associated task knowledge, and multiple threads can run independently and in isolation (Salvucci & Taatgen, 2008). Multiple threads are managed in parallel on a single procedural processor, only one of them can use the procedural processor at a time. In other words, the resources are not always available for all of the threads to use concurrently. That is, without the leading by any supervisory control structure, the threads are still restrained by the available resources (Borst et al., 2010). As a consequence, only one resource can be used by one thread at a time (Salvucci & Taatgen, 2008). The interference in multitasking, according to the Threaded Cognition Theory, might be explained with a cooking analogy: If there is only one stove and you’re using it to boil noodles; others cannot use the stove



at the same time and they must wait until you are done using it. Similarly, when thread A is using a particular resource, thread B will have to wait for thread A to be finished before it can access the same resource. However, different threads can use different resources simultaneously and interference occurs only when multiple threads demand the use of the same resource (Salvucci & Taatgen, 2008). In addition, there is no central executive control, each of these threads has its own executive control because multiple threads are coordinated by a cognitive processor and distributed across multiple processing resources (Boorst & Taatgen, 2007). At any given time, production rules of all threads can be selected. When multiple rules (of different threads) match, the rule belonging to the thread that has least recently been processed will be executed. This makes sure that none of the threads will starve as long as they have matching production rules. In general, Threaded cognition theory has avoided the problems of earlier theories and has succeeded in explaining a wide range of multitasking behavior, such as multitasking in driving, track and choice experiments (Salvucci & Taatgen, 2008), and perfect time-sharing experiments (Schumacher et al., 2001).

Last but not least, Limited Capacity Model (Lang 1995, 2000, 2006) has been frequently used to explain why people failed to process information in multitasking environment. The model describes that human cognition is limited, and it can only retain four items at a given time (Buschman et.al., 2011) and under multitasking situation this limited cognitive capacity will suffer and memory performance thus will be decreased. In other words, when people attempt to gain information beyond the limitation such as multitask with two or more works, it demands more cognitive capacity than what is already available; as a result, bad performance cannot be avoided (Lang 1995, 2000, 2006)

## **General and Domain-Specific Cognitive Capacities**

Although it is generally accepted that multitasking can cause interference, there is a persistent disagreement on the exact nature of such interference (Baddeley, 1986; Cowan, 2001, 2005; Hazeltine et al., 2006). Some researchers argue that the non-specific or domain-general cognitive abilities are distinctive to the human mind (Samuels 1998, Fodor 2000). Investigators in the domain-general school claim that the serial nature of a central stage of response selection is the reason why there is interference in multiple task performance (Han & Marois, 2013). For example, when we aim to do two sensory–motor tasks simultaneously, the response to the second task is usually delayed (Welford, 1952). Since only a single response selection operation can proceed at a time, a central bottleneck would happen when there is a competition of two or more tasks (Meyer & Kieras, 1997b; Pashler, 1984, 1994; Smith, 1967; Welford, 1967). Researchers like Kahneman (1973), Navon and Gopher (1979) thus insist that there is a pool of general resources which control all attentional activities, as long as task A and task B do not take up all the resources of the same pool, both skills can be presented with success simultaneously. Supporting the theoretical position, Cowan (1988, 1995) argued for a central, limited-capacity system that restricts working memory capacity. For instance, he demonstrated in a series of experiments that there is a competition between auditory and visual arrays for limited working memory storage capacity and, for that reason, intermodal savings are not expected. As a whole, then, these researchers claim that interference occurs when the central processing mechanism for one task is occupied by another because the cognition is domain-general,

Following Fodor’s definition that domain specificity is one of the defining features of human cognition (Fodor, 1983), some researchers believe that cognitive abilities are domain-specific (Khalidi, 2010) and domain-specific limitations are the main reason for multitask

performance interference. In particular, these researchers argue that humans have several attention mechanisms, ranging from sensory input (e.g. proprioceptive, vision) to response output (e.g. verbal, motor) to memory representations (e.g., visual, verbal, temporal-spatial), and each mechanism has its own resource limitations (Wickens, 2002). Thus, if two tasks share or compete for common resources that go beyond the allowance, costs will occur (Wickens, 2002). Although human cognitive capacity is undoubtedly limited (Buschman et al., 2011), the domain-general vs. domain-specific debate has continued to this day. In the next sections, we will focus on one particular set of issues – the issue of message input modalities and the interference of processing messages of same and different modalities in a media multitasking context.

## **Input Modality and Modality-Specific Interference**

### **Input Modalities in Media Multitasking**

The influence of message modalities on cognitive activities, especially memory performance, has received a great deal of research attention in cognitive psychology. In their experiments, many researchers (e.g., Bird and Williams, 2002; Crowder, 1986; Frankish, 1985, 1995; Glenberg and Swanson, 1986) have demonstrated that short-term and long-term memory retention and retrieval are subject to the influence of the modalities of presented information. Several researchers specifically noted that loss of memory is larger when the same modality is involved in the presentation and processing of information (e.g., Treisman, 1969; Yuille & Ternes, 1975; Wickelgren, 1965). Treisman's (1969) model of attention, for example, explicitly treated presentation modality and mode of analysis as important variables in determining whether selection attention effects would occur. When analyzing two messages presented in the same modality, according to the model, interference is likely to occur because both messages must compete for access to the same analysis mechanism. However, if the two messages are

presented in different modalities, then both can be processed without interference because different analyzing systems are assessed (Wong, 2001). Dennis (1977) tested the modality-specific interference in his experiments in which participants performed a primary task by listening to a message while performing at the same time a secondary task that required them to monitor a list of words presented either aurally or visually. Results of the experiments showed that participants who received a list of words orally had more errors in memory than those who received a list of words visually. Penny (1989) also reported that the modality of presentation impacted how subjects organize information; specifically, memory recall was improved when words presented in two modalities (visual-audio) compared to words presented in only one modality. The results were corroborated by a more recent study by Lewandowski and Kobus (1993) in which student participants performed better in remembering words presented simultaneously in different modalities (visually and auditory) than in the same modality. Taken together, these findings are in agreement with the general assumption that human cognitive abilities are domain specific.

Further evidence supporting the domain-specific nature of human cognition in general, and modality-specific interference in particular, came from dual-task performance studies in cognitive psychology. The common goal of these studies was to identify and explain the conditions in which concurrent cognitive tasks could be performed with or without mutual interference. For example, in their studies of artificial grammar learning, Conway and Christiansen (2006) found no interference in concurrent learning of two artificial grammars because they were executed in separate modalities. Baddeley and Logie (1999) proposed that working memory (WM) performance was tied to a particular domain such as visual or auditory and limitations in memory developed from competition in domain-specific stores. In other

words, multiple domain-specific working memory stores are assumed to operate independently. To test the same assumption, Baddeley and Logie (1999) investigated dual-task costs during the simultaneous presentation of a visuospatial WM task and an auditory object WM task. Results of the study confirmed the hypothesis that the dual VM tasks were self-regulating from each other with little or no interference. Follow-up studies showed that dual tasks involving the same stimulus categories led to near-concurrent activation of both stimulus categories, which created crosstalk or a binding problem in performance (e.g., Logan & Gordon, 2001).

Modality-specific interference was examined in a number of dual-task performance studies. Using the retroactive interference paradigm, several studies (e.g., Clayton & Warren, 1976; den Heyer & Barrett, 1971; Murray & Newman, 1973; Salthouse, 1974) investigated the attendance and independence of visual and verbal encoding of specific stimulus dimensions. In these experiments, participants were asked to recall the identity and location of letters in a matrix. Recall of stimulus information frequently monitored the presentation of either an auditory or a visual interfering activity. Generally, the forms of recall are seen under these conditions indicates that letter location is mainly encoded visually and letter identity is primarily encoded verbally. Because of this independence, if location information were collected visually, then the recall of this information would be more inclined to intervention from a visual inserted activity. Similarly, if identity information is stored verbally, then the recall of this information will be more tended to from a verbal added activity.

Many studies examined modality-specific interference in human memory under the dual coding theoretical framework (Paivio, 1986, 2007) which postulates that human cognition has developed uniquely into separate but interconnected verbal and nonverbal representational subsystems. The verbal subsystem processes semantic stimuli such as speech or written word

while objects like symbols or images are processed by the nonverbal subsystem. These systems are structurally and functionally distinctive; therefore, each system can be active on its own, or both systems can be active at the same time. Supporting the theory, Constantinidou and her colleagues (Constantinidou, 1999; Constantinidou & Baker, 2002; Constantinidou & Neils, 1995; Constantinidou, Neils, Bouman, Lee, & Shuren, 1996) demonstrated in a series of experiments that visual presentation of objects (with or without the simultaneous auditory presentation) resulted in better learning, recall, and retrieval of information than the auditory presentation alone. In experiments that studied the modality effect by comparing audio-visual and visual only memory instructions, Mousavi et al. (1995) found that instructions presented in audio-visual form produced better learning than visual-only instructions. Likewise, Mayer and Moreno (2003) showed that audio-visual presentations resulted in superior memory and problem-solving performances. Together, these results not only confirmed the presence of modality-specific interference, they also provided some support for the feasibility of multitasking in a modality-rich environment, so long as modality-specific cognitive resources are made available (Treisman & Davies, 1973; Shiffrin & Grantham, 1974; Massaro & Warner, 1977; Mulligan & Shaw, 1981; Alais; Wickens, 1980).

Despite the fact that media messages are often presented in multiple modalities, relatively little mass communication research has been done to examine input modalities and their influence on performance in a media multitasking environment. An earlier study by Chaiken and Eagly (1976) found that when an easy message was presented in written, auditory, or video form, the comprehension of the message did not differ. In contrast, the comprehension of a difficult message was best communicated in written form. Likewise, Jacoby, Hoyer and Zimmer (1983) found that print messages were better comprehended than video or audio messages. Liu and

Stout (1987) showed that advertising messages presented in pictures plus words or pictures alone were more effective than words alone in enhancing message recall and inducing positive thoughts and attitudes. Brunken et al. (2002) found that audiovisual presentation of text-based and picture-based learning materials induced less cognitive load than the visual-only presentation of the same material. Nasco and Bruner (2007) also presented evidence that, through various modality combinations, different types of media could differentially affect attention, vividness, comprehension, and decision-making. Lui and Wong (2012) demonstrated that people who frequently use different types of media at the same time appeared to be better at integrating information from multiple senses - vision and hearing - when asked to perform a specific task. More recently, Cobbs, Jensen, Turner and Walsh (2014) tested the dual code theory in an advertising study by showing participants brand logos and news broadcasts on a screen at the same time. Their results confirmed the hypothesis that both verbal and nonverbal processing systems could be triggered simultaneously when an audience is exposed to information presented in multiple modalities.

There appears to be a dearth of research on the relationship between message modalities and memory performance in a media multitasking environment, notwithstanding the importance of memory in our daily lives. Indeed, memory underpins all other cognitive activities, including the processing of vast amounts of media information. We rely on memory so heavily that it is safe to say that life without memory would be nearly impossible. To fill the empirical void, this study attempts to test one general hypothesis derived from the literature reviewed above.

**H: In media multitasking, messages presented in different modalities will reduce modality-specific interference, thus enhancing memory performance**

### CHAPTER THREE: METHODOLOGY

In order to test the hypothesis, an experiment was conducted using a 2 x 3 factorial between-subjects design. The design manipulated two independent variables: Modality of news broadcasts (audio news vs. audio-visual news) and modality of commercials (visual commercials vs. audio commercials vs. audio-visual commercials). Mimicking a typical dual-task experiment, participants were instructed to remember as much as they could about the content presented in the news broadcast as well as the commercials. The six experimental conditions were summarized in the table below.

**Table 1** The Experiment Conditions

Condition	Task 1	Task 2
1	Audio news	Audio commercials
2	Audio news	Audio-visual commercials
3	Audio news	Visual commercials
4	Audio-visual news	Audio commercials
5	Audio-visual news	Audio-visual commercials
6	Audio-visual news	Visual commercials



## Materials

Stimulus materials consisting of online news stories and commercials were presented simultaneously on a large project screen. The news stories and commercials were prerecorded into five-minute-ten-seconds segments through the use of Microsoft split screens software. Each segment contains five news stories and ten commercials, all in English language. To minimize prior familiarity, the news broadcast was selected from a foreign source (Arirang news of Korea at [www.arirang.com](http://www.arirang.com)), and the commercials feature brands that are not currently available in the U.S. market. The transcript of the news broadcast is presented in Appendix A. The table below shows the news story topics and commercial brands.

**Table 2** News Story Topics and Commercial Brands

News Stories	Commercials
1. Prime Minister of UK vows to do everything to bring ISIS to justice	1. Darlie Expert White toothpaste
2. National Security Adviser of Korea visits US	2. Selecta ice cream
3. United Nation focuses on North Korea Human Rights	3. Harvey Norman shopping center
4. Chinese is the biggest spender in Korea	4. Marigold yogurt drink
5. Korean Electric Vehicle (EV) sale decrease despite global sale spike	5. Pan Asia Bank Cooperation
	6. Scott's emulsion
	7. Kirei Kirei anti-bacteria soap
	8. Ni Jiom cold remedy
	9. Srilankan Airlines
	10. Cho8.org Vietnamese classified ads

## **Participants**

The participants consisted of 88 undergraduate students attending the University of South Florida's College of Arts and Science as well as College of Engineering. Professors were asked for permission to visit their classes to solicit participants. The students were encouraged to participate in the study by their professors. The students were assured that their participation was strictly voluntary, and that there was no penalty for refusal to participate. All personal information was kept confidential.

## **Procedure**

The experiment was conducted in six separate sessions, each representing an experimental condition during one classroom visit. Upon arrival, participants were first presented with the Informed consent, followed by experimental instructions presented on the screen. The instructions began with the general purpose of the study and the nature of media multitasking. Participants were then instructed to pay equal amount of attention to the news stories and commercials presented on the split screen. Halfway through the experiment participants were reminded again to pay equal attention to the news and commercials. Following exposure to the stimulus materials, participants were instructed to respond to dependent measures in writing.

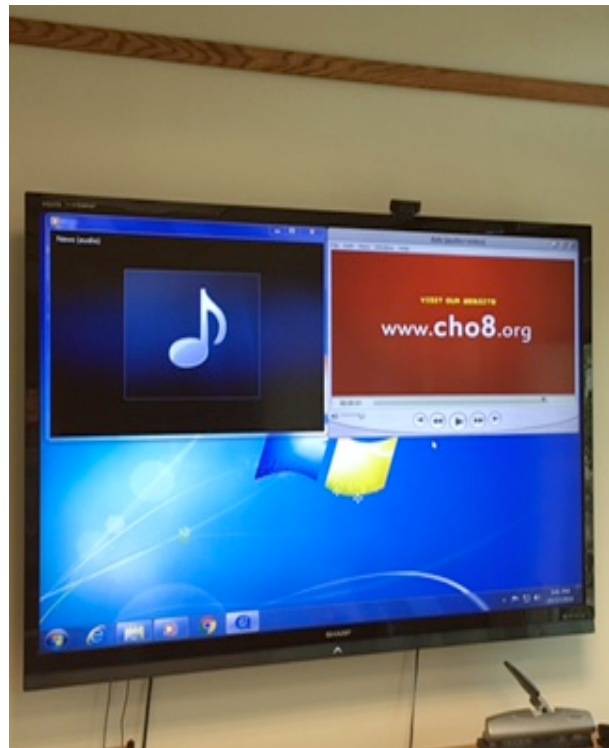
The consent form informed the students that his or her participation was strictly voluntary, he or she has the alternative to choose not to participate in this research study; therefore the students were free to participate in this research or withdraw at any time. There would be no penalty or loss of benefits he or she was entitled to receive if he or she stopped taking part in this study. His or her decision to participate or not to participate would not affect his or her student status (course grade) or job status. The information he or she contributed was

private and confidential; and other than the Principal Investigator, and Co-Investigator and The University of South Florida Institutional Review Board (IRB), no one else had access to the completed questionnaires. Non-consenting students were encouraged to review course materials in the classroom or leave the room until the survey was over. Finally, participants were told that there were no known risks associated with this study, and that there were no direct benefits to them for their participation.

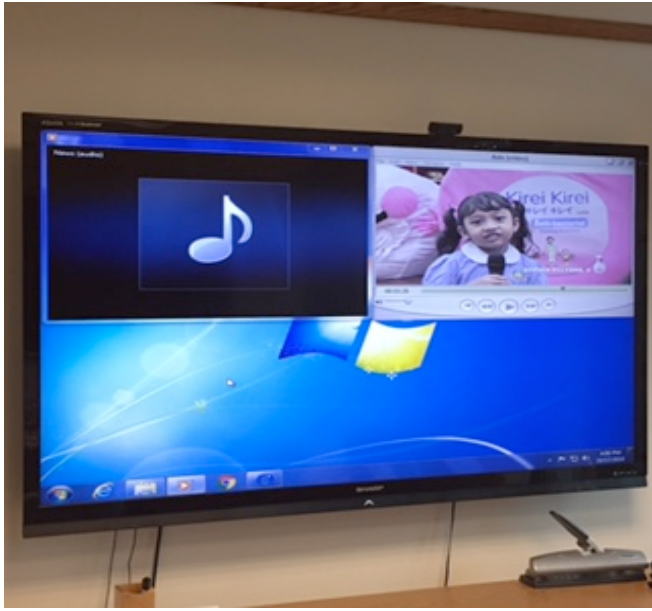
The six experiment were presented in figures below:



**Figure 1:** Audio News – Audio Commercials



**Figure 2:** Audio News – Audio-Visual Commercials



**Figure 3:** Audio News – Visual Commercials



**Figure 4:** Audio-Visual News – Audio Commercials



**Figure 5:** Audio-Visual News – Audio-Visual Commercials



**Figure 6:** Audio-Visual News – Visual Commercials

## **Dependent Measures**

*News Aided Recall:* Memory of the news stories was measured by an aided recall test by asking participants to perform sentence completions tasks and answer questions after exposures. Sentences were drawn from the online news stories and the number of correct answers was used as the aided recall score (Glynn & Di Vesta, 1979). For example, one question was, according to the news, who has condemned the beheading of a Scottish Aid worker as an act of sure evil? Another question was, leading the path was.....trailing behind are..... (See Appendix B for more examples). To quantify the aided recall responses, investigator coded the responses (For the coding scheme, please refer to Appendix D). For the aided recall of story information, the intercoder reliability was using Krippendorff's alpha for interval level coding (Hayes, and Krippendorff, 2007).

*Commercials free recall:* Commercial recall will be measured using a free-recall test. Participants were instructed to "please write down into the table as many brand names, product types of the commercials that appeared in the video/audio/visual-audio as possible". The number of correct answers was used as the free recall score (Glynn & Di Vesta, 1979) (please refer to Appendix C for commercials free recall). Means of the scores was compared to examine if there is any big differences in memory among the nine conditions.

## **Data Analysis**

Statistical data analysis was performed using SPSS 22.0. The main research hypothesis was tested by Analysis of Variance (ANOVA) at an alpha level of  $p < .05$ . ANOVA results pertaining to hypothesis testing were summarized below.

1. Main effect of task 1 (modality of news) on dependent measures
  - a. News recall: audio-visual > audio only

- b. Commercial recall: audio-visual > visual or audio only
- 2. Main effect of task 2 (modality of commercials) on dependent measures
  - a. Commercial recall: audio-visual > visual or audio only
  - b. News recall: audio-visual > audio only
- 3. Interaction effect of task 1 & 2 (modality of news and commercials) on dependent measures

Greater interference between tasks 1 & 2 when they were presented in the same modality (audio news + audio commercials, audio-visual news + audio-visual commercials) than when they were presented in different modalities (audio news + visual commercials, audio-visual news + audio commercials, audio news + audio-visual commercials, audio visual news + visual commercials)

## CHAPTER FOUR: RESULTS

In this section, hypothesis-testing results are presented. Statistical data analysis was presented using SPSS 22.0. Analysis of variance (ANOVA) was conducted to test the main research hypothesis at an alpha level of  $p < .05$ . The results section is broadly divided into three subsections: dependent variable: news recall, dependent variable: brand recall and dependent variable: product recall.

### **Dependent Variable: News Recall**

A significant main effect of news modality was found ( $F=6.065$ ,  $df=1,82$ ,  $p=.016$ ,  $\eta^2=.069$ ). The results reflect that the mean of audio-visual news condition ( $M=2.47$ ) is greater than the audio-only news condition ( $M=1.54$ ) (Table 3).

The results indicate that main effect of commercial modality was significant ( $F=6.239$ ,  $df=2,82$ ,  $p=.003$ ,  $\eta^2=.132$ ) (Table 4). In particular, post hoc comparison (Tukey's test) shows that participants who were presented in the visual-only commercial condition ( $M=3.89$ ) resulted in greater recall than the audio-only commercial condition ( $M=1.48$ ) ( $p=.003$ ). Similarly, the visual-only commercial condition ( $M=3.89$ ) resulted in a greater level of recall than the audio-visual commercial condition ( $M=1.72$ ), ( $p=.007$ ). However, the audio-visual commercial condition ( $M=1.72$ ) was found to lead to the same level of recall as the audio-only commercial condition ( $M=1.48$ ), ( $p=.915$ ) (Table 5).

In contrast, the interaction effect of news modality and commercial modality failed to achieve statistical significance ( $F=2.32$ ,  $df=2,82$ ,  $p=.105$ ,  $\eta^2=.054$ ) (Table 4). The modality-specific interference hypothesis predicts that the effect of news modality on news recall depends on whether commercials are presented in the same or different modality. Specifically, greater interference (i.e., poorer news recall) would occur when news and commercials are presented in the same modality than when they are presented in different modalities. ANOVA results indicated that the interaction effect was not significant. The hypothesis was not supported. These results are summarized in Figure 7.

**Table 3** Mean and Standard Deviation of News Modality and Commercial Modality with News Recall as a Dependent Variable

News Modality	Commercial Modality	Mean	Std. Deviation	N
Audio only	Audio only	1.0714	1.32806	14
	Visual only	2.2222	2.94863	9
	Audio-visual	1.5833	2.77843	12
	Total	1.5429	2.33065	35
Audio-visual	Audio only	1.7895	2.22558	19
	Visual only	5.4000	4.00555	10
	Audio-visual	1.7917	1.91059	24
	Total	2.4717	2.85282	53
Total	Audio only	1.4848	1.90593	33
	Visual only	3.8947	3.81364	19
	Audio-visual	1.7222	2.19885	36
	Total	2.1023	2.68260	88



**Table 4** Interaction Effect of News Modality and Commercial Modality with News Recall as a Dependent Variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	131.163 <sup>a</sup>	5	26.233	4.346	.001	.209
Intercept	417.339	1	417.339	69.147	.000	.457
NEWS	36.604	1	36.604	6.065	.016	.069
COMMERCIAL	75.308	2	37.654	6.239	.003	.132
NEWS * COMMERCIAL	27.980	2	13.990	2.318	.105	.054
Error	494.917	82	6.036			
Total	1015.000	88				
Corrected Total	626.080	87				

a. R Squared = .209 (Adjusted R Squared = .161)

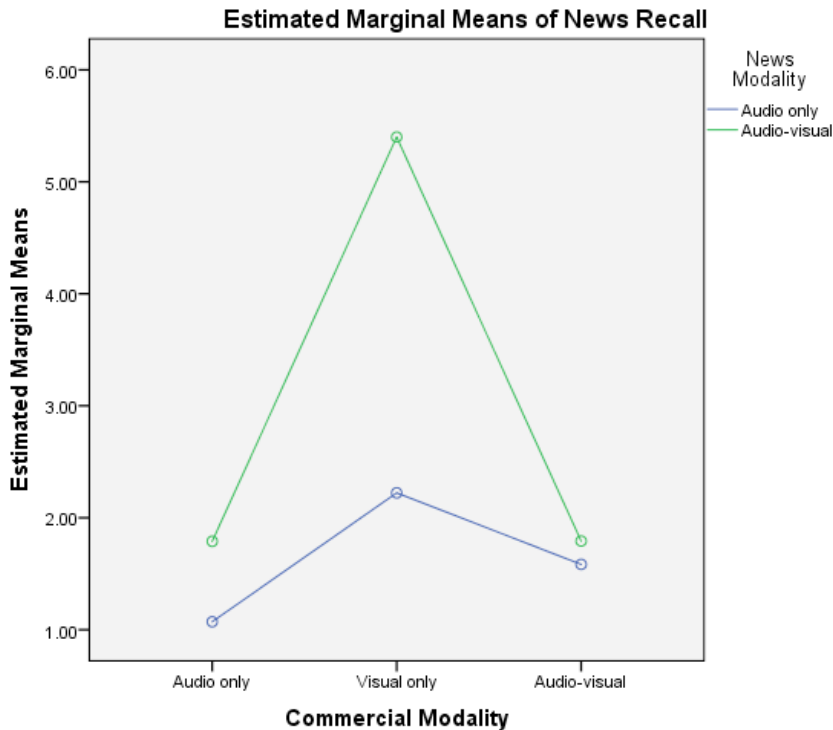
**Table 5** Differences in Commercial Modality with News Recall as a Dependent Variable Post Hoc Test (Tukey HSD)

(I) Commercial Modality	(J) Commercial Modality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Audio only	Visual only	-2.4099*	.70750	.003	-4.0987	-.7211
	Audio-visual	-.2374	.59207	.915	-1.6507	1.1759
Visual only	Audio only	2.4099*	.70750	.003	.7211	4.0987
	Audio-visual	2.1725*	.69665	.007	.5096	3.8354
Audio-visual	Audio only	.2374	.59207	.915	-1.1759	1.6507
	Visual only	-2.1725*	.69665	.007	-3.8354	-.5096

Based on observed means.

The error term is Mean Square (Error) = 6.036.

\*. The mean difference is significant at the .05 level.



**Figure 7:** News Modality and Commercial Modality Condition Interaction for News Recall

**Dependent Variable: Brand Recall**

The results shows that there was no significant main effect of news modality ( $F=3.075$ ,  $df=1,82$ ,  $p=.083$ ,  $\eta^2=.036$ ). Specifically, the mean of the audio-visual news condition and audio-only news condition resulted in the same level of brand recall ( $M=.66$ ) = ( $M=.91$ ).

On the other hand, the results indicate that the main effect of commercial modality was significant ( $F=9.804$ ,  $df=2,82$ ,  $p=.000$ ,  $\eta^2=.193$ ). Especially, the post hoc comparison (Tukey’s test) shows that participants who were presented in the visual-only commercial condition had greater recall ( $M=1.37$ ) than those who were exposed in the audio-only commercial condition ( $M=.12$ ), ( $p=.000$ ). In contrast, the visual-only commercial condition ( $M=1.37$ ) resulted in the same level of recall as the audio-visual commercial condition ( $M=1.03$ ), ( $p=.508$ ). The audio-

visual commercial condition resulted in a greater level of recall than the audio-only commercial condition ( $M=.12$ ), ( $p=.002$ ).

Supporting the hypothesis, there was a significant interaction effect of news modality and commercial modality ( $F=3.499$ ,  $df=2,82$ ,  $p=.035$ ,  $\eta^2=.079$ ). The modality-specific interference hypothesis predicts that the effect of commercial modality on brand recall depends on whether news is presented in same or different modality. Specifically, greater interference (i.e., poorer brand recall) would occur when news and commercials are presented in the same modality than when they are presented in different modalities. Figure 8 shows that, relative to other modality combinations, brand recall was the highest when news and commercials were presented in different modalities ( $M_{\text{audio-only news+visual-only commercials}}=2.11$ ). ANOVA results indicated that the interaction effect was significant. The hypothesis was thus supported.

**Table 6** Mean and Standard Deviation of News Modality and Commercial Modality with Brand Recall as a Dependent Variable

News Modality	Commercial Modality	Mean	Std. Deviation	N
Audio only	Audio only	.1429	.36314	14
	Visual only	2.1111	2.14735	9
	Audio-visual	.9167	1.31137	12
	Total	.9143	1.52183	35
Audio-visual	Audio only	.1053	.31530	19
	Visual only	.7000	.67495	10
	Audio-visual	1.0833	1.17646	24
	Total	.6604	.95964	53
Total	Audio only	.1212	.33143	33
	Visual only	1.3684	1.67367	19
	Audio-visual	1.0278	1.20679	36
	Total	.7614	1.21290	88

**Table 7** Interaction Effect of News Modality and Commercial Modality with Brand Recall as a Dependent Variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	32.746 <sup>a</sup>	5	6.549	5.639	.000	.256
Intercept	55.622	1	55.622	47.889	.000	.369
NEWS	3.572	1	3.572	3.075	.083	.036
COMMERCIAL	22.775	2	11.387	9.804	.000	.193
NEWS * COMMERCIAL	8.129	2	4.064	3.499	.035	.079
Error	95.243	82	1.161			
Total	179.000	88				
Corrected Total	127.989	87				

a. R Squared = .256 (Adjusted R Squared = .210)

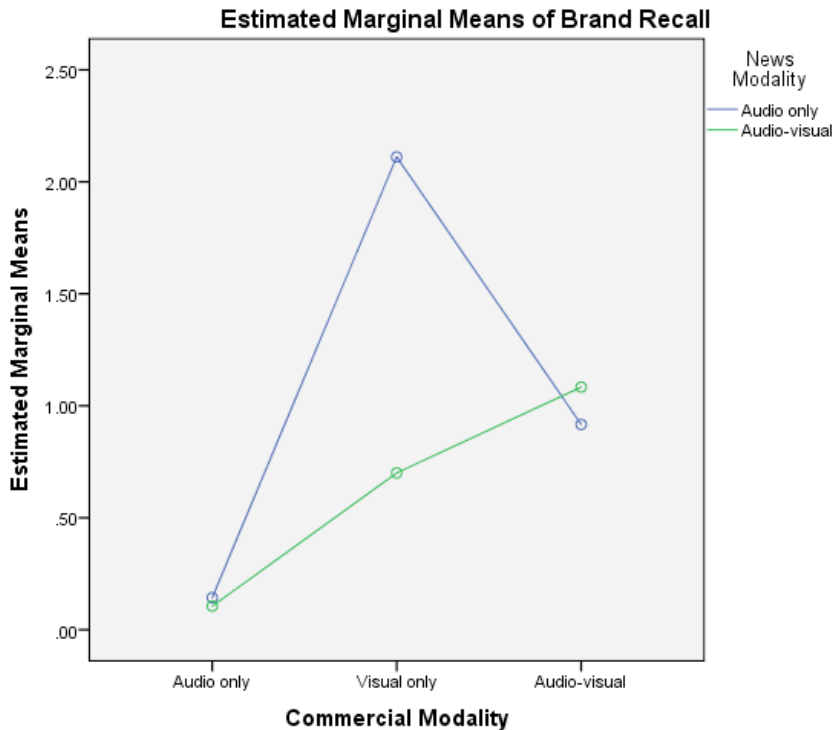
**Table 8** Differences in Commercial Modality with Brand Recall as a Dependent Variable Post Hoc Tests (Tukey HSD)

(I) Commercial Modality	(J) Commercial Modality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Audio only	Visual only	-1.2472*	.31037	.000	-1.9881	-.5064
	Audio-visual	-.9066*	.25973	.002	-1.5265	-.2866
Visual only	Audio only	1.2472*	.31037	.000	.5064	1.9881
	Audio-visual	.3406	.30561	.508	-.3888	1.0701
Audio-visual	Audio only	.9066*	.25973	.002	.2866	1.5265
	Visual only	-.3406	.30561	.508	-1.0701	.3888

Based on observed means.

The error term is Mean Square (Error) = 1.161.

\*. The mean difference is significant at the .05 level.



**Figure 8:** News Modality and Commercial Modality Condition Interaction for Brand Recall

**Dependent Variable: Product Recall**

The results indicate that the main effect of news modality was not significant ( $F=1.818$ ,  $df=1,82$ ,  $p=.181$ ,  $\eta^2=.022$ ). The audio-visual news condition resulted in the same level of product recall ( $M=1.79$ ) than the audio-only news condition ( $M=1.91$ ).

There was a significant main effect of commercial modality ( $F=21.215$ ,  $df=2,82$ ,  $p=.000$ ,  $\eta^2=.341$ ). In specific, post hoc comparison (Tukey’s test) results shows that participants who were performed in the visual-only commercial condition obtained better recall ( $M=2.58$ ) than the ones who were presented in the audio-only commercial condition ( $M=.45$ ), ( $p=.000$ ), whereas the visual-only commercial condition ( $M=2.58$ ) perceived in the same level of the audio-visual commercial condition ( $M=2.72$ ), ( $p=.938$ ). The audio-visual commercial condition recalled greater level ( $M=2.72$ ) than the audio-only commercial ( $M=.45$ ), ( $p=.000$ ).

Supporting the hypothesis, the results indicate that the interaction effect of news modality and commercial modality was significant ( $F=4.122$ ,  $df=2,82$ ,  $p=.020$ ,  $\eta^2=.091$ ). The modality-specific interference hypothesis predicts that the effect of commercial modality on product recall depends on whether news is presented in same or different modality. Specifically, greater interference (i.e., poorer product recall) would occur when news and commercials are presented in the same modality than when they are presented in different modalities. As shown in Figure 9, relative to other modality combinations, product recall was the highest when news and commercials were presented in different modalities ( $M_{\text{audio-only news+visual-only commercials}}=3.56$ ). ANOVA results indicated that the interaction effect was significant. The hypothesis was thus supported.

**Table 9** Mean and Standard Deviation of News Modality and Commercial Modality with Product Recall as a Dependent Variable

News Modality	Commercial Modality	Mean	Std. Deviation	N
Audio only	Audio only	.5000	.65044	14
	Visual only	3.5556	1.01379	9
	Audio-visual	2.3333	1.43548	12
	Total	1.9143	1.63368	35
Audio-visual	Audio only	.4211	.60698	19
	Visual only	1.7000	1.56702	10
	Audio-visual	2.9167	2.22470	24
	Total	1.7925	2.00344	53
Total	Audio only	.4545	.61699	33
	Visual only	2.5789	1.60955	19
	Audio-visual	2.7222	1.99444	36
	Total	1.8409	1.85625	88

**Table 10** Interaction Effect of News Modality and Commercial Modality with Product Recall as a Dependent Variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	120.819 <sup>a</sup>	5	24.164	11.072	.000	.403
Intercept	283.736	1	283.736	130.013	.000	.613
NEWS	3.967	1	3.967	1.818	.181	.022
COMMERCIAL	92.597	2	46.299	21.215	.000	.341
NEWS * COMMERCIAL	17.993	2	8.996	4.122	.020	.091
Error	178.954	82	2.182			
Total	598.000	88				
Corrected Total	299.773	87				

a. R Squared = .403 (Adjusted R Squared = .367)

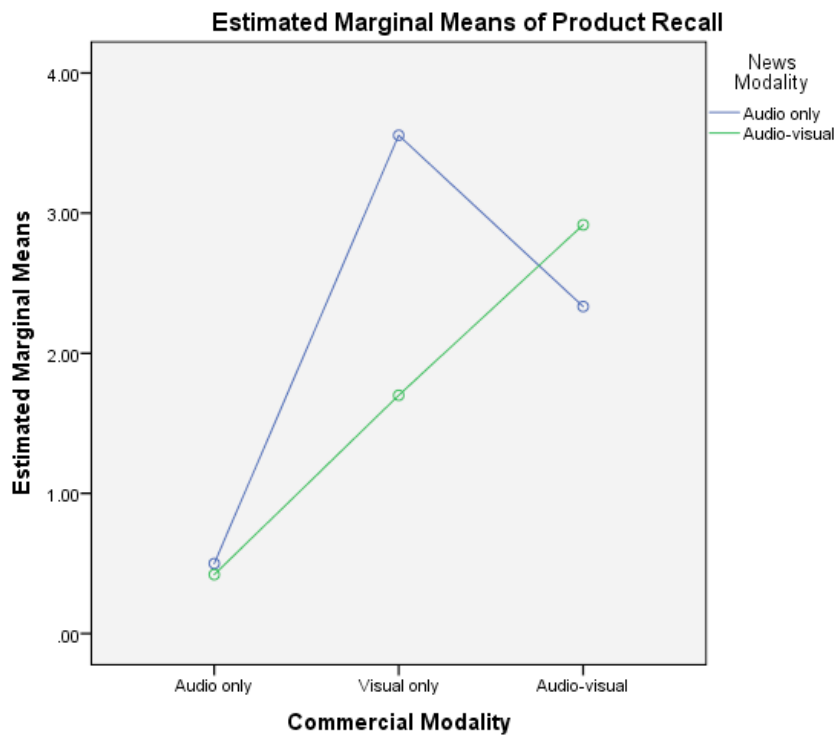
**Table 11** Differences in Commercial Modality with Product Recall as a Dependent Variable. Post Hoc Tests (Tukey HSD)

(I) Commercial Modality	(J) Commercial Modality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Audio only	Visual only	-2.1244*	.42543	.000	-3.1399	-1.1089
	Audio-visual	-2.2677*	.35602	.000	-3.1175	-1.4178
Visual only	Audio only	2.1244*	.42543	.000	1.1089	3.1399
	Audio-visual	-.1433	.41891	.938	-1.1432	.8567
Audio-visual	Audio only	2.2677*	.35602	.000	1.4178	3.1175
	Visual only	.1433	.41891	.938	-.8567	1.1432

Based on observed means.

The error term is Mean Square (Error) = 2.182.

\*. The mean difference is significant at the .05 level.



**Figure 9:** News Modality and Commercial Modality Condition Interaction for Product Recall



## **CHAPTER FIVE: DISCUSSION OF FINDINGS**

Extending prior research, the present study used a student sample to examine the role of message modalities in information processing in media multitasking environment. In this section, I present a further discussion of the results and their implications for theory and practice as well as recommendations for future research.

Learning from previous research that has investigated how same modality multitasking is perceived more difficult and more interference to task performance than multitasking in combining different modality tasks (e.g. Wang et. al., 2010; Xu, 2008). This present research expands the simple multitasking into a media multitasking environment. A general hypothesis was derived, and tested by dependent variables: news recall, brand recall and product recall. Specifically, the modality-specific interference hypothesis predicts that greater interference such as poorer news recall would happen when news and commercials are performed in the same modality than when they are presented in different modalities; however, the analysis and results presented indicate that there is no support for the hypothesis since there was no significant interaction effect of news modality and commercial modality on news recall. Nevertheless, the modality-specific interference hypothesis testing results provided support that relative to other modality combinations, brand recall was the highest when news and commercials were presented in different modalities. Likewise, relative to other modality combinations, product recall was the highest when news and commercials were performed in different modalities. Although the interaction effect of news modality and commercial modality on news recall did not support the

hypothesis, the fact that the interaction effect of news modality and commercial modality on brand recall and product recall received support, suggest the important role of message modalities in memory performance of media multitasking environment especially in advertising.

As many dual-task performance studies used the retroactive interference paradigm (e.g. Clayton & Warren, 1976; Murray & Newman, 1973; Salthouse, 1974) proved that visual and verbal encoding of specific stimulus are independent; furthermore, Paivio's dual coding theoretical framework (1986; 2007) indicates that human cognition has developed uniquely into separate but interconnected verbal and nonverbal representational subsystems. This research extends the model and theoretical framework by showing that the fact that the commercials were presented in different modalities in a media multitasking activity increased the level of recall although they were not familiar to the participants. However, some results of the present study seem to be inconsistent with the previous studies in specific-modality interference. The interaction effect of news modality and commercial modality on news recall was not supported the hypothesis could be possibly explained for the lesser interest in news stories in general. In addition, because the sample is undergraduate students, which corresponds to millennial generation (18-34 years old), it also seems possible that this generation does not consume news by going directly to news providers. In other words, young adults pay significant less attention to TV news; instead, they learn news mixed with social connection, problem solving, social action, and entertainment (American Press Institution, 2015) that might make their attention unequal and impact their memory performance of news regardless of the modality presented.

Even though the ANOVA results only partly support the hypothesis, together the findings lend to support the important role of message modalities in memory performance of media multitasking activities.

### **Theoretical Implications**

Multitasking has been around for decades and although most researchers agree that multitasking causes interference (e.g., Spink, 2008; Kahneman, 1973; Pasler, 1984, 1994; Kieras & Meyer, 1997) they disagree with the reason why interference occurs (e.g., Baddeley, 1986; Cowan, 2001, 2005; Hazeltine et al., 2006). Some researchers believe that human cognition ability is domain-general, interference happens when the central processing mechanism for one task is occupied by another. For example, as mentioned in the literature review, Welford (1952) in his experiment in which the PRP paradigm adopted that when we try to conduct sensory-motor task at the same time, the response to the second task is usually postponed. Similarly, Meyer & Kieras (1997) use the computational models of multitasking to explain that a central bottleneck will cause a competition of two or more tasks simultaneously. On the other hand, other researchers argue that human cognition is domain-specific and interference that occurs in multitasking is domain-specific interference. In his multiple resources theory, Wickens (1984, 2002) proves that human cognition has several attention mechanisms such as sensory input, response output and memory representations and interference occur when two tasks share or compete for common resources. Likewise, in Threaded Cognition Theory, Salvucci and Taatgen (2008) confirm that threads have their own executive control and they are coordinated by a cognitive processor and distributed across multiple processing resources. Thus interference only happens if these threads demand the same resources.

Although the interaction effect of news modality and commercial modality on news recall did not support the hypothesis, the majority of hypotheses are supported by the interaction effect of news modality and commercial modality on brand recall and product recall thus reinforcing the school of domain-specific human cognition. In other words, this study has given another hand to support the belief that domain-specific limitations are the main reason for the multitask presentation interference. In addition, human memory is independently but interconnected; therefore as long as the messages are presented in different modalities, the interference will be decreased. Many studies have explored the negative impacts of media multitasking and the influence of message modalities on cognitive activities has caused a big attention in cognitive psychology; however, it is believed that the findings of the present study took a combined look at the role of message modalities on human cognition, especially in memory performance of a media multitasking environment.

### **Practical Implications**

The results of the present study demonstrate that message modalities play a key role in transportation law enforcement as well as public safety. In specific, understanding that human cognition is domain specific limitations and the method in which messages are presented in different modalities are less interference, most of the states in America ban driving and texting but not calling on the phone and driving. It is clear that texting and driving both require people's visual modality, which cause more interference and restrict driver's ability to see objects ahead; thus not only their lives but also other people on the road might be put in danger. Although there are only 5 states that forbid hand-use cell phones while driving in general (New York; New Jersey; Connecticut; California and District of Columbia), the fact that the other 45 states allow

using cell phones while driving indicate that the school of modality-specific interference is gaining the advantage. In addition, this study illustrates how entertainment has organized in cars. There should be a crucial purpose of having a radio in the car for drivers but not a small TV. This could be explained that listening to the radio while driving causes not that much interference.

In addition, the findings of the study also raise a question toward companies about their advertising strategies. Nowadays, online advertising is considered as an effective way to bring companies' products to consumers. Companies have tried to introduce their products on an online network as much as they could; for example, Facebook users are familiar with the spot for advertising on the right side of their Facebook pages; however, the question is whether this advertising method really works? The findings of this research shows that people performed in better recall in commercials when messages are presented in different modalities, in this case Facebook users are required to distribute their visual attention at the same time; as a result; they might choose to spend time on their main purpose other than the advertisement or even if they see the advertisement they will not be able to remember the products. This situation could be applied for any other online network as well. Therefore, it is essential that companies learn about the role of message modalities in order to be sure that their money and efforts bring real productivity.

### **Research Limitations and Future Research Recommendations**

With regard to the study limitations, this present study's findings should not be generalized. Although this study reveals some significant implications, and efforts were made to ensure the validity, there are some limitations that are evident. First of all, the fact that news

stories were chosen as an independent variable could impact the results. Although the participants were reminded that they should pay equal attention to both the news stories and the commercials, young people tend to have less interest in traditional news stories, some people thus might have paid less attention to the news stories than the commercials. Future studies should consider using different independent variables that have the same level of interest by young participants. If this consideration is taken into account, then participants should spend their focus on both of them equally; therefore it should have a chance to have the effect of news modality on news recall supports the hypothesis. Additionally, more efforts can be invested in devising ways to control the partition of attention during media multitasking conditions in future.

Second, the sample population was limited. Due to time constraints and available resources, this study included a total 88 undergraduate participants. The small sample population may have had an impact on the results. Moreover, ideally this study should be conducted in 3X3 condition to have entire findings that might change the results of the effect of news modality on news recall. In addition, the big gap between 6 groups of participants (for example, one group had 10 participants while the other had 24 participants) might influence on the findings. The perfect size of each group for further research should be ranged from 10 to 15 participants.

## **Conclusion**

In conclusion, the overall goal of this present research was to study the relationship between message modalities and memory performance in a media multitasking environment. In the belief of human cognition is domain-specific, this study intended to examine the modality-specific interference by employing two independent variables: Modality of news broadcast and modality of commercials. Findings from the study indicate that relative to modality

combinations, brand recall and product recall was the highest when news and commercial were presented in different modality. Unfortunately, the results reflected there was no significant interaction effect of news modality and commercial modality on news recall, however, this study has shown that message modalities play the important role in memory presentation after the majority of the hypotheses were supported. Last but not least, the research also strengthens the belief that human cognition is domain-specific and reinforces the presence of modality-specific interference.

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## APPENDICES

### Appendix A: News script

**Reporter:** British Prime Minister David Cameron has condemned to the beheading of a Scottish Aid worker as an act of sheer evil following the release of a video of appearing to show the killing of David Haynes by an Islamic State militant. Cameron says the UK will do “everything in its power to hunt down those murderers and ensure they face justice however long it takes”. Haynes was kidnapped in March last year in Syria while helping of a French humanitarian Aid agency there. The video was released Saturday by Islamic State militants in it a man appearing to be hanging his knees in front of a masked man who warns alliance with the US will only accelerate the UK's destruction. Haynes is the third Western capt taken by the Islamic State, which has captured territory in Iraq and Syria.

Shifting our gears to a different story now, National Security advisor Kim Kwan-Jin left on a four-day trip to the United States this Sunday, while in Washington, Kim will meet with the American counterpart Susan Rice and other senior US officials for discussions on a wide range of issues including North Korea. Kim is also expected to discuss Seoul’ plans for supporting Washington fights against Islamic State. This is his first trip to the US since taking office in June and come during a time when North Korea is taking aggressive steps to bring itself out of diplomatic isolation. Pyongyang’s long time diplomatic heavy weight Kang Suk Ju is on a four-nation trip to Europe and Foreign Minister Lee Su Jung class to address to the UN General Assembly in New York later this month.

And on the sidelines of that upcoming UN General Assembly, a high-level meeting on North Korea's human rights situation will also take place it will bring renewed attention to the issue following Landmark UN report earlier this year that found widespread systematic and gross human rights violations, our Kim Min Ji has this report:

**Kim Min Ji:** “Top diplomats from South Korea, the US and North Korea will come face-to-face at a high-level meeting on North Korea's human rights situation the meeting slated to take place on the sidelines of the upcoming UN General Assembly is expected to hide diplomatic tensions on the issue. The US, South Korea and the UN High Commissioner for human rights have been organizing the meeting to garner support for UN General Assembly resolution on the issue. Pyongyang's human rights situation is received greater International attention this year following the release of a report by the UN Commission of inquiry that accuses North Korea's leaders, a widespread systematic and gross human rights violations. Reflecting Washington's growing interest in the issue, US Secretary of State John Kerry has reportedly decided to attend the ministerial meeting. In his Asia policy speech last month, Kerry said the North Korea's prison camps must be shut down immediately. Meanwhile North Korea appears to be making an effort to defend itself.”

“The North's Foreign Minister Lee Su Jung is scheduled to address the General Assembly which was marked North Korea's first ministerial addressed in 15 years. And on Saturday Pyongyang released its own assessment of the human rights situation claiming the rights of North Korean people are well protected under its socialist system. The report also said that Pyongyang has open to holding talks with any countries at anytime on the human rights situation in North Korea (Kim Min Ji, Arirang News)”

**Reporter:** Chinese tourists are the biggest spenders on Korea according to new data from Shinhan Bank and the Korea culture information service agency. Further spend a total of 4.8 million won or roughly 4.7 billion dollars on their credits during the first six months of the year. Up the total Chinese consumers account for nearly 53 % or about 2.4 billion dollars, the report shows that they spent the most on shopping followed by accommodations and dining. Japan was the second biggest spender followed by the US

Shifting our gears to some green energy news. Sale of Electric Vehicles jumped 1.5 times the first half of the year from 2013, unfortunately EV by Korean automakers Hyundai and Kia only two microscopic piece of that pie, .2% to be exact. According to numbers released Sunday by automotive industry portal marked lines over 60,000 EVs were sold worldwide between the months of January and June 2014, a 40.4% increase from the same period last year.

Leading the pack was Nissan's Leaf with global sales of 24,344 or 40% of the Global EV sales trailing behind are Tesla's Model S BMW I3 Renault Zoe. Korea's EV model Ray sold just 139 in the first half of 2014 with overall EV sales declining from 531 in the year 2012 to 277 in 2013.

## Appendix B: News Questionnaire

### Aided Recall measurement for news:

Now you will be asked some questions about the news. Please write down in the answers based on your memory of the news. Do not worry too much about getting the spelling and the grammar right.

1. According to the news, who has condemned to the beheading of a Scottish Aid worker as an act of sure evil?
2. According to the news, a video released by....., in it a man appearing to.....
3. Haynes was kidnapped in March last year in Syria while.....
4. Haynes is the third Western cast taken by....., which has captured territory in .....
5. Where does the Korean National Security Adviser travel?
6. How many days does Korean National Security Adviser stay in the US?
7. Korean National Security Adviser is expected to discuss on a wide range of issues including..... He also expected to discuss Seoul's plans for supporting Washington fights against.....
8. Top diplomats from South Korea, the US and North Korea will come face-to-face at a high-level meeting on what issue?
9. ....is received greater International attention this year following the release of a report by the UN Commission of inquiry that accuses North Korea's leaders: a .....and.....violation.
10. ....has opened to holding talks with any countries at anytime on the..... in North Korea.
11. According to new data from Shinhan Bank and the Korea culture information service agency,.....tourists are the biggest spenders on Korea?
12. Which one is the second biggest spender and which one is the third?
13. The biggest spenders spend the most on....., followed

by....., and.....
<b>14.</b> Korean's EV (Electric Vehicle) sales.....despite the global EV sales spike
<b>15.</b> How many were EV sold worldwide?
<b>16.</b> Leading the path was ..... trailing behind are.....

## Appendix C: Commercial Questionnaire

### Commercial Free Recall

Please recall and write down into the table as many brand names of the commercials that appeared in the video/audio/visual-audio as possible.

**Note: please do not look at the last question until you are done with this question**

Brand names	Scores (for investigator only)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	



**Now all the product names that appeared in the commercials are listed below, please write down their product types**

Product names	Product types	Scores (for investigator only)
Darlie Expert White		
Selecta		
Harvey Norman		
Marigold		
Pan Asia		
Scott's emulsion		
Kirei Kirei		
Nin Jiom		
Srilankan		
Cho8		

## Appendix D: Coding Scheme

### News: Recall units

Unit 1	<p><b>British Prime Minister David Cameron</b> has condemned to the beheading of a Scottish Aid worker as an act of sure evil following the release of a video of appearing <b>show the killing of David Haynes by an Islamic State militant</b>. Cameron says the UK will do “everything in its power to hunt down those murderers and ensure they face justice however long it takes”.</p> <p>Haynes was kidnapped in March last year in Syria while <b>helping of a French humanitarian Aid agency there</b>. The video was released Saturday by Islamic State militants in it a man appearing to be hanging his knees in front of a masked man who warns alliance with the US will only accelerate the UK's destruction.</p> <p>Haynes is the third Western cast taken by <b>the Islamic State</b>, which has captured territory in <b>Iraq and Syria</b>.</p>
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<p>Unit 2</p>	<p>Shifting our gears to a different story now National Security advisor Kim Kwan-Jin left on <b>a four-day trip</b> to the United States this Sunday, while in Washington, Kim will meet with the American counterpart Susan Rice and other senior US officials for discussions on a wide range of issues including <b>North Korea</b>. Kim is also expected to discuss Seoul' plans for supporting Washington fights against <b>Islamic State</b></p> <p>This is his first trip to the US since taking office in June and come during a time when North Korea is taking aggressive steps to bring itself out of diplomatic isolation. Pyongyang's long time diplomatic heavy weight Kang Suk Ju is on a four-nation trip to Europe and Foreign Minister Lee Su Jung class to address to the UN General Assembly in New York later this month.</p>
<p>Unit 3</p>	<p>And on the sidelines of that upcoming UN General Assembly, a high-level meeting on North Korea's human rights situation will also take place it will bring renewed attention to the issue following Landmark UN report earlier this year that found widespread systematic and gross human rights violations, our Kim Min Ji has this report:</p> <p>Top diplomats from South Korea, the US and North Korea will come face-to-face at a high-level meeting on <b>North Korea's human rights situation</b> the meeting slated to take place on the sidelines of the upcoming UN General Assembly is expected to hide diplomatic</p>

	<p>tensions on the issue.</p> <p>The US, South Korea and the UN High Commissioner for human rights have been organizing the meeting to garner support for UN General Assembly resolution on the issue. <b>Pyongyang's human rights situation</b> is received greater International attention this year following the release of a report by the UN Commission of inquiry that accuses North Korea's leaders: a <b>widespread systematic and gross human rights</b> violations. Reflecting Washington's growing interest in the issue, US Secretary of State John Kerry has reportedly decided to attend the ministerial meeting. In his Asia policy speech last month, Kerry said the North Korea's prison camps must be shut down immediately.</p>
Unit 4	<p>Meanwhile North Korea appears to be making an effort to defend itself.</p> <p>The North's Foreign Minister Lee Su Jung is scheduled to address the General Assembly which was marked North Korea's first ministerial addressed in 15 years. And on Saturday Pyongyang released its own assessment of the human rights situation claiming the rights of North Korean people are well protected under its socialist system. The report also said that <b>Pyongyang</b> has open to holding talks with any countries at anytime on <b>the human rights situation</b> in North Korea</p>

Unit 5	<p><b>Chinese tourists</b> are the biggest spenders on Korea according to new data from Shinhan Bank and the Korea culture information service agency. Further spend a total of 4.8 million won or roughly 4.7 billion dollars on their credits during the first six months of the year. Up the total Chinese consumers account for nearly 53 % or about 2.4 billion dollars, the report shows that they spent the most on <b>shopping</b> followed by <b>accommodations</b> and <b>dining</b>. <b>Japan</b> was the second biggest spender followed by <b>the US</b></p>
Unit 6	<p><b>Sale of Electric Vehicles jumped 1.5 times the first half of the year from 2013, unfortunately EV by Korean automakers Hyundai and Kia only two microscopic piece of that pie, .2% to be exact.</b> According to numbers released Sunday by automotive industry portal marked lines <b>over 60,000 EVs</b> were sold worldwide between the months of January and June 2014, a 40.4% increase from the same period last year.</p> <p>Leading the pack was <b>Nissan's Leaf</b> with global sales of 24,344 or 40% of the Global EV sales trailing behind are <b>Tesla's Model S and BMW I3 Renault Zoe</b>. Korea's EV model Ray sold just 139 in the first half of 2014 with overall EV sales declining from 531 in the year 2012 to 277 in 2013.</p>

## **Aided Recall Coding Instructions**

For this coding, each fill in the blank question, or each answer is one unit. The questions will be coded for right/wrong response. The unit for agreement will be the total aided recall score for each case. The following guidelines will be followed:

1. Each question has a specific answer. If the response provided by the subject is the specific answer or any other everyday expression implying the specific answer, the response will be judged correct (e.g. IS/ISIS instead of Islamic State militant).
2. The spelling and grammar of the response will not factor into evaluation as long as a meaningful identification of the intended answer can be made. Even if the response sounds like the specific answer, the response will be considered right (e.g. Pyongyang will be evaluated same as Pongyong, Pangyong, etc.).

**Appendix E: IRB Approval Letter**



UNIVERSITY OF  
SOUTH FLORIDA

October 11, 2016

RESEARCH INTEGRITY AND COMPLIANCE  
Institutional Review Boards, FWA No. 00001669  
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799  
(813) 974-5638 • FAX (813) 974-7091

Le Nguyen Communication Tampa, FL 33612

**RE: Exempt Certification**

IRB#: Pro00028125

Title: Media multitasking and Memory: The Role of Message Modality

Dear Le Nguyen:

On 10/11/2016, the Institutional Review Board (IRB) determined that your research meets criteria for exemption from the federal regulations as outlined by 45CFR46.101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF HRPP policies and procedure.

Please note, as per USF HRPP Policy, once the Exempt determination is made, the application is closed in ARC. Any proposed or anticipated changes to the study design that was previously declared exempt from IRB review must be submitted to the IRB as a new study prior to initiation of the change. However, administrative changes, including changes in research personnel, do not warrant an amendment or new application.

Given the determination of exemption, this application is being closed in ARC. This does not limit your ability to conduct your research project.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

A handwritten signature in black ink that reads "John A. Schinka, Ph.D." The signature is written in a cursive style.

John Schinka, Ph.D., Chairperson

USF Institutional Review Board