



Article

“The Theater of the Mind”: The Effect of Radio Exposure on TV Advertising

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Abstract: Contemporary society requires communication strategies that integrate different media channels in order to improve advertising performance. Currently, there are not many scientific research studies of the various mass media, comparing the results of audiovisual advertising to purely audio or visual messages aimed at detecting the best combination of media, especially from a neurophysiological perspective. This study aims to investigate the effects of previous exposure to an advertisement via radio on the consumers’ response to the same advertisement shown on television (TV) or as a banner on a website. A total of seventy participants in a between-subjects experiment watched several television commercials during the advertising break of a documentary or saw some banners during a web surfing task. Half were first exposed to the same advertisements via radio. The results have shown that participants who previously listened to the radio advertisements spent a longer time looking at the brand and had a higher engagement when watching the same advertisements on television. Moreover, they had a different kind of visual attention to the website banners. This pattern of results indicates the effect of mere exposure—that is, the exposure to a radio advertisement enhances the effectiveness of the same advertisement via television or web, offering useful insights for media planning campaigns. Even if mere exposure has been extensively studied, cross-media research is scarcely explored, whereas this study detected the effects of mere exposure in a cross-media communication strategy, showing that it can be measured through psychophysiological methods.

Keywords: advertising; media effects; mere exposure; neurophysiology; effects of emotions

1. Introduction

Radio has the power to create pictures in the audience’s mind, stimulating them to “see” what they are listening to (Bolls 2002). The ability to evoke a sort of “visual perception” while listening to an advertisement implies the possibility of engaging the listeners in visual exposure to the product. For this reason, being exposed to a radio advertisement could enhance the familiarity of the audience with the message and can affect the consumers’ reaction to the same advertisement when shown on television. Following Berlyne’s (Berlyne 1960; Anand and Sternthal 1990) two-factor theory, in the first exposure to a message, there may be a certain amount of uncertainty and repetition that may reduce a negative response, increasing effectiveness (Cox and Cox 1988; Hansen and Wänke 2009) at moderate levels of repetition (Cacioppo and Petty 1979). This is due to “habituation”, which is the process by which initial uncertainty or negativity towards an unfamiliar stimulus is attenuated (Robinson and Elias 2005; Vakratsas and Ambler 1999).

1.1. Comparison between Media

According to [Liu and Stout \(1987\)](#), there are very few scientific studies on the various mass media which compare the results of audiovisual advertising to audio-only messages. [Chaiken and Eagly \(1976\)](#) submitted a sample of messages intended to persuade, in both easy and hard-to-understand versions in print, videotape and audio only formats. Messages that were difficult to understand were more effective, both in persuasion and in understanding, when they were presented in written form. Simple messages were more persuasive in videotape format and acceptable in the audio format, while understanding was the same for all three media. [Klein \(1981\)](#), when comparing radio, press and TV, observed that recollections of the message's content immediately after exposure were significantly greater with radio and print than TV, but after about two weeks, all three were equally forgotten. [Soldow \(1983\)](#) showed that TV can refresh the memory of a product more effectively than either radio or press. [Jacoby et al. \(1983\)](#) found that written advertising results in a better understanding of the message, whether it be complex or simple, than radio or TV (which are about equal in this respect). The reason for this phenomenon is attributed to the fact that reading is not subject to the distractions that are present in dual mental processes such as responding to an audiovisual stimulus. [Liu and Stout \(1987\)](#) suggested that viewing TV induces the formation of arguments against the desired persuasive message more frequently than those found listening to the radio.

[Greenfield and Beagles-Roos \(1988\)](#) explored the potential of stimulating the imagination in relation to different media, noting that the radio elicited a type of imagination based on the use of verbal elements that was different from those heard in the radio message, while, instead, television aroused a kind of imagination that reflected the same terms heard in its verbal content. In general, TV is more memorable, mainly in regard to actions and characters, and radio performs better in helping the audience to remember what is heard. As for radio, studies have shown that it can create pictures, as listeners "see" what they hear ([Bolls 2002](#); [Loverock and Modigliani 1995](#); [MacInnis and Price 1987](#)), enhancing the familiarity of a television advertisement. Moreover, imagery advertisements are more personally relevant to the audience ([MacInnis and Price 1987](#)) and lead to higher involvement and to a more favorable response ([Babin and Burns 1997](#); [Bolls et al. 1998](#); [Bone and Ellen 1990](#); [Miller and Marks 1997](#); [Unnava and Burnkrant 1991](#); [Unnava et al. 1996](#)).

An effect of the interaction between the media was also observed: the subjects who first listen to the radio version and then the television version of the same message produce better imaginative results, in terms of both quantity and quality, and remember them better than when they see the television medium first and then the radio one. The reason for this is linked to the fact that the radio version requires a greater mental effort which, as a correlated effect, is maintained in the following phase of television viewing (a dynamic effect that cannot occur if the media sequence is reversed). [Edell and Keller \(1989\)](#) carried out research on the combined use of TV and radio, noting that exposure to TV only promoted a greater recall of the brand and claim compared to the radio. Using more than one medium revealed, instead, that a strategy of mixed media (TV, radio and radio-then-TV) resulted in reduced recollection compared to TV only. In comparing the two mixed media conditions (radio-then-TV and TV-then-radio), the former caused better recall of the message than the latter. Moreover, in the latter, less of the auditory content of the message was recalled. Finally, with only the radio-then-TV condition, the viewers remembered the claim and content better. This was verified subsequently when video advertising did not exactly copy the radio version, but only mentioned the salient elements, thus giving the viewer more freedom of interpretation than an exact copy of the content of the radio version would allow. [Buchholz and Smith \(1991\)](#) confirmed that the motivation to deal with an advertising message has a different role in TV compared to radio. When the audience has low involvement, TV is more effective in terms of brand recall and recollection of the content of the message when compared to radio. When the motivation to process the message is high, radio stimulates personal interpretations, due to links between the contents of the message and the personal experiences of the subject, which are stronger than the links created with TV. Finally, when subjects are motivated, brand recall and the contents of the message are equivalent between the two media.

DeFleur et al. (1992) showed how the recollection of information is better when it is written on paper or seen on a computer screen than it is when seen on TV or heard on the radio. A study on the beliefs and perceptions of listeners experiencing various media has shown that women have a more positive perception of radio than men. Wolin and Korgaonkar (2003) asserted that for men, web advertising is perceived as more “useful” than radio, and for women, the internet presents advertising content which is more “offensive” than that found on the radio. A further study by Dash and Belgaonkar (2012) has shown that the internet is perceived as the most convenient and accessible way of finding information, the press is most effective at changing attitudes towards a product or service, and TV is most effective in influencing purchase decisions regarding low-priced products. Finally, radio is the chosen instrument for young people when they have to make a purchase decision; most adults would prefer another medium. A neuroscientific study by Peacock et al. (2011) revealed that radio advertising generated a stronger emotional reaction (arousal) and higher engagement than similar television messages. There is, however, evidence to the contrary. Helmreich (1976) suggested that most studies (Barrow and Westley 1959; Gunter 1979; Siegel 1973; Vig 1980; Waite 1979) show how material broadcasted on television is remembered better than when broadcasted on the radio. These results—favoring TV—are based specifically on the two-channel aspects—auditory and visual—of communication that characterizes TV, which, in fact, causes mutual reinforcement and enhancement during the processing (Greenfield and Beagles-Roos 1988).

1.2. The Mere Exposure Effect

In the 1960s, Robert Zajonc demonstrated that simply exposing the subjects to a stimulus led them to rate it more positively (Zajonc 1968; Zajonc 2001). This psychological phenomenon is known as the “mere exposure effect”, by which people tend to develop a preference and a positive attitude towards stimuli, such as an advertisement, a product, or a logo, that they have been repeatedly exposed to. The psychological mechanism underlying mere exposure is the activation of a learning process that shapes the individual attitude because of the familiarity with the stimulus. In fact, repeated exposure increases familiarity, which enhances a positive response (Zajonc 1968). Several psychologists have proposed different explanatory hypotheses regarding the phenomenon of the mere exposure effect. According to Birnbaum and Mellers (1979), a key role is played by the mnemonic process of recognition. More deep, repeated exposures to a stimulus make it more recognizable, according to the assumption that people generally prefer familiar things over unfamiliar ones. Moreland and Zajonc (1979) proposed a contrasting explanation in which they underestimate the importance of recognition and argue that exposure is sufficient to lead directly to the formation of a positive emotional response. This view suggests that repeated exposure has two independent effects: firstly, it directly increases positive emotions (eliciting liking); secondly, it leads to greater recognition (causing familiarity). A third explanatory model, subsequent to those described above, is called the “two-factor model” and focuses on the relationship between repeated exposure and perceptual fluency. In particular, according to this model, repeated exposure increases perceptual fluency and the latter induces a sense of familiarity towards the stimulus, resulting in a more favorable affective response (Lee 2001).

In the last few decades, the mere exposure effect has been demonstrated in a wide range of stimuli, such as music (Wilson 1979), paintings (Meskin et al. 2013), faces (Zebrowitz et al. 2008), tasting (Pliner 1982) and advertising (Ruggieri and Boca 2013). In the advertising field, Fang et al. (2007) found that people who had been previously exposed to advertising banners rated them more favorably than other banners that they had not seen before. Other authors found similar results for television advertising (Ruggieri and Boca 2013). Repetition and affect have an inverted, U-shaped relationship (Cacioppo and Petty 1979; Calder and Sternthal 1980; Crandall et al. 1973; Schmidt and Eisend 2015).

Furthermore, mere exposure has been measured using a variety of rating procedures, such as ratings of liking, pleasantness, and forced-choice preference judgments (Bornstein 1989). Some studies have also measured mere exposure by adopting physiological and neuroscientific methods such as skin

conductance (Öhman and Soares 1998), electromyography (EMG) (Dimberg et al. 2000) and Functional Magnetic Resonance Imaging (fMRI) (Morris et al. 1998).

Most studies on mere exposure have examined intramodal stimuli, particularly of the visual modality. However, some studies suggest the presence of mere exposure during object recognition using visual and tactile sensory systems (Easton et al. 1997; Reales and Ballesteros 1999; Suzuki and Gyoba 2008). In this study area, the mere exposure effect has scarcely been explored from the cross-media research standpoint, whereas this study detects the mere exposure effect in a cross-media communication strategy, measuring it through psychophysiological methods.

The aim of the present study is to verify whether there is a difference in the visual behavior of brands and emotional response between consumers exposed to a television advertisement or a website banner and consumers exposed to the same advertisement, who previously listened to it via radio. We propose that consumers respond differently to a television advertisement and a web banner if they are previously exposed to an analogous advertisement via radio.

The study hypotheses are as follows:

Hypothesis 1 (H1). *Participants who were previously exposed to an advertisement via radio will have a more positive response to the same advertisement viewed on television.*

Prior exposure to an advertisement enhances familiarity and pleasure. Moreover, high imagery advertising conveyed through the radio is effective at fostering positive attitudes (Bone and Ellen 1992; Childers and Houston 1984; Lutz and Lutz 1977; Unnava and Burnkrant 1991). Visual attention towards a stimulus is influenced by the viewer's motivations, attitudes and interests (Calitri et al. 2009; Hoffman 1998; Lavie and Dalton 2014; Mogg et al. 2003; Pieters and Wedel 2004; Songa and Russo 2018; Herpen and Trijp 2011; Yang et al. 2002). This leads to our second hypothesis.

As for the second hypothesis, it is considered that the prior exposure to a radio advertisement will change the visual attention to the promoted brand in advertisements that are visual (television and web banners). In particular,

Hypothesis 2a (H2a). *Participants previously exposed to an advertisement via radio will demonstrate greater visual attention to the brand from the same advertisement watched on television.*

Hypothesis 2b (H2b). *Participants previously exposed to an advertisement via radio will demonstrate greater visual attention to the same brand in a web banner.*

2. Materials and Methods

2.1. Stimuli

The stimuli were two 30-s radio advertisements and two corresponding 30-s television advertisements and web banners relating to the same advertising campaign. To avoid the effect of the specific product, the advertisements promoted two different kinds of products/services. In more detail, the two chosen brands are real and are an electric power supplier, named ENEL (Brand 1), and a bank, named FINECO (Brand 2). These two brands were chosen because they were completely comparable and had complete integrated communication, composed of radio advertisement, television advertisement and web banners, in the same period, with the distractors used in the experimental protocol.

The specific stimuli related to the selected radio advertisements, TV advertisements and web banners are described in Appendix A.

2.2. Participants and Procedure

A total of 70 subjects (50% male, 50% female) aged between 25 and 55 years (mean = 41; $SD = 8.45$) participated in the experiment in exchange for financial compensation. The participants

were experimentally naïve, with normal vision and no history of neurological problems. Each participant conducted the study individually, unaware of the purpose of the study, and was informed that he/she would be identified with a code in order to guarantee privacy. Before exposure to the stimuli, a screening questionnaire was administered to understand whether potential participants were clients of those brands, in order to avoid an influencing effect given by brand awareness. For this reason, the participants in the study were those that were indicated not to be clients of this specific bank or electric power supplier. The experiment was conducted in a quiet room, where the temperature and the light were kept constant. After providing informed consent, the participants were comfortably seated 60 cm away from the computer display (a Dell 43.9 cm monitor) embedded with the SMI-RED250 system.

Forty subjects were exposed to television advertisements, randomly assigned to each of the following conditions: (1) television advertisement (20 subjects) or (2) radio and television advertisements (20 subjects). The participants in the television condition were exposed to a neutral documentary, interrupted by an advertising break in which the target advertisements were shown among other commercials of the same duration, used as distractors. The advertisements were shown in a random order to avoid the effect of order or sequence of the stimuli. Before starting the recording of eye movements, a 5-point calibration was carried out using SMI iViewX software. The participants in the radio and television condition performed the same experiment with the addition of a previous exposure to the same advertisements via radio.

The remaining thirty subjects were exposed to web banners. They were randomly assigned to each of the following conditions: (1) web banners (15 subjects) or (2) radio advertisements and web banners (15 subjects). The participants in the web banners condition were presented with some web pages showing different advertising banners. The banners comprised the two targets and other banners of the same size. The participants in the radio advertisements and web banners condition viewed the same web pages but were previously exposed to radio advertisements. Throughout the whole experiment, the participants' eye movements, the cortical activation and the physiological parameters were recorded.

2.3. Dependent Variables

2.3.1. Visual Behavior

Eye movements were recorded in real time using a SMI-RED250 system, which allows users to measure the subjects' visual attention (Laubrock et al. 2007) by recording an image of the eye and determining the precise gaze position on the visual field by means of an infrared light. SMI-RED250 is a horizontal bar, fixed under the screen, in front of the face of the experimental subject.

We analyzed participants' visual attention to the brand shown in the television advertisements, comparing the time spent on the brand area between the subjects in the two conditions for each media: "television advertisements" versus "radio and television advertisements"; "web banners" versus "radio advertisements and web banners". In order to measure the time spent on brands in both the visual spots and the web banners, AOIs (areas of interest) were created in correspondence with the brand areas in the TV spots and in the web banners. The AOI defines circumscribed regions in the stimulus that the researcher is interested in gathering data about (Holmqvist and Andersson 2017).

In particular, the parameter of "dwell time" was used, indicating the amount of time (calculated in milliseconds) that respondents spent on the AOI. In TV spots, indeed, the dwell time percentage was calculated by dividing the fixation time spent on the AOI by the overall time for which the brand was displayed on the screen and multiplying the result by 100. Similarly, in the web condition, the dwell time percentage was obtained by dividing the duration of the banner fixation by the length of stay on the web page where the brand banner was present, multiplied by 100.

This index was used in previous research about consumers' responses to advertisement and reflects the relevance of the stimulus (Krugman et al. 1994). Since mere exposure is a phenomenon that produces a greater preference towards the stimuli to which we have already been exposed

(Zajonc 1968), we hypothesized that the condition in which the radio preceded the TV would elicit a greater perception of relevance-interest towards the brand, measurable through visual fixation time.

2.3.2. Neuro and Psychophysiological Signals

The emotional reaction to advertisements was measured using indirect techniques, able to detect the more spontaneous aspects of consumers' emotional reactions in real time. These kinds of measurements assess the variation in the body parameters reflecting emotional activation (Bechara et al. 2000; Damasio 1994; Peter 2007; Larsen et al. 2003; Poels and Dewitte 2006; Posner 2016; Smith and Gevins 2004; Vitouch 1997). These variations are not under the subjects' control, thus indirect techniques allow us to also measure emotions of which the participant is unaware (Bechara et al. 2000; Damasio 1994; Peter 2007), offering objective and complete information that is less biased than direct techniques based on explicit questions (Eser et al. 2011; Hubert and Kenning 2008; Murphy et al. 2008; Page 2012; Stewart and Furse 1982). Indeed, people can forget their responses to preserve their self-image or they may say what is considered more socially acceptable (Crosby et al. 1980; DeMaio 1984; Edwards 1957; Maass et al. 2000; Marlow and Crowne 1961; Paulhus 1984; Roccato and Zogmaister 2010). Moreover, subjects' answers can be distorted unintentionally due to the lack of introspection abilities (Banaji 2001; Boca 1996; Greenwald and Banaji 1995; Kitawaki and Nagabuchi 1998) and the difficulty of verbalizing emotions (Penn 2006). For these reasons, direct techniques are suitable to measure emotions that are definite and conscious and that the subject intends to report truthfully to the researcher (Jacoby et al. 1992; Greenwald and Banaji 1995). As a considerable component of an emotional response and cognitive process is unconscious (Butler 2008; Hubert and Kenning 2008; Morin 2011; Page 2012), the neuropsychophysiological approach has been widely used in advertising research (Fugate 2007; Ohme et al. 2011; Senior and Lee 2008).

In the current experiment, we used the Thought Technology FlexComp System (Biograph Infiniti Software, Thought Technology Ltd., Montreal, Quebec, Canada) to record the neuro and psychophysiological signals sampled at 256 Hz, in line with the literature indicating an average of at least 100–200 Hz to guarantee a number of samples that provides an accurate representation of the signal (Figner and Murphy 2011). Both the neural and the skin conductance signals have been standardized with respect to the baseline, represented by a neutral stimulus consisting of a documentary. An increase in conductivity, due to greater sweat production caused by a greater activation of the sweat glands controlled by the sympathetic nervous system through the hypothalamus, is an arousal index (activation) of the subject (Ravaja 2004; Bolls et al. 2001; Lang 1995; Bradley and Lang 2000).

The prefrontal asymmetry index was introduced over 40 years ago by Davidson (Davidson et al. 1979) and is based on a theoretical framework arguing that human emotions are organized in a two-dimensional space, characterized by the dimensions of the motivational trends of approach and avoidance. The motivation to approach is related to positive emotions, such as interest, joy and happiness. On the other hand, motivation to avoid reflects negative emotions, such as fear and sadness. Davidson has conducted a series of studies in which he has shown that these motivational trends have a neuronal basis, linked to the alpha band activity (8–12 Hz) in the frontal regions of the left and right brain hemispheres. In particular, greater activity of the frontal region of the left hemisphere occurs when there are stimuli able to create positive emotions, whereas a greater activation of the right hemisphere occurs when stimuli elicit negative emotions (Davidson 1993, 2000; Davidson et al. 1990). This index reflects the subject's tendency to approach or avoid the stimulus (Davidson et al. 1990; Harmon-Jones et al. 2010; Price et al. 2012; Rutherford and Lindell 2011) and it has been used in previous research to measure advertising effectiveness (Astolfi et al. 2009; Ohme et al. 2011; Ohme et al. 2010a; Ohme et al. 2009, 2010b; Vecchiato et al. 2010, 2011). The index was computed to have higher (lower) values indicating a higher tendency to approach (avoid) the stimulus.

The neural signal was measured through two electroencephalography electrodes placed over the F3 and F4 positions, corresponding to the left and right sides of the frontal lobe according to

the International 10-20 system. The “frontal alpha asymmetry” (FAA) index was computed as the difference in alpha power band (8–12 Hz) between the electrode placed on the right hemisphere (F4) and the electrode placed on the left hemisphere (F3).

As for the skin conductance aspect, the term “electrodermal activity” (EDA) was introduced by Johnson and Lubin (1966), generally referring to all the electrical phenomena affecting the skin.

The galvanic response of the skin (GSR) depends on the activity of the sweat glands under the control of the autonomic nervous system (Dawson et al. 2000) and therefore does not respond to the conscious control of the individual.

The principle of GSR is based on the fact that the sweat contains a conductive saline solution which causes a lowering of the resistance to the passage of the current, determining an increase in the skin’s ability to conduct an electric current. An increase in the activity of the sweat glands, and therefore a reduction in the conductivity of the skin, corresponds to an increase in arousal (Boucsein 2012). Thus, to obtain an index of arousal, we recorded the psychophysiological signal of skin conductance (Bolls et al. 2001; Bradley and Lang 2000; Lang 1994; Ravaja 2004) using two electrodes (11 mm, Ag/AgCl) placed on the index and middle fingers of the non-dominant hand. The skin conductance level has been used in several previous studies to analyze TV commercials (Kohan 1968; Lajante et al. 2012; Ohme 2009; Peacock et al. 2011; Vecchiato et al. 2014).

The mean values of both FAA and skin conductance were computed for each stimulus. In order to measure the changes in both parameters due only to the stimuli and to consider inter-subject differences, the values were z-score transformed using the mean value and the standard deviation of the last 30 s of the baseline.

3. Results

3.1. Hypothesis 1

The first hypothesis predicted that participants will have a more positive response to a television advertisement if they were previously exposed to the same advertisement via radio. This hypothesis was tested by comparing the psychophysiological signals of the participants in the two experimental conditions (“television” and “radio and television”).

Results have shown a significant difference between the participants in the television advertisement condition and those in the radio and television advertisement condition. In particular, participants who were exposed to the radio advertisements before watching the television advertisements showed a higher skin conductance level and a higher FAA index than the other participants. This pattern of results reflects a more intense and positive emotional response to the television advertisements if participants previously listened the same advertisements via radio. Table 1 shows the results of the comparison. The same results were verified by separately considering the two advertisements (Table 2).

Table 1. Response to advertisement comparison.

	Emotional Response				
	TV Ad	TV Ad Post-Radio	t Value	df	Pr (> t)
FAA Index	1.67	3.18	−3.27	62	<0.01 **
Skin conductance	0.38	0.87	−8.21	62	<0.001 ***

*** Significant at the 0.001 level (two-tailed). ** Significant at the 0.01 level (two-tailed).

Table 2. Response to advertisements.

		Emotional Response				
		TV Ad	TV Ad Post-Radio	t Value	df	Pr (> t)
Brand 1	FAA Index	0.20	0.78	−14.06	30	<0.001 ***
	Skin conductance	0.61	0.90	−6.33	30	<0.001 ***
Brand 2	FAA Index	3.13	5.57	−4.60	30	<0.001 ***
	Skin conductance	0.15	0.85	−28.64	30	<0.001 ***

*** Significant at the 0.001 level (two-tailed).

3.2. Hypothesis 2

The second hypothesis predicted that listening to a radio advertisement could change the participant's visual attention to the brand while watching a visual advertisement from the same campaign. Particularly, H2a posited that the prior exposure to an advertisement via radio leads to greater visual attention to the brand in the same advertisement watched on television. To test this proposition, dwell time data of the participants in the two conditions were submitted to a chi-square analysis. In particular, we considered the percentage of dwell time on the brand compared to the total visible time of the brand. We posited a relationship between emotional preference and visual attention, because dwell time was used in previous research on consumers' responses to advertisements as an index of the stimulus relevance (Krugman et al. 1994).

Results have shown that the group of participants who were previously exposed to the advertisements via radio paid greater visual attention to the brand in the same advertisements watched on television (percentage TV = 32%, percentage TV post-radio = 52.9%; $\chi^2 = 8.94$, $p < 0.01$). This result was verified for both the advertisements (Table 3).

Table 3. Dwell time (%) on the brand areas (TV advertisements) comparison.

		Dwell Time			
		TV Ad	TV Ad Post-Radio	χ^2	Pr (> t)
Brand 1		0.40	0.65	12.53	<0.001 ***
Brand 2		0.24	0.41	6.58	<0.01 **

*** Significant at the 0.001 level (two-tailed). ** Significant at the 0.01 level (two-tailed).

H2b predicted that previous exposure to radio advertisement will increase the attention to the brand in web banners from the same advertising campaign. Results have shown that the group of participants who were previously exposed to the advertisements via radio paid greater visual attention to the brand in the web banners from the same advertising campaign (percentage web = 77.5%, percentage web post-radio = 91%; $\chi^2 = 5.27$, $p < 0.05$). This result was verified for both the advertisements (Table 4).

Table 4. Dwell time (%) on the brand areas (web banners) comparison.

		Dwell Time			
		Banner Ad	Banner Ad Post-Radio	χ^2	Pr (> t)
Brand 1		0.70	0.89	11.07	<0.001 ***
Brand 2		0.85	0.93	3.27	<0.05 *

*** Significant at the 0.001 level (two-tailed). * Significant at the 0.05 level (two-tailed).

Additional statistical analyses were performed on the dwell time data. A two-way ANOVA considered the radio as the first factor (two levels: presence of radio; absence of radio) and the type of media as the other factor (two levels: TV vs. web).

The assumption of homogeneity was prior verified using Levene's test for equal variances.

Significant effects were found for radio, $F(56,1) = 27.01$, $p = 0.000$, $\eta^2 = 0.335$, and type of media, $F(56,1) = 150.65$, $p = 0.000$, $\eta^2 = 0.730$, and no statistically significant interactions for radio and media were found.

The confirmed significant differences highlighted that even if, in general, the web media shows higher dwell time values, when only a single media is used, such as TV only (dwell time mean = 31.13, $SD = 13.25$) or web only (dwell time mean = 76.80, $SD = 14.32$), dwell time means are lower than when the radio is also used (TV + radio dwell time mean = 52.20, $SD = 16.61$; web + radio dwell time mean = 91.87, $SD = 8.26$).

4. Discussion and Conclusions

Previous research highlighted the role of the perception of familiarity in the development of preferences and found that prior exposure enhances the pleasure of advertisements. As the relationship between repetition and affect is U-shaped, a moderate prior exposure is effective in promoting a positive response. Radio advertising can create pictures in consumers' minds, enhancing the familiarity of the advertisements. For this reason, listening to a radio advertisement can moderate prior exposure to the same advertisement watched on television. Moreover, radio has the power to create strong imagery, and imagery advertisements lead to a more favorable audience response.

For these reasons, we hypothesized that a television advertisement will provoke a more positive response (H1) and higher visual attention (H2a and H2b) to the brand (reflecting a higher interest) if the consumers were previously exposed to the same advertisement via radio. We hypothesized the same effect on visual attention to the brand for web banners from the same advertising campaign. In order to test these hypotheses, the participants watched some television advertisements during a documentary break or viewed some web banners while surfing a website. Half of them were previously exposed to the same advertisements via radio.

The first hypothesis (H1) predicted, by comparing the psychophysiological signals, a greater positive response from participants to a television advertisement if they were previously exposed to the same advertisement via radio. Our results confirmed this hypothesis: participants who were exposed to radio advertisements before watching television advertisements experienced a higher skin conductance level and a higher FAA index than the other participants. These results are consistent with some studies showing evidence that prior exposure to an advertisement enhances familiarity and pleasure; similarly, other research suggested that the level of imagery advertising conveyed by radio affects the development of positive attitudes (Bone and Ellen 1992; Childers and Houston 1984; Lutz and Lutz 1977; Unnava and Burnkrant 1991). Furthermore, findings are consistent with the "mere exposure effect" and with other studies suggesting that repeated exposure leads to higher involvement and a more favorable audience response (Babin and Burns 1997; Bolls et al. 1998; Bone and Ellen 1990; Miller and Marks 1997; Unnava and Burnkrant 1991; Unnava et al. 1996). The second hypothesis (H2a) posited that the prior exposure to an advertisement via radio leads to greater visual attention to the brand in the same advertisement watched on television. In addition, the third hypothesis (H2b) predicted that prior exposure to a radio advertisement increases the attention to the brand in web banners from the same advertising campaign. Results of the comparisons between the two groups showed a significant difference in the visual behavior of the brand for both the web banners and the television advertisements. In particular, participants who listened to the advertisements via radio showed a tendency to watch the brand area more in the television advertisements and web banners. The additional analyses using two-way ANOVA followed this trend. The higher dwell time in relation to the web-based advertisements (in the conditions both with and without radio) could depend on the nature of the stimulus, which combines static and dynamic visual elements, requiring users to engage

in different actions simultaneously (Malhotra 2008) and allowing a different type of visual attention than with the television. However, results highlight that, in this case, the effect of the radio also significantly increases the means of dwell time in both the used media, supporting the effect of mere exposure and the influence of radio exposure. Furthermore, the fact that no statistically significant interactions between radio and media were found supports the mere exposure effect, since all the principal effects occur in relation to the dependent variable, which is the effect of radio exposure in each condition. Moreover, an analysis of variance did not show statistically significant results about content (type of brand) differences. This result shows that mere exposure is not affected by the type of brand. These findings are in line with the literature on eye tracking according to which eye movements are correlated with memorization (Wedel and Pieters 2000) and brand consideration (Pieters and Warlop 1999). In addition, some authors found that product choice (Laan et al. 2015) and preference (Schotter et al. 2010) can be predicted by the duration of fixations. Furthermore, our results are neuroscientific evidence supporting the results of a previous study in which the radio-TV combination indicated greater memory performance than the condition with TV only (Edell and Keller 1989). Overall, these results are in line with the findings by Numberger and Schwaiger (2003) about the synergic effect of different media on increasing the effectiveness of advertising. The positive effect of radio on television advertisement can be explained by the “mere exposure effect” theory, which postulates a more positive reaction to previously encountered stimuli (Zajonc 1968). In fact, this psychological phenomenon describes how subjects develop preferences towards stimuli that they repeatedly have been exposed to. In particular, the psychological mechanism of mere exposure is based on a learning process leading subjects to more favorable attitudes due to familiarity with the stimulus.

Another explanation could be related to the ability of the audio stimuli to activate the default mode network (DMN), a region located in the left hemisphere (Raichle et al. 2001) which is implicated in introspection and daydreaming (Wilkins et al. 2014), in visual mental imagery (Zhang et al. 2018), in thoughts involving the spontaneous projection of oneself into alternative settings (Andrews-Hanna et al. 2010) and internal narrative (Northoff et al. 2006). We suggest that these mental processes can be elicited while listening to a radio message. This can increase the ease of the successive elaboration of the same messages conveyed by other media such as television, enhancing the preference for these stimuli (Morgenstern et al. 2013; Seamon et al. 1995; Seamon et al. 1997).

As a laboratory experiment, this study has some limitations. Firstly, the setting was different from a naturalistic listening environment as the participants sat in front of a screen wearing some electrodes. For our purpose, the level of control offered by a laboratory was crucial to conduct a valid study. Nevertheless, we tried to replicate as closely as possible the condition of real-world advertising exposure, presenting the participants with a documentary interrupted by an advertising break, thus inserting the media messages into media content. Moreover, we measured the psychophysiological signals in a relaxed and neutral condition in order to obtain a benchmark of each subject’s activation in that experimental situation. This allowed us to measure the emotional activation by the specific stimulus as variations from the neutral activation. A second limitation of the study is the use of commercial advertisements. To reach more generalizable results, we chose two different categories of products/services, but future research must explore the effects of the exposure to radio advertisements on different kinds of television advertisements, such as social advertisements or public service announcements. Moreover, previous research found some variables that influence the degree of imagery, such as concrete versus abstract language (Bone and Ellen 1990), auditory structural complexity (Potter and Choi 2006), plausibility of evoked mental images (Bone and Ellen 1990) and sound effects (Atwood 1989). Another limitation of this study is the lack of self-report measurements. This study did not provide a questionnaire so as not to influence the different steps of the experiment and, therefore, the emotional activation and the attention of participants. Future studies could deepen this aspect by dividing participants into two main groups, one with the administration of a questionnaire and one without, in order to assess the cognitive side of the evaluation of brands, memorization of spots,

preference and associated emotions. This would be useful to also elucidate possible influences on neurophysiological and on attention different activations and results, after stimulating a cognitive evaluation. We conducted exploratory research that aimed to gather preliminary information that will help us to understand the effects of radio on television advertising, but future research must examine this topic in depth, comparing, for instance, the effects of radio advertisements with different degrees of imagery, testing by means of neuroimaging or electrophysiological techniques both how the regions of the default mode network modulate their activity in response to radio advertising messages and the effects of different media combinations in order to create a more effective communication campaign. For example, it could be useful to understand the effects of an inverted order of media (for instance, TV before radio; TV before web; web before radio) to extend the knowledge of media-mixed functioning. Moreover, it would be interesting to verify the relationship between the brain's reactions and changes regarding purchase intentions related to the products or services present in advertising messages.

This study has some strengths: to our knowledge, there are very few scientific research studies of the various mass media comparing the results of audiovisual advertising to purely audio or visual messages in order to detect the most effective combination of media, especially from a neurophysiological perspective; in this line of research, our study represents an important new contribution. Furthermore, the results highlight the possibility of improving advertising performance by utilizing other media, especially radio. Indeed, our research provides evidence that radio advertisements have a strong effect on web and television advertisements in terms of consumers paying more visual attention to the brand and consumers' engagement, supporting the usefulness of a media mix and suggesting that creating a multichannel campaign with radio advertisements can produce a more successful campaign. Moreover, even if mere exposure has been extensively studied, cross-media research is scarcely explored, whereas this study detected the mere exposure effect in a cross-media communication strategy, showing that it can be measured through psychophysiological methods.

To conclude, this study attempts to provide three major contributions to psychology and marketing research. Firstly, within consumer psychology, there are no studies aimed at measuring the mere exposure effect with cross-modal stimuli. For this reason, we tried to study a lesser explored research topic. Secondly, most of the previous studies adopted self-report methods to measure the mere exposure effect. This study extends the literature by providing an additional study adopting psychophysiological techniques. Thirdly, the psychological literature on the mere exposure effect on cross-modal stimuli was previously conducted by comparing the visual and tactile modalities. This research confirms that, in addition to visual and tactile modalities, the phenomenon of mere exposure also occurs with auditory and visual stimuli.

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Appendix A.

The used stimuli are described as follows.

Appendix A.1. Spot Radio

Original Italian Radio Spot Transcription	Radio Spot English Translation
Brand 1—ENEL Electric Power Provider	
<p>“La caldaia non risponde più ai comandi!” “No! Finiremo tutti congelati!” “Non drammatizziamo, forse c’è una speranza . . . ” Per chi è o diventa cliente ENEL ENERGIA, c’è Enel tutto ok caldaia. A 9 euro al mese, iva inclusa per 24 mesi, hai il servizio assistenza guasti 24h/24, un intervento di manutenzione ordinaria ed il bollino blu. Chiama 800 900 860. ENEL ENERGIA, ti apre un mondo. I dettagli dell’offerta su enel.it ENEL ENERGIA per il mercato libero.</p>	<p>“The boiler is no longer responding to commands!” “No! We will freeze ourselves!” “Don’t dramatize, maybe there’s a hope . . . ” For those people who are or become customers of ENERGY ENEL, there’s “Enel all right boiler”. At 9 euros per month, VAT included for 24 months, you can get the service 24h/24, ordinary maintenance and the seal of approval. Call 800 900 860. ENERGY ENEL makes you discover a new world. For further details: enel.it ENERGY ENEL for the free market.</p>
Brand 2—FINECO BANK	
<p>Da 5 a 500 megapixel, da focale 2.3 a 2.1, 60 fps. La tecnologia di cui stiamo parlando è l’occhio, lo strumento migliore per guardare assieme i tuoi prossimi progetti. Per questo noi di FINECO investiamo sulla tecnologia più evoluta che esista: L’UOMO. Un consulente per i tuoi investimenti e tutti i servizi in un unico conto. Messaggio con finalità promozionali. Per fogli informativi: fincobank.com e Fineco Center. FINECO: la banca che semplifica la banca.</p>	<p>From 5 to 500 megapixels, focal from 2.3 to 2.1, 60 FPS. The technology we’re talking about is the human eye, the best tool to look at your next projects together. That’s why we, at FINECO, invest in the most advanced technology that exists: HUMAN BEING. We offer a consultant for your investments and all the services in just one account. Message for promotional purposes. For further details: fincobank.com and Fineco Center. FINECO: the bank that simplifies banking.</p>

Appendix A.2. Spot TV

Each description shows images of the beginning of the spot, of the central section and the final section of the spot.

Appendix A.2.1. Brand 1—ENEL Electric Power Provider

The protagonist of the commercial is a well-known Italian presenter. At the beginning, the presenter enters a completely pink room. While he is speaking, he continues to walk through a virtual apartment and reaches a frozen and snowy room.

In the meantime, he mentions the possibility of having problems with the boiler and, at this moment, there is a close-up on his mobile phone.

The viewer can see the app from which it is possible to book the “repair service”.

Meanwhile, two skiers appear to highlight the cold situation following a boiler breakdown.

The presenter does not stop and continues to walk, now entering an orange room.

At the moment at which he mentions the “seal of approval”, the room suddenly turns blue.

Now, there is a change of scenery, and the viewer can see the protagonist in a kitchen. He sits on a table and continues to provide logistical information. The commercial ends with a close-up on the image of the well-known presenter and the number to call is presented on the right.

At the same time as the presentation of this sequence of images, in the background, the presenter says:

“If you join Energy Enel you will be in a cheerful world. If you have problems with your boiler, it will not be a problem because with “Enel safe boiler” you can book the service “without problem” active 24h/24. You will have the maintenance and the seal of approval

with only 9 euros per month, for 24 months. Call Energy Enel, it will make you discover a new world”.



Figure A1. Beginning of the spot.

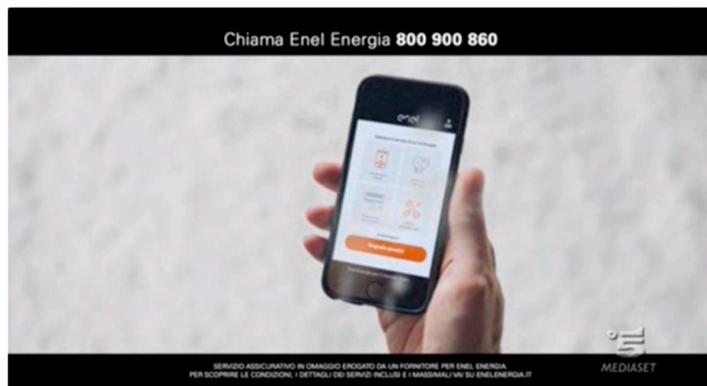


Figure A2. Central section of the spot.



Figure A3. Final section of the spot.

Appendix A.2.2. Brand 2—Banner FINECO BANK

The commercial begins with the presentation of several human images on a light grey background. On the background, there are clear references to technology (programming, optics/photographic tools and three-dimensional reconstructions of the city and of our planet). In order, the following appear: a young lady, a middle-aged man, a woman with her dog, a close-up on the blue and expressive eyes of a woman, a father with his son, a man with his head in his hands, then the image returns to the initial woman, a close-up on another eye and in the end a smiling person.

After this, there is a change of scene: now, the frame consists of the inside of the bank, and the shot shifts to a consultant at work. The frame widens: the viewer can see the consultant, the customer, the workstation, then the whole office and the FINECO logo in the background.

The commercial ends with a clear presentation of the claim and logo.

At the same time as the presentation of this sequence of images, in the background, the voiceover says:

“Have you ever wondered what makes our lives easier?

What tools will we trust most?

For us to FINECO BANK, we can never work without the most advanced existing technology: the human being. This is the only technology that can read your emotions and understand your needs.

With us you can have a consultant for your investments and many services in a single account.

FINECO: the bank that simplifies banking”.

Background song with increasing intensity: People help the people by Birdy.



Figure A4. Beginning of the spot.



Figure A5. Central section of the spot.



Figure A6. Final section of the spot.

Appendix A.3. Web Banners



Figure A7. Brand 1—Banner ENEL Electric Power Provider.

Translation of the claim: Join us in our cheerful world with “Enel all right boiler” from Energy Enel.



Figure A8. Brand 2—Banner FINECO BANK.

Translation of the claim: we have always invested in the most advanced technology: human beings.

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