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Master Thesis

The Effectiveness of Split-screen Television Advertisement:
An Eye-tracking Study

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Best regards,
Surendra and Tobias

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1. Abstract

In the regular format (full-screen) of advertisement, viewers have multiple ways to avoid exposures to the advertisement. To reduce such Ad avoidance behavior, another form for television advertising, the split-screen format has been proposed as an alternative. The present study aims to identify the effect of this alternative advertisement format on ad processing. An empirical investigation was conducted to compare the full-screen format and split-screen format of advertising, in terms of visual attention and brand memory. Results indicate that there is no direct relationship between screen format and memory for the brands being advertised. However, the indirect effect through visual attention was significant. In contrast to our prediction, compared to split-screen, the full-screen format increases visual attention on advertisement and consequently brand memory. We additionally investigated whether program involvement level (in term of sports interest and cycling interest) moderate the relationship and found out that full-screen format leads to higher visual attention and brand memory than the split-screen format in low and medium program involvement level, whereas there is no difference in two formats for high involvement program.

2. Introduction

The first ever television advert was broadcasted on July 1, 1941, during a baseball match between Brooklyn and Philadelphia Phillies. The advert was 10 seconds long and the cost was $9. In comparison, a 30-second commercial during the Super Bowl 2018 had an estimated cost of $3.5m (Statista, 2018). Over the decades, the advertisement has evolved into the most prominent medium for building product awareness for example in the 1990s, on average, 19 out of 60 minutes on television was the advertisements. This development created services such as TiVO and on-demand content where one can skip advertisement, and restrictions in terms of the total amount of advertisement allowed on average per hour of broadcasting. Even so, consumers are today exposed to hundreds of brands on a daily basis. This new reality has highlighted the need to understand and devise strategies that can captivate consumers' attention, such as incorporation of more sophisticated ways to imprint a

strong memory or an experience. Global corporations such as Google, Yahoo, and Pfizer spend millions of dollars on marketing annually trying to understand the effectiveness of visual marketing. This requires finding answers to key questions like where does the eye see first, what attracts the eye's attention and where do consumers fixate their vision when they enter a store or look at an advertisement so that their products are the ones that capture consumers attention (Wedel & Pieters, 2006). Moreover, the growth of on-demand providers such as Netflix and HBO, and the shift in preference to channels such as YouTube over television by the young generation, has further sharpened the competition for their attention and time. Meanwhile, broadcasters are sharpening the focus on keeping their viewers loyal and preventing channel-swapping (Dix & Phau, 2017).

This new dynamic environment in media has made viewers less loyal to one channel, evidenced by a decrease in television viewers and the increase in users on other channels (Kantar TNS, 2016). Even though this shift has occurred, broadcasters are still charging premiums for advertisement slots and are implementing innovative ways of keeping their viewers away from zapping during advertisement breaks. The latest and most quickly adapting way of doing this is to apply split-screen format during live-events, for example, NFL is planning to implement this way of broadcasting during the 2018 season (Munson, 2017). With split-screen format, viewers are exposed to the advertisements without interrupting the program and this is more likely to reduce zapping behavior. This may lead to increased satisfaction amongst the audience since he or she might not experience the same interruption from the advertisement. However, there is no research that actually measures whether this way of broadcasting generates enhanced value for the advertiser in terms of improving brand recognition and recall since a significant predictor for changing the channel is the advertisements (Dix & Phau, 2017).

This study has chosen sports broadcast as a suitable setting for its research, since this is the preferred arena adopting split-screen advertisement, and one might assume that live sports are preferred to be watched without interference. Even though alternative channels are getting a higher market share, television is still the preferred media for generating awareness for products and services. Henceforth, we hope that our findings

are of interest for both media- agents, buyers, and channels by answering if split-screen advertisement increases both brand recognition (short-term) and viewer satisfaction – in simple terms; do you get a bigger bang for your buck?

3. Literature Review

In the following section, we present an overview of the previous literature on the subject of visual attention and memory, the impact of advertisement on brand memory and distractors of the television advertisement.

3.1. How does content affect attention? Identifying the relationship between memory and visual attention.

McMain and Kastner (2009) define visual attention as 'a set of cognitive operations, which mediates and select what is of relevance, at the same time filters out irrelevant information from the visual scene.' This field of study has in the recent years gained huge amount of attention in the areas of experimental psychology and marketing research, and often in studies involving advertisement on TV, especially due to the valuation of the relationship between visual attention and memory established on the grounds of Information Processing Theory in various studies (Rossiter, Silberstein, Harris & Nield, 2001; Meyers- Levy & Malaviya, 1999). Many studies have identified that visual attention should be measured based on the amount of time an individual keeps his or her eye on the screen or object, and modern technology such as eye-tracking have made it easier to measure where the eye fixates. Anderson and Levin (1976) found a relationship between visual attention and the type of program aired, especially amongst younger viewers. However, what interests' individuals differ from person to person. A study from Rossiter, Silberstein, Harris, and Nield (2001) implied a positive relationship between visual content which stimulates the left brain and memory. This might suggest that programs or advertisement that are logical and structured might be more remembered than those embracing a more fun and emotional theme.

3.2. *What are the elements of a television advertisement that have on impact brand memory and recognition?*

There have been several studies considering various elements of television advertisements and its effectiveness in terms of increasing brand recognition and awareness, brand attitude and purchase intention. These studies have employed different variables such as *program context* (Furnham, Han & Mcclelland, 2017), *length of advertisement* (Rossiter et al., 2001; Patzer, 1991), *position of advertisement* (Lee &Tse, 2001), *program involvement* (Murry, Lastovicka & Singh, 1992), *program-advertising congruity* (Furnham & Goh, 2013) and *frequency* (Newell & Henderson, 2010) in order to find the relationship between the elements of advertisement and brand memory. Furnham et al., (2017) study used different types of settings in order to identify what increases unaided and aided brand recall. The results showed that both unaided and aided recall were higher for humorous advertisements than for non-humorous advertisements. Similarly, Rossiter et al. (2001) found out that videos scenes held on screen for 1.5 seconds or longer and scenes that provoke the fasters brain activity in the left frontal hemisphere improved ad recognition. Not only the length but also the position of advertisement is found to have an impact on memory. In a study conducted by Lee and Tse (2001), it was found that that advertisement placed at the end have higher recall than an advertisement placed at other position.

3.3. Distractors influencing the effectiveness of television advertisement

TV advertisement is considered as effective and successful if it accomplishes a specific objective or goal. This is often monetary or intangible, such as increasing awareness, knowledge or interest in a product or service (Liaukonyte, Teixeira and Wilbur, 2015). Despite the incremental use of internet and on-demand services, companies still spend a considerable part of their media budget on TV advertisement. However, devices such as smartphones and tablets have evolved into distractors when viewers use them simultaneously while watching television, thus misleading them away from the advertisement on TV (Chowdhury, Finn & Olsen, 2007; Speck & Elliot, 1997). Besides the challenges posed by the competing technology, it has also been discovered that the general attitude towards advertisement on TV is decreasing, in comparison to traditional print ads and radio, mainly because people find these ways of advertisement to be less intrusive (Shavitt, Vargas & Lowrey, 2004). Hence, more and more might

choose to mute the TV during commercial breaks, leave the living-room, talk with other people in close proximity or divert their attention to other sources of stimuli. For example, in a study by Lee (2001), the author discovered that more than 80% of viewers divert their attention to other sources of stimuli during commercial breaks. In a previous study, Meurs (1998) found that 28% of viewers stop watching the TV, switch the channel or zap between different ones (Moriarty & Everett, 1994). This evolvement has constricted time-spans where advertisers need to capture the viewers' attention in order to get an effect from their media investments.

3.4. How to reduce ad avoidance behavior so as to increase the advertisement effectiveness?

Fortunately, many studies have been conducted to find the ways to reduce ad avoidance behaviors. One alternative for traditional advertisement, which has been widely used, is product placement that is integrated with the program and has been demonstrated to reduce avoidance behavior (Meenaghan, 1991). In a quasi-natural experiment done by Davtyan and Cunningham (2017), it was found that people have a more positive attitude towards this way of advertising, in comparison to traditional TV advertisement, since it supposedly adds pragmatism and soundness to movie scenes and helps in character development (Russell, 2002). However, viewers are becoming more aware of product placements and there is a rising concern regarding the effectiveness of such types of advertisement (Karniouchina, Uslay & Erenburg, 2011). This might suggest that viewers have developed defensive mechanisms to avoid promotional content by naturally diverting their attention to the object and not the brand itself. Moreover, this way of advertising has been found to be less suitable in providing details of product benefits and has been subjected to new laws and regulations. For example, certain countries made it mandatory to inform viewers that the introduction of products in a program are solely for advertising purpose (Law & Braun, 2000).

To combat advertisement-avoidance behavior from the viewer, a new form of television advertisement known as the split-screen advertisement has emerged. This method has primarily been applied to live sports broadcasts, where it is hard to accommodate natural commercial breaks without enraging the audience, since every moment is crucial, and viewers rarely want to miss a second of the event. There has

been little research on the effectiveness of this kind of advertisement, however, it is arguable that it has been developed so that the viewer never feels the urge to change the channel during commercial breaks, which may lead to greater attention towards the ad presented. Chowdhury, Adam, and Olson (2007) did the most relevant study on the topic of split-screen format, revealing that the format did reduce ad-zapping during advertisements compared to the traditional full-screen format. Although their findings do suggest a relationship between screen-format and zapping behavior, it is still unanswered if there is a relationship between screen-format and attention, and whether this, in turn, affects brand memory and recognition.

4. Gaps in Literature

There remain several gaps in the current literature which our research project aims to mitigate. First of all, we aimed to contribute to the young and still scarce stream of literature by applying visual attention theory and we wanted to demonstrate the application of eye tracking approach to predict the impact on memory.

Secondly, we conducted our experiment in a very real-life setting, where we created a homelike environment. In most of the previous studies, participants were forced to sit in a laboratory and behave in a certain way. Contrary to this, in our study we allowed them to move freely within in the room and on top of that, we also allowed them to use their smartphone, read newspapers and eat snacks, which we believe simulated a normal room condition. The visual element of television has not received any scientific attention except a study by Chowdhury, Finn & Olsen (2007) which found out that split-screen format reduces ad-zapping intentions. We believe that the study could have contributed more on this scarce stream of literature had they examined the impact of screen format on variables such as the Ad recall and recognition.

Thirdly, our study utilized signal detection theory which has been widely used in psychology but is under-represented in marketing and studies on consumer behavior. To the best of our knowledge, no research has been conducted on memory recall for television advertisements using the Signal Detection Theory. Those studies which have used a dichotomous variable for memory (Pechmann & Stewart, 1990) have not

considered the impact of false alarm, which is the condition when a participant says he/she has seen an object which has not been presented in the study. Similarly, when unaided questions such as "Can you tell me what commercials you saw during the program?" (Krugman, Cameron & White, 1995), were asked to the participants for the recall of advertisement during a program, the participants could have mentioned the name of brands which were not in the actual advertising and such possible false alarms have not been taken into consideration in previous studies.

Overall, we have not found any studies that have used eye-tracking to answer a similar research question as this study is presenting. One might argue that the scarce literature topic is due to that this is a young research field. Henceforth, we hope that this study can fill certain gaps in the literature and create more unknowns for further studies to explore.

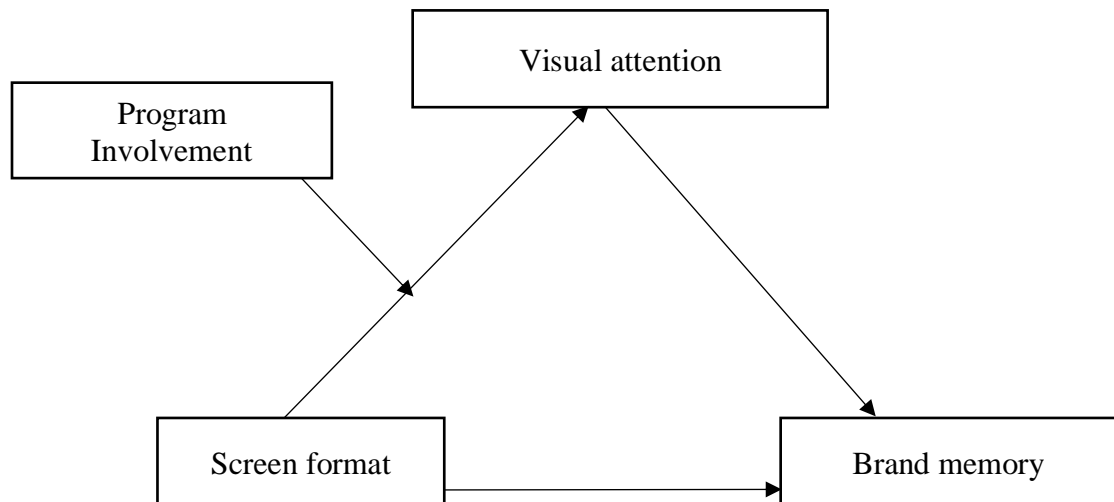## 5. Theoretical Background, Conceptual model, and hypotheses.

Figure 1: Conceptual Model

5.1. The Impact of screen format on brand recall for the brands being advertised

The television watching process includes multiple activities and it requires varying levels of attention. Various studies have been done to understand how audience look, listen and talk while viewing television. The Split-screen ensures that the number of television viewers is equal to the number of advertisement viewers as advertising and programming are displayed simultaneously. However, such a forced exposure may impact viewers memory regarding advertising brand, as viewers might take advertising as a distracter and pay more attention to the program than the advertisement. On the other hand, split-screen advertisement increases viewing time, as viewers will lose a part of the program if they divert their attention from the screen (Krugman, Cameron and White, 1995). The consumer information processing of advertising is closely related to the link between attention to advertising and viewing duration. The majority of Information processing (IP) theories have found a strong relationship between the processing of the content and the memory for the content. Rossiter, Silberstein, Harris, and Nield (2001) found out that the longer scene in advertisement leads to higher recognition of the scene in subsequent memory tests. Henceforth, one might argue that more advertisement-exposure leads to higher advertisement-memory, therefore, the split-screen format should in a perfect world increase brand-memory and be of more value for advertisers than standard format broadcasts, since viewers watching a full-screen tend to lose interest between shows and in commercial breaks. This notion has been demonstrated empirically where, for example, customers spending more time looking at a banner ad are more likely to notice an advertisement's content (Sherman and Deighton. 2001). Furthermore, viewers are more interested in watching their program than the advertisements. Thus, the advertisements that are placed sequentially with the program are more likely to be avoided by the viewer and less likely to be recalled. Hence, we proposed the following hypothesis:

Hypothesis 1: Compared to advertisement broadcasted in full-screen format, advertisement broadcasted in a split-screen format will lead to higher brand memory for the brands being advertised.

5.2. Does the screen format impact the visual attention?

As mentioned earlier, viewers are forced to watch the advertisement in split-screen and spend more time on screen than in full-screen. In split-screen format, both the broadcast and the advertisement are sharing the viewers' visual attention and as previously touched upon, the viewers are forced to have another element within their fixation area. However, this also suggests that the viewer spends more time watching the screen, hence, also the advertisement. Another visual aspect of split-screen advertising that may affect visual attention is that split-screen advertisements are still not usual and it has been found that visual attention is automatically drawn to areas where an unexpected stimulus pop out. Research in visual psychology have found that infrequent or novel stimuli can cause an automatic orientation effect (Becker & Horstmand, 2011; Itti & Baldi, 2009) and since advertisement broadcasted in split-screen format tend to appear suddenly, viewers might be drawn automatically towards that area of the screen. Thus, we proposed the following hypothesis:

Hypothesis 2: Compared to advertisement broadcast in full-screen format, advertisement broadcasted in split-screen format will lead to higher visual attention towards the advertisement.

5.3. The impact of visual attention on the brand memory

Consumers are exposed to thousands of brands every day, from banner-adverts in social media-channels to traditional paper-ads in magazines or newspaper. Hence, marketers have been naturally interested where consumers focus their vision, due to evidence of a correlation between eye movement and attention, attention, and fixation, and fixation and cognitive processing (Krugman, Fox, Fletcher, Fischer & Rojas, 1994; Wedel & Pieters, 2000). Today, technology has made it even more important to capture consumers attention, since marketing arenas that before was occupied by one brand, is now filled with multiple. Nowadays, brands need to ensure that their advertisement not only creates awareness but also maintain it. Since eye-movement are direct indicators of attention, measuring attention to memory in a real setting would be beneficial (Wedel & Pieters, 2000). Eye-tracking has been used in different ways for years and has been recognized as superior, compared to other methodologies in terms of

measuring eye-movement and consumer decision making (Bettman, Johnson & Payne, 1991). However, today's equipment creates more accurate and informative readings, making it possible to follow consumers eye-movement across shelves in supermarkets or during online shopping.

It is known that consumers move through two dimensions, where the first stage is *pre-attentive*. This is where the consumer absorbs all the visual information available in their vision at that time, rapidly – gazing. The second dimension, *attentive*, is the stage where the consumer starts to fixate and focus their attention on specific objects, and in this stage recognition/remembrance of e.g. brands are made (Munoz, Mendez & Carmona, 2018). Multiple psychology studies reported a strong correlation between attention and cognitive processing, and support that the degree of attention controls the cognitive relationship. Munoz *et al* (2018) found out that there is a positive relationship between attention and ad-recall, suggesting that consumers are more likely to remember advertisements that have caught their attention. In an experimental study conducted by Wedel and Pieters (2000), using eye-tracking approach, it has been found that fixation to the pictorial and the brand improves memory for the brand being advertised whereas it was not the case for the text fixations. This has led to the following hypotheses:

Hypothesis 3: Participants with a higher level of visual attention, as measured by total fixation duration, fixation count and average visit duration on the advertisement, will have a significantly higher memory for the brands being advertised than the participants with a lower level visual attention.

Hypothesis 4: The impact of screen format on the memory for the brands being advertised is mediated by the level of visual attention on the advertisement.

5.4. Does program involvement moderate the relationship between screen format and visual attention?

A number of studies have found that there is a positive relationship between program involvement and memory for the advertising (Soldow and Principe, 1981; Norris and

Colman, 1992; Tavassoli, Schultz and Fitzsimons, 1995) but none of these studies have tested moderation effect of program involvement. As summarized by Moorman, Neijens, and Smit (2007), program involvement here can be defined as an *active* (attentional focus of viewers), and *motivated* (willingness of viewers to process the information) state indicating interest and arousal (the antecedents of the involved state) induced by a television program. Generally, program involvement is higher when the program or broadcast is personally relevant and suspenseful, and when these conditions are present, consumers' viewing tends to be more goal-oriented. This could lead to a decrease in attention-level from other peripheral stimuli, such as advertisement (Janiszewski, 1998). Considering that the level of interest in cycling and sports is highly variable among the viewers, the viewers with a higher interest in sports and cycling might have higher program involvement, due to of relevancy of the program to them, compared to other viewers. Hence, they are likely to be more concerned about the outcome of the sport-event than the advertisements. So, we expect that individuals with a lower level of program involvement are more likely to have higher visual attention on the advertisement, compared to those with a high level of program involvement. Thus, we develop the following hypothesis regarding the impact of program involvement in the relationship between screen format and visual attention:

Hypothesis 5: The effect of screen format on the visual attention is moderated by the level of program involvement, as measured by interest in cycling and interest in sports.

6. Methodology

6.1. Design

An experimental design has been chosen in this research project in order to try to explain the cause and effect relationship between screen-condition and brand memory. First respondents were invited randomly for an experiment, using social media as a recruitment-channel and the participants were then divided equally into two different groups. In both conditions (Split-screen and full-screen format), room environment, screen size, and program content were consistent, only screen-format was dissimilar. After watching the video, a questionnaire was distributed to respondents. First, respondents were presented with demographic variables. Second, we presented

memory questions and this part was divided into two different parts. In the first part, respondents were presented with aided recall questions and in the second part, they were presented with unaided questions, where participants were asked to name the brands they could remember. We measured the dependent variable *brand memory* using aided question. On the next part, we measured sports interest and cycling interest using a 7-point Likert scale. Lastly, Data from the eye-tracking device were collected and coded after participants left the room.

6.2. Participants

The sample consisted of ninety-six participants (n=96) who were recruited through Kantar TNS official recruitment system. All participants were rewarded 800kr as incentives for participating in the experiment. The participants were chosen on the basis of average television watch-time per day and evenly weighted on gender and age.

Demographic	Frequency	Percentage
Gender		
Male	45	46.9
Female	51	53.1
Total	96	100
Age		
18-29	27	28.1
30-39	28	29.2
40-49	22	22.9
>50	19	19.8
Total	96	100
Average Television watching time		
Less than an hour	19	20
1-2 hours	39	41.1
2-3 hours	28	29.5
3-4 hours	6	6.3
>4 hours	3	3.2
Total	96	100

Table 1: Demographic profile of the sample.

6.3. Stimuli

Two different kinds of videos were created for the experiment, one for split-screen format and one for the full-screen format. In the Split-Screen format, the advertisements were displayed simultaneously with the broadcast by splitting the live content into two quadrants (Figure: 2). At the top left, the race continued, while at the bottom right corner, the advertisement was shown, and the remaining two quadrants of the screen remained empty. When the advertisement was displayed, the quadrant used for advertisement was larger than quadrant used for program and, the audio from the race was replaced by audio from the advertisement. Program content was scaled to fit within an area of 5° 20´ 0.24´´ visual angle and the advertisements were scaled to fit within an area of 13° 3´ 0.20´´.

Figure 2: Split-screen format

In the full-Screen format (Figure 3), the Tour De France 2017 broadcast was interrupted with commercial breaks. When the advertisement was displayed, the viewers were prevented from watching the part of the race and when the advertisement was over, the race returned to full-screen from where the race was proceeding. This was done to create a real-life viewing experience where viewers miss a part of the live sports program when advertisements are sequentially placed within the live program. Similar to split-screen format, audio of the race was replaced by audio of advertisement when the advertising was displayed. In full-screen format, both program content and advertisement were scaled to fit within an area of 20° 10´ 0.93´´ visual angel.

Figure 3 Full-screen format

The program used to present the different conditions was a recording of 18th lap of the Tour de France 2017. It was chosen because it had captured a lot of viewers' attention in Norway during the summer month.

6.4. Procedure

A standard 10m^2 located at Kantar TNS office was used as the laboratory. The office was decorated as a TV-area and was designed to create a home-like environment, in order to create a realistic setting. It contained a couch and a coffee-table situated in front of a 42" Samsung television, located on the table were three daily newspapers (VG, Dagens Næringsliv, and Dagsavisen), refreshments and snacks.

The participants were asked to arrive at Kantar TNS offices in Oslo and were greeted by the receptionists. In order to ensure that no information regarding the experiment was disclosed prior, the receptionist was only told to meet and greet. The experience was completed with only one participant at a time, and each participant was given instructions regarding how the experiment was being. Since it was important that participants got a home-like feeling, they were allowed to move around, use their smartphone or read the newspaper any time in between.

The eye-tracking equipment was adjusted and calibrated for each participant by an experienced moderator before they were left alone in the laboratory. The participant

was exposed for either condition one (full-screen) or condition two (split-screen). Both conditions lasted 18 minutes and showed the similar lap from Tour de France 2017 and advertisements were displayed at the similar times during the broadcast. Each condition included advertisements for 19 different brands. After the video session, the moderator entered the laboratory and provided the participant with further guidance on how to proceed with the questionnaire. At this stage, the moderator stayed with the participants in order to ensure a high rate of questionnaire-completion. All participants were debriefed after the completion of the experiment.

6.5. Measures

Since this study aims to understand the relationship between observation and memory, we found eye tracking as a suitable tool for measuring visual attention. Here individual data-points are recorded during the total exposure period, in order to measure attention through areas of interest – hereby called AOIs (Figure 4). In this study, the AOIs consist of 19 different advertisements, live broadcast of stage 18 in Tour de France 2017, and two different objects (newspaper and smartphone). As we are only interested in observing the visual attention towards advertisement, other AOIs are not taken into consideration for further analysis.
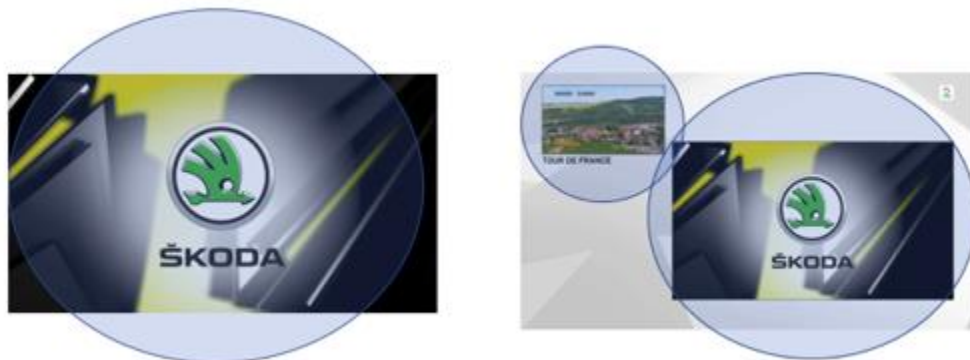

Figure 4: AOI points

Each AOIs was measured by total fixation duration, fixation count and average visit duration and these KPIs were measured similarly in both conditions. Holmqvist and Nyström, (2011) defined a fixation as a period of time when the eye remains still and this phenome can range from tens of milliseconds up to several seconds. The basis for

utilizing this measure is that previous research has emphasized that exposure is a cue for increased memory (Park & Hopfinger, 2008). In order to develop the measurement item for each construct, we utilized previous research and theories. As eye movements are indicators of visual attention, we used fixation duration as used by Wedel and Pieters (2006) and average visit duration as used by Krugman, Cameron, and White (1995). The data collected was processed through Tobii Pro software and eye-tracking glasses. The eye-tracking equipment was calibrated in order to adjust for individual variations in eye-movement and focus. This was done automatically by the software and the participants had to focus on a card (6.4x8.9cm) containing a black circle.

The cycling- and sports interest of respondents were measured using a 7-point Likert scale, where 1 is "Very Low" and 7 is "Very High". In order to measure brand-recall, we conducted a survey that was given to the participants after the experiment and the survey involved both aided and un-aided questions. In the un-aided question, each participant was asked to list the brands they recalled from the advertisement. In aided-questions, participants were provided with list of nineteen real (brands that were actually shown in the advertisement) brands and six fake (brand that were not shown in advertisement) brands and were told to pick the option "YES" if they feel they have seen the brand in the advertisement else "NO".

Variables	Type	Remark
Brand memory	Dependent variable	Calculated as dPrime (d') explaining participants brand recall.
Total Fixation duration	Mediator	Total time a participant has fixated on a given AOI.
Fixation count	Mediator	The total number of fixation within each AOI.
Average visit duration	Mediator	The total time each participant has visited AOI.
Sports interest	Moderator	Measured sports interest of the participants using a 7-point Likert scale.
Cycling interest	Moderator	Measured cycling interest of the participants using a 7-point Likert scale.
Screen format	Dependent variable	Two different formats of television advertising.

Table 2: Variables used in the study

Signal Detection theory for the memory variable

Signal detection theory (SDT) was initially developed by the psychologist as a tool to distinguish between signals (stimuli) and noise (no stimuli) amongst radar-staff (ref). Since then it has been applied in various research from recognition of old and new items to medical diagnosis, where some of the most popular ways of utilizing SDT is

with simple yes/no tasks, rating and forced-choice tasks (Cradit, Tashchian & Hofacker, 1994; Sing & Curchill, 1986; Stanislaw & Todorow, 1999).

However, SDT has also been applied to marketing studies where advertisement-recognition has been of interest, in order to produce an estimate of the participants' memory accuracy of the advertisements presented during the study (Cradit, Tashcian & Hofacker, 1994). Singh and Curchill (1986) used SDT to improve advertisement-recognition testing, however, the authors argue that some changes have to be made when estimating response bias parameter B and discriminatory ability parameter A'. While measuring advertisement recognition, such an obstacle has been solved by calculating d' (dprime), which has been considered as a superior measure of STD (Cradit *et al.,* 1994). Similarly, Stanislaw and Todorov (1999) apply this method in their study regarding SDT measures calculation.
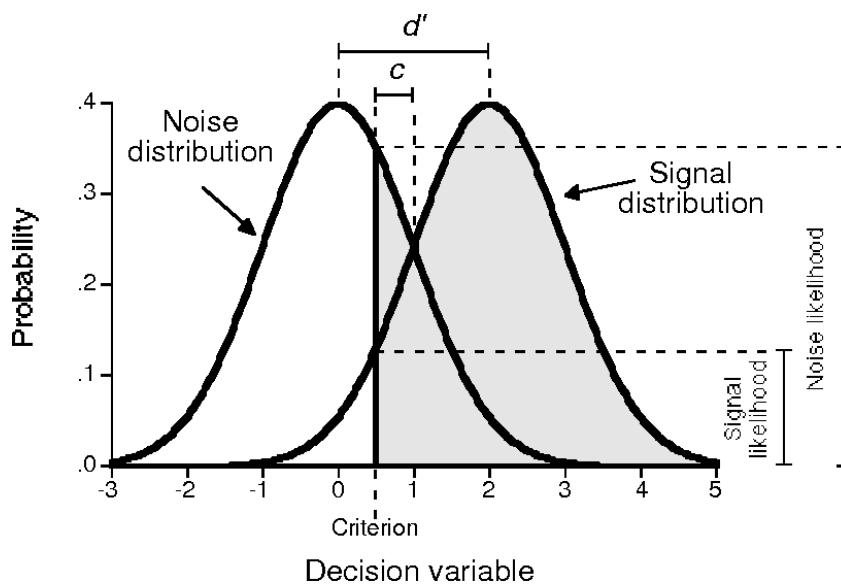

Figure 5: Distribution of the decision variable across noise and signal trials, showing d', c, and the likelihoods on which β is based (Stanislaw and Todorov, 1999).

In simple yes/no tasks, the signal trials (where a signal is present) and the respondent answer correctly – yes there was a signal present – is termed as a *correct hit*, whilst on noise trial (where there is no signal present) and the respondent answer- yes there was a signal present- is termed *false alarm*. The hit-rate and the false-alarm rate creates the foundation for the calculation of d' and since d' is the gap between the noise- and signal

distribution, as seen in figure 5, one should calculate the variable in the following way for yes/no tasks (Stanislaw and Todorov, 1999):

$$d' = {}^{-1}(H) \, {}^{-1}(F).$$

Simplified, subtracting the z score that corresponds to the false-alarm rate from the z score that corresponds to the hit rate. Furthermore, utilizing excel-software, d' is calculated with the following commands:

DPRIME = NORMSINV(H) – NORMSINV(F) - Where (H) and (F) are hit-rate and false-alarm values.

By using SDT measures, one might overcome and minimize the effect from participants and response bias – since participants in e.g., experiments are exposed from both real brands (real signals) and fake brands (real false alarms), allowing for a more accurate variable for further analysis.

7. Data Analysis

The statistical analysis in this thesis was performed using SPSS (Version 25) with Hayes PROCESS macro installed. To test the first hypothesis whether the split-screen format showed significantly higher brand memory for the brands being advertised as compared to the full-screen format, we applied independent sample t-test after testing all three assumptions of independent sample t-test analysis.

Similarly, to test the second hypothesis that the split-screen will lead to the higher visual attention, we considered three different measures for visual attention: *Total Fixation, Fixation count,* and *Average visit duration.* First, we measured a correlation between these three variables by creating a correlation matrix (Table 3) to see how the variables relate to each other. A Pearson correlation coefficient revealed a highly positive and strong correlation between *Total fixation and Fixation count,* $r(94)=.89$, *total fixation* and *Average visit duration* $r(94)=.69$ and *fixation count* and *Average visit duration* $r(94)=.673$. As these three variables are highly correlated with each other, we may calculate factor score and create one single variable but there was no consistency in measurement scale among the three variables, which is the basic requirement to

conduct factor analysis. Variables *Total fixation duration and Average visit duration* were measured in milliseconds and variable *fixation count* was measured in term of the number of counts. So, in order to identify the suitable measures for the visual attention, we took all three measures of visual attention both in mediation model and moderation mediation model. We found out that variable *Average visit duration* fitted best in our full model and used this variable to test all hypotheses of visual attention.

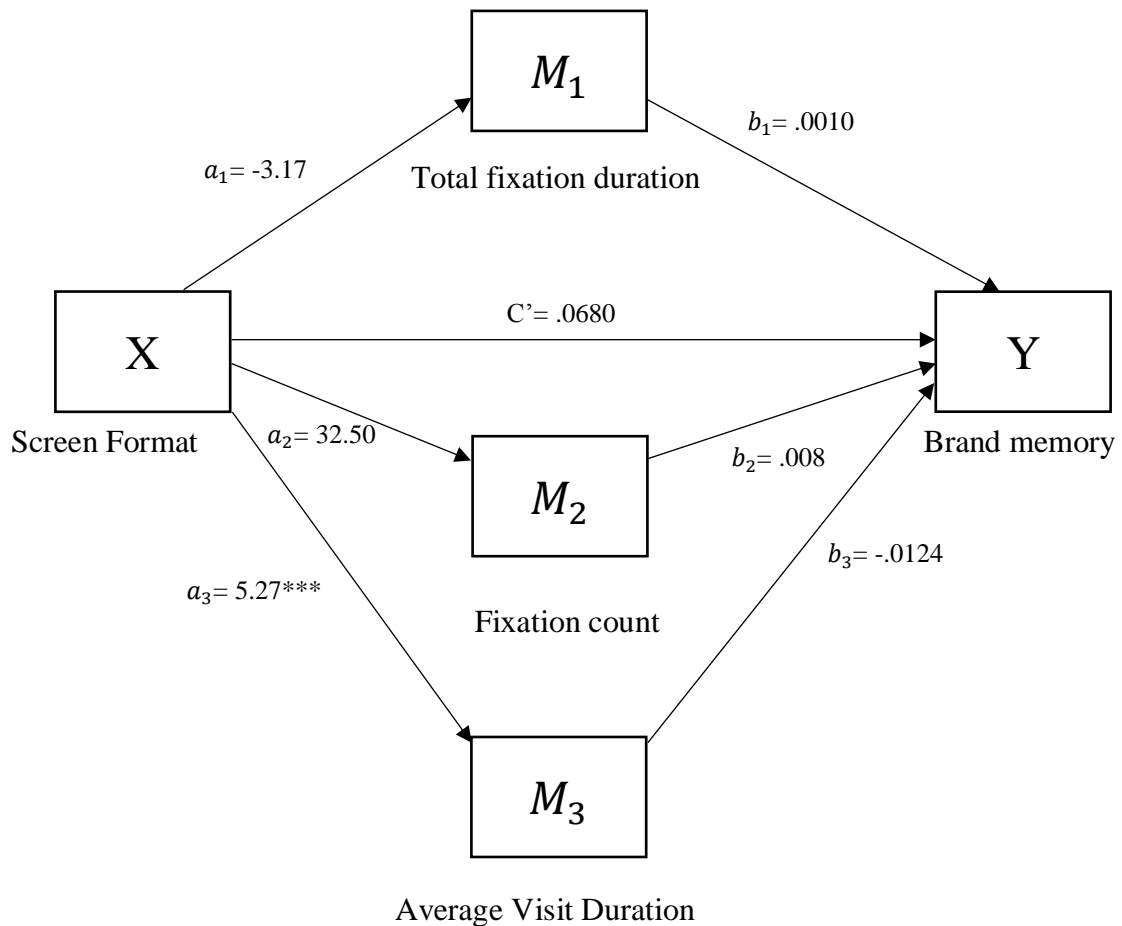| Variables	Total fixation duration	Fixation count	Average visit duration
1.Total fixation duration	1.00		
2. Fixation count	.889***	1.00	
3. Average visit duration	.690***	.673***	1.00

*** significant at $p < .001$

Table 3: Correlation between three measures of visual attention

To test the third hypothesis, we ran regression analysis as both of our variables *Average visit duration* and *Brand memory* are continuous variables. We excluded the other two measures of visual attention as we detected no significant indirect effects of *Total fixation duration* and *fixation count* as mediators.

To test the fourth hypothesis, that the relationship between screen format and memory for the brands being advertised would be mediated by visual attention, we estimated Hayes' (2013) parallel multiple mediator model
 (Figure 6) using three different measures of visual attention. We choose to apply *mean center*, which means that our independent and mediator/moderator variable are mean centered average score subtracted from every variable. This allows for the value 0 to become the average score, an easy method to understand the simple slopes. Data transformation was not required for other variables as Hayes (2013) does not require the normality assumption to be met. Since the parallel multiple mediator model showed no significant mediator effect of any of the three variables (Figure 6), we tested model 4 in PROCESS (Hayes, 2013) three times with three different measures of visual

attention (Appendix 1). Models with *Total fixation duration* and *Fixation count* as mediators showed no significant mediation effect so both of these variables were excluded from further analysis and variable *Average visit duration* showed significant mediation effect at $p<.10$, so we only took the variable *Average visit duration* for further analysis.

*** significant at $p<.001$

Figure 6: Statistical diagram of the parallel multiple mediator model. In this diagram X represents the dependent variable (here the screen format), Y the dependent variable (here brand memory) and M_1, M_2 and M_3 represent the mediator variables (Total fixation duration, Fixation count, and Average visit duration).

To test the final hypothesis, whether program involvement serves as moderators and how this moderating effect could influence the mediating effect of visual attention, we applied the Hayes PROCESS macro model 7 (Hayes, 2013), which allow us to check for moderated mediation effect. We first tested *cycling interest* and *sports interest* as

moderators in two different models (Appendix 2). Both of these models showed similar effect size so to include both *cycling interest* and *sports interest,* we created a new moderator variable *program involvement* for further analysis by taking an average of these two variables. The descriptive statistics for the selected variables are given in Table 4.

Variable	Mean	Standard deviation	1	2	3
1.Program involvement	4.00	1.24	1.00		
2. Memory (D' Prime)	1.15	0.64	-.021	1.00	
3. Average visit duration	8.25	5.15	.026	.179	1.00

Table 4: Descriptive statistics and Intercorrelations between the selected variables.

8. Results

8.1. Impact of screen format on the brand memory

In order for us to conduct the independent samples t-test to see the difference between brand memory for the two different screen formats, several additional assumptions must be fulfilled: (i) assumption of independence (ii) assumption for normality, and (iii) assumption of homogeneity of variances. The study was designed so that one person can watch only one of the two screen formats. Thus, we consider the assumption of independence as satisfied, as the same participant cannot appear in the other group. We checked for normality by conducting a Shapiro-Wilk test, which showed a memory variable (*dprime*) is normally distributed ($p=.232$). Thus, the assumption of normality is met for our dependent variable. To check the assumption of homogeneity of variances, we conducted a Levene's tets. We find that variances are homogeneous ($p =.125$), thus the assumption of homogeneity of variances is met.

The result of independent sample t-test showed no significant difference in the means of brand memory for the advertised brands between split-screen (*M*=1.13, *SD*= .730) and regular screen (*M*=1.16, *SD*= .548; t(1,94)=-.184, *p*=.854). The results suggest that

the screen format does not have any direct impact on brand memory for the brands being advertised. Thus, we failed to confirm the *hypothesis 1*.

8.2. Impact of screen format on visual attention

Before conducting the independent sample t-test to see the difference in visual attention for the two different screen formats, we checked for normality of by conducting a Shapiro-Wilk test. The Shapiro Wilk test shows that *Average visit duration* ($p<.001$), is significant. The assumption of normality is thus not met. To continue the analysis, we transformed the variable *Average visit duration* using the technique used by Templeton (2011), which retains the original series mean and standard deviation to improve the interpretation of results. We created new variable *NormAvgVisit* as a dependent variable and conducted independent sample t-test.

The relationship between screen format and visual attention did not go in the direction we expected. The result of independent sample t-test showed a significant difference in the means of visual attention on AOI between split-screen (*M*=5.90, *SD*=3.98) and regular screen (*M*=10.56, *SD*=4.78; t(1,93)=-5.16, *p*<.01). The results suggest that participants in regular screen format have higher visual attention towards AOI (advertisement for the brands) than participants in the split-screen format. Thus, *hypothesis 2* was rejected, rather we found the opposite relationship between screen format and visual attention for the advertisement.

8.3. Impact of visual attention on brand memory

To analyze the relationship between visual attention and brand memory, we ran a simple linear regression with *average visit duration* as an independent variable and *brand memory* as a dependent variable. As we have already tested for the normality of these two variables in the earlier analysis, we used normally distributed memory variable (*dprime)* as a dependent variable and used transformed visual attention variable, *NormAvgVisit* as an independent variable. The regression model parameters of a participant are given by Equation 1.

$$Brand\ memory_{(i)} = \beta_0 + \beta_1.Visual\ attention_{(i)} + \varepsilon_{(i)} \qquad (Eq.\ 1)$$

Variable	Estimate	Standard error	t-statistic	p-value
Intercept	.927	.127	7.323	.000
Visual attention	.027	.013	2.030	.045

a- Significant at $p<.05$

Table 5: Results of regression analysis based on Equation 1.

The linear relationship between *dprime* and *NormAvgVisit* was significant (F(1,93)= 4.121, $p<.05$), with R^2 of 4.2%. The regression equation suggested the following relationship *Brand memory= .927+ .027*Visual attention.* Despite low R^2, the linear regression indicated the positive relationship between visual attention and memory for the advertised brands as we predicted. In another word, the results showed that if a participant had the higher visual attention, it enhanced the memory for the brands being advertised. Therefore, *Hypothesis* 3 was confirmed.

8.4. Mediation of Visual attention

The estimation of the simple mediation model comparing split-screen to the split-screen group showed no significant direct effect (see path coefficient *c'* in Figure 7 and Table 6), indicating that there was no influence of the screen format on memory for the brands being advertised independently of the mediator visual attention.

Consistent with our result from independent sample t-test and contrary to our prediction, regular screen format was positively related to visual attention (see path coefficient *'a'* in Figure 7 and Table 6) at $p<.01$, suggesting that viewers in regular screen format showed higher visual attention on AOI than those in split-screen format. Additionally, visual attention positively predicted memory for the brands being advertised while controlling for the screen format (see path coefficient *b* in Figure 7 and Table 6) at $p<.10$, meaning that those viewers who had higher average visit duration on AOI also showed higher memory for the brands being advertised.

Most fit to the mediation hypothesis was the estimation of the indirect effect ($a \times b$) of screen format on memory for the brands being advertised. Accordant with our hypothesis, there was evidence of a significant indirect effect of screen format on brand memory through visual attention ($a \times b= 0.15$, bootstrap confidence interval: .0167 to .3037), meaning that visual attention functioned as a mediator between screen formats

and brand memory. Thus, *hypothesis 4* was confirmed.
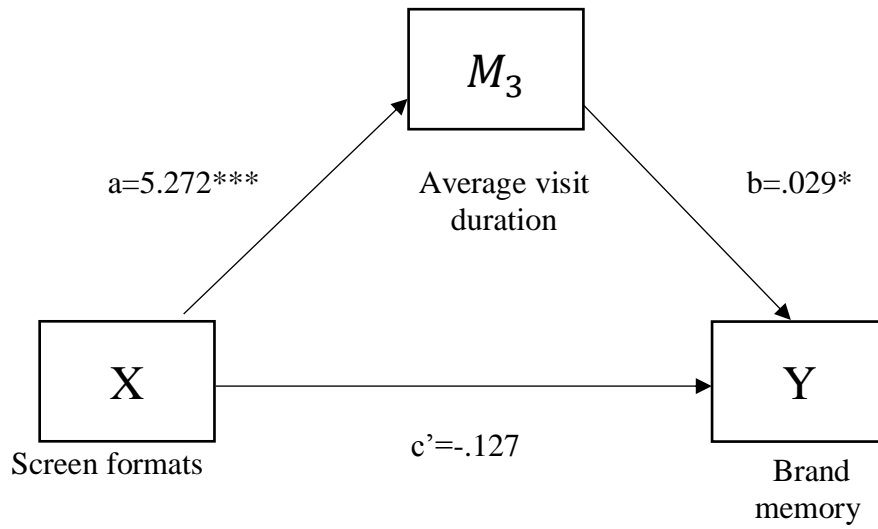
*significant at $p < .10$, ** significant at $p<.05$, *** significant at $p<.01$

Figure 7: Statistical diagram of the simple mediation model of the comparison between split-screen and full-screen format.

		M (Average visit Duration)					Y (brand memory)			
Antecedent		Coeff.	*SE*	*p*	t		Coeff.	*SE*	*p*	t
X (Screen format	a	5.27***	.90	.000	5.82	c'	-.127	.151	.403	-.840
M (Avg visit duration)	-	-	-	-	-	b	.029*	.015	.055	1.944
Constant		.293	1.44	.839	.203		.8545	.2227	.002	3.8375

$R^2=.265$ $\qquad\qquad$ $R^2=.039$

F(1,94)=33.855, P<.01 $\qquad$ F(2,93)=1.907, P>.05

*significant at $p < .10$, ** significant at $p<.05$, *** significant at $p<.01$

Table 6: Regression coefficient (Coeff.), standard errors (SE), and model summary information of the simple mediation model depicted in (Figure 7) for the comparison between split-screen format and full-screen format.

8.5. Moderation of the mediation by program involvement

While investigating possible moderation of the mediating effect of average visit duration by program involvement, we found statistically significant moderation of the effect of screen format on average visit duration (see path $XW \rightarrow$ M with coefficient a_3 in Figure 8 and Table 7). This indicates that the effect of screen format on average visit duration depends on the level of program involvement, thus suggesting that program involvement functioned as a moderator of the mediating effect of visual attention. Thus, *Hypothesis 5* was confirmed.

Furthermore, taking a closer look at the interaction plot (Figure 9) it seems that there were differences in visual attention between the level of program involvement. For

example, in split-screen format, increase in program involvement leads to an increase in visual attention, whereas in full-screen format, increase in program involvement leads to a decrease in visual attention. Additionally, we estimated the conditional indirect effect $((a_1 + a_3 \, W) \times b)$ of the screen format on brand memory through visual attention to further investigate whether the mediation of visual attention was moderated by the program involvement. The result (Table: 6) showed that the conditional indirect effect to be positive and significant for low $((a_1 + a_3 \, x \, (-1.5053)) \, x \, b = .2268$, bootstrap confidence interval: .0208 to .4269) and medium program involvement $((a_1 + a_3 \, x \, (-.0053)) \, x \, b = .1476$, bootstrap confidence interval: .0132 to .2918) and non significant for high program involvement $((a_1 + a_3 \, x \, (1.4947)) \, x \, b = .0684$, bootstrap confidence interval: -.0193 to .2087).

Thus, the indirect effect of screen format on brand memory through visual attention was significantly positive, except among the viewers with a high level of program involvement, where no significant indirect effect could be detected. Consequently, comparing split-screen format with the regular-screen format, the mediating effect of visual attention appeared to be moderated by program involvement.
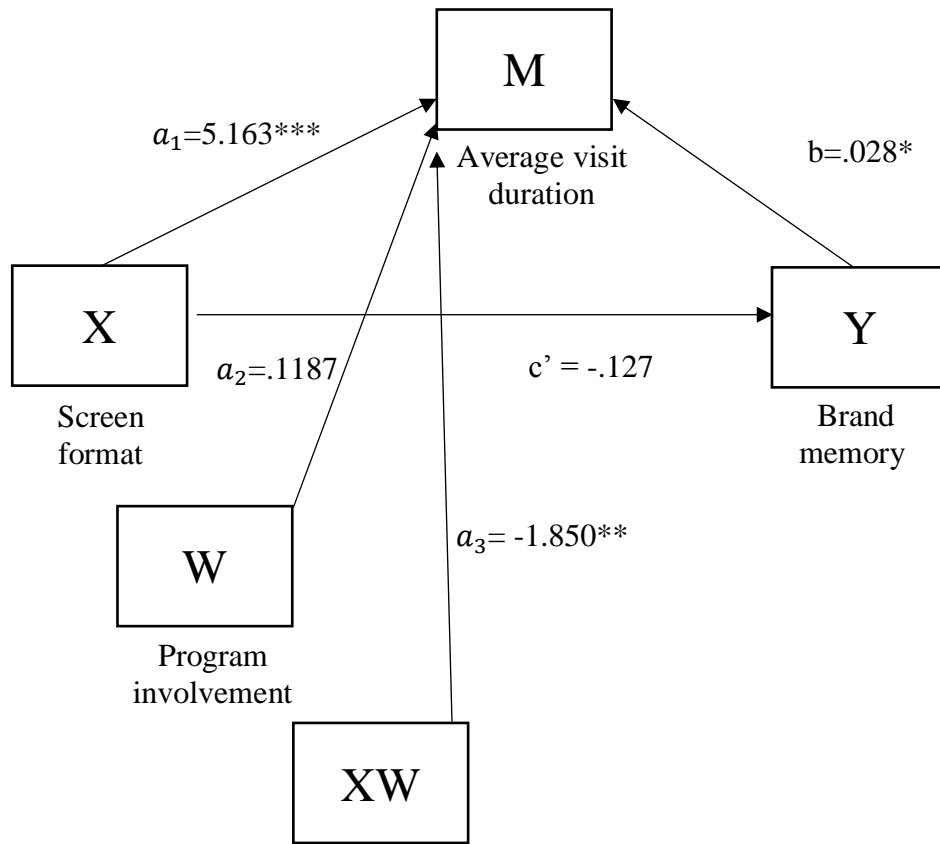
*significant at $p < .10$, ** significant at $p<.05$, *** significant at $p<.01$

Figure 8: Statistical diagram of the total effect moderation models comparing the split-screen format to the full-screen format with average visit duration as a mediator and program involvement as a moderator variable

Antecedent		Coeff.	SE	p	t
		Consequent			
		M			
		(Average visit duration)			
X (Screen format)	a_1	5.163***	.890	.000	5.800
W (Program involvement)	a_2	.1187	.3621	.7437	.328
X x W	a_3	-1.850**	.726	.0125	.3279
Constant		8.364	.448	.000	18.805

$$R^2 = .307$$

$$F(3,91) = 13.452, p < .01$$

*significant at $p < .10$, ** significant at $p < .05$, *** significant at $p < .01$

Table 7: Regression coefficients (coeff.), standard errors (SE), and model summary information of the total effect moderation model depicted in Figure 8 for the comparison between split-screen format and the full-screen format with cycling interest as a moderator variable.
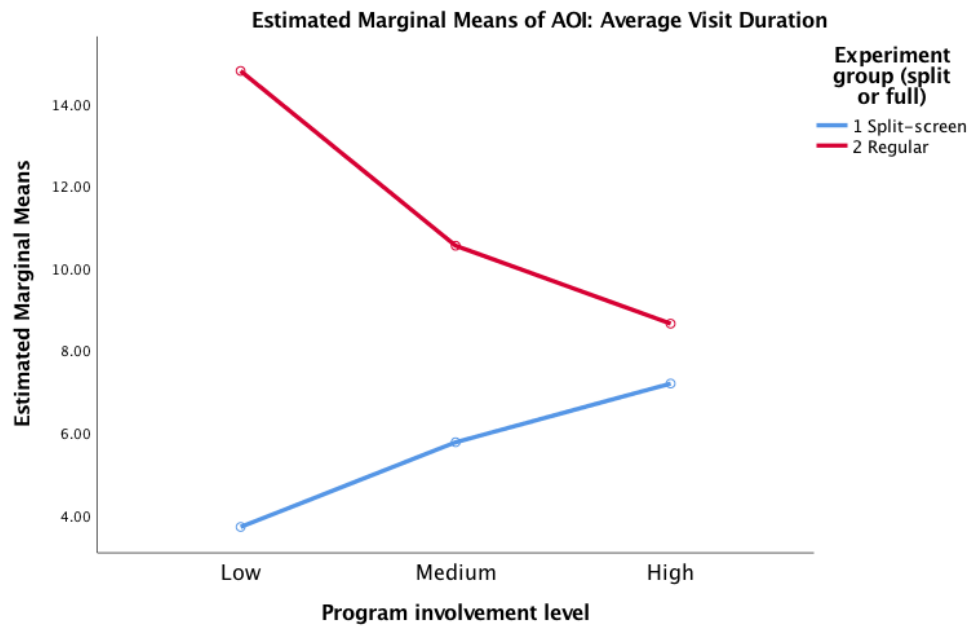
Figure 9: A visual representation of the moderating effects of program involvement level when comparing full-screen format with the split-screen format.

Note: To make the interpretation simpler, the interaction plot was created by recoding *program involvement* variable into new variable *prog_inv_recode* with three different levels as follow:

$$1\text{-}3 = \text{``Low''}$$
$$3\text{-}5 = \text{``Medium''}$$
$$5\text{-}7 = \text{``High''}$$

Program_involvement	Coeff.	Boot*SE*	BootLLCI	BootULCI
-1.5053	.2268	.1031	.0208	.4269
-.0053	.1476	.0710	.0132	.2918
1.4947	.0684	.0580	-.0193	.2087

Table 8: Regression coefficients (Coeff.), Bootstrap Standard errors (BootSE), and bootstrap confidence interval (BootLLCI and BootULCI) of the moderated mediation effect shown in Figure 8.

9. General discussion

9.1 Overall findings

The present study examines how two different methods of advertising impact the brand memory for the advertised brand. Building on insights from visual attention and cognitive processing literature, we proposed that advertisement broadcasted in split-screen format can lead to higher memory for the advertised brands. The results have provided insights on how screen format can have an impact on brand memory through visual attention and how program involvement level can moderate this relationship. Even though the result showed no significant direct relationship between screen format and brand memory, the mean difference in the brand memory might imply that there is some impact. On the other hand, it is also worth mentioning that the screen format has an indirect impact on memory through visual attention.

Our findings may seem discouraging for advertisers or broadcasters that have invested in this new technology. Contradictory to our predictions, advertisement broadcasted in full-screen advertisement received higher visual attention compared to split-screen advertising. This could have a natural explanation, since there is only one fixation point during an advertisement in full-screen format, meaning that the viewer has fewer distractions. Furthermore, we thought that other elements in close proximity such as smartphones would be more of interest during commercial breaks. Another possible explanation is that since we used a previous lap of the Tour de France and not a live broadcast, the viewer found it of little interest. This might have reduced the participants program-involvement, leading to lesser though and attention towards the sudden advertisement message. Interestingly, the study supports the notion from previous research that there is a relationship between visual attention and brand memory. We were also able to identify and confirm an indirect relationship between screen format and brand memory, mediated by visual attention. Concerning our moderated mediation hypothesis, we detected a significant moderating effect of program involvement on the mediating effect of visual attention. The result suggests that channels with a higher share of low and medium involvement programs would benefit more from using full-screen format than channels with high involvement programs such as live sports events, where there is no difference in between the two formats, split-screen and full-screen.

9.2. Theoretical Implications

To the best of our knowledge, this study is one of the first looking at the relationship between screen-format and brand memory utilizing eye-tracking technology. Prior research has found evidence of the relationship between visual attention and memory and program involvement and visual attention. Furthermore, a study found a link between program involvement and advertisement effectiveness (Soldow, 1981). We extended this concept and have taken it further by looking into the different levels of program involvement, and how it moderates the relationship between screen-format and advertisement effectiveness. Even though our initial hypothesis was not confirmed, we hope that our study encourages future experiments and research to look into the relationship between screen-format and viewer satisfaction, a relationship that due to our findings should be of interest for broadcasters and advertisers.

9.3. Managerial Implications:

Even though the direct relationship between screen format and brand memory has not been confirmed by this study, other significant relationships might have several implications for managerial practice.

Our findings showed that the full-screen format leads to higher visual attention and we also found the positive relationship between visual attention on advertisement and memory for the brands being advertised. This result contradicts with our prediction and from a managerial perspective, it does not seem reasonable for the manager to invest on split-screen advertisement just because it has been introduced as an innovative method by the advertisers.

This study has demonstrated that the program involvement level has an impact on the relationship between screen format and visual attention on the advertisement. For low and medium program involvement level, the full-screen format is clearly superior to split-screen format in term of visual attention on the advertisements, whereas, for high involvement program, there is no any difference in between these two screen formats. This implies that full-screen format may be more beneficial for low and medium

involvement program such as documentaries and non-live sports broadcast than high involvement program such as live sports broadcast.

10. Limitation

This research project tries to distribute balance between broad scientific contribution and the specific measures our supporting company TV 2 Norway is interested in. The sample composition might be too narrow as participants were only selected from Oslo only which we acknowledge as a threat to the external validity of this research. To generalize it broadly, the future research can use our model with a sample from different cities of Norway so that the results of the study are generalizable to all the parts of Norway. Our research is primarily focused on memory-based effect but the memory-based measures do not account for the complete spectrum. So, future studies might focus on other measures such as attitude toward the brand, purchase intention, brand loyalty and customer satisfaction. On the other hand, it could also be interesting to see how the memory-based measures impact the other measures.

It might also be worthwhile to see the impact of screen format on long-term memory, as the impact might be different in the short- and long run (Moschi & Moore, 1982). So, future studies can utilize longitudinal data to see if the impact on memory is long lasting or it fades away along with the time and how it is different in two different screen formats. During our study, due to various constraints, we were unable to measure pre-existing brand memory of the advertised brands and it has been found that accounting for differences in pre-existing knowledge is paramount in obtaining valid comparisons brand memory for two different advertising formats (Draganska, Hartmann, & Stanglein, 2014). The future research might consider measuring the lift i.e. difference in the brand recall before and after the exposure to the advertising instead of traditional brand-recall measurements. In our experiment, we have used pre-recorded video clips. However, the level of program involvement might be different in the live sports broadcast and split-screen has been found to be more relevant for live broadcast so it would be interesting to compare the difference between these two screen formats during live program, where the level of program involvement is very high

A further limitation of our research is the complexity behind the data collection method. There are various forms of eye-tracking data, and the quality of the data varies. Most of the factors which might influence the data quality are human-related. The most common reason is the recording environment, which has a strong influence on the data quality. Furthermore, operator mistakes and the actual participants not following the guidelines or accomplish the task given are frequent reasons for data loss or low-quality output. Moreover, previous studies have also uncovered that studies involving experiments with real participants have to take the sample characteristics into consideration. For example, all the participants have similar eyesight, and none uses lenses or glasses (Holmqvist *et al*, 2012). To sum up, if eye-tracking is used correctly and the researchers are aware of the pitfalls, the data can provide valuable insight.

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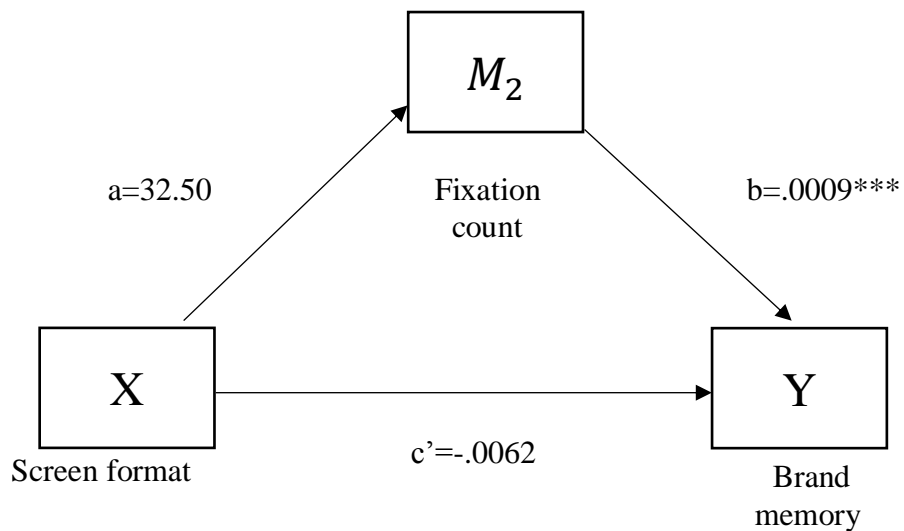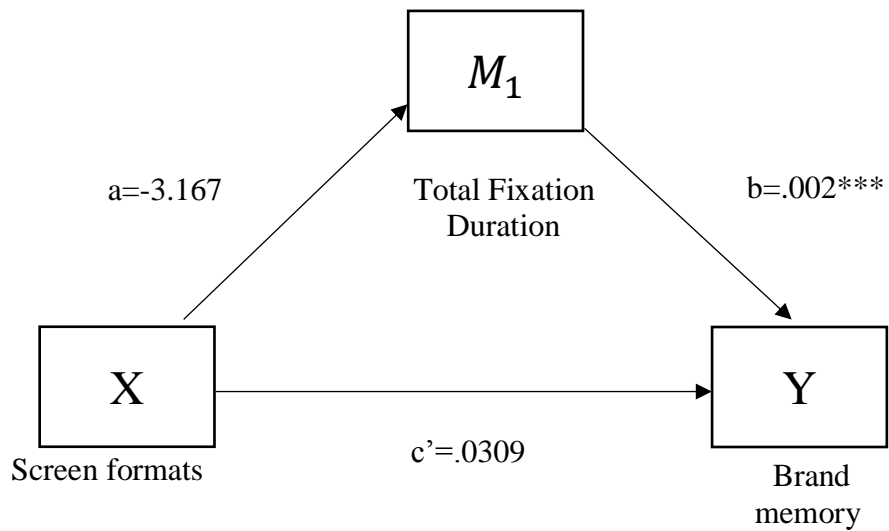
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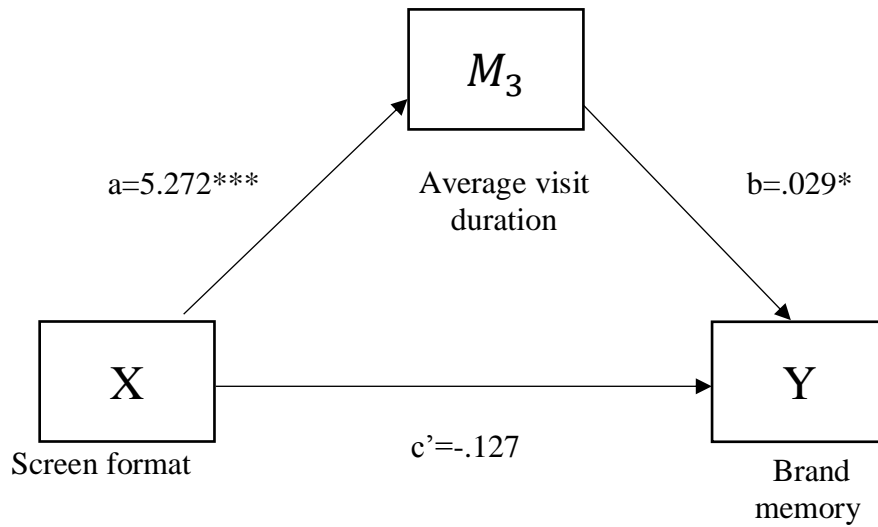
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Appendix

Appendix 1: Statistical diagram of the simple mediation model where X represents the independent variable (here the screen formats), Y represents the dependent variable (here brand memory) and $M_1, M_2,$ and M_3 represent three measures of visual attention acting as mediators in the model.
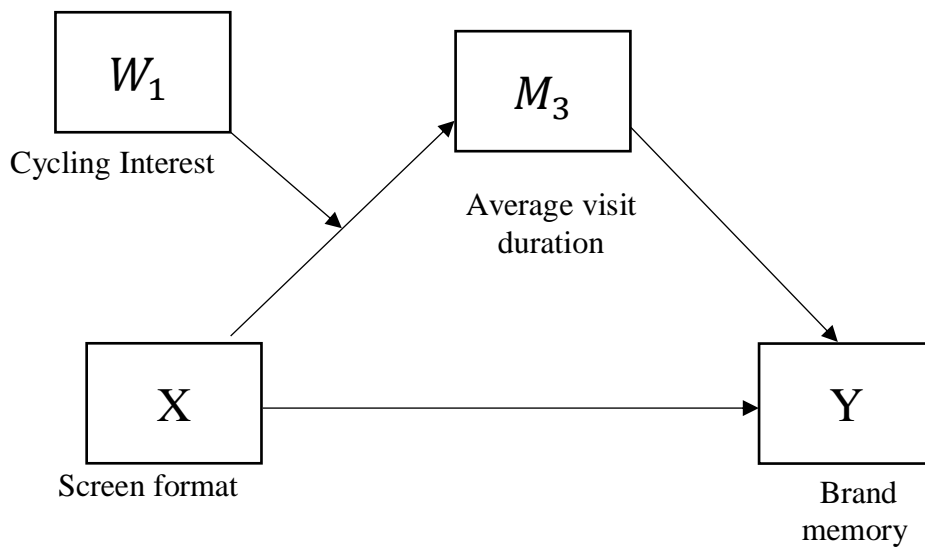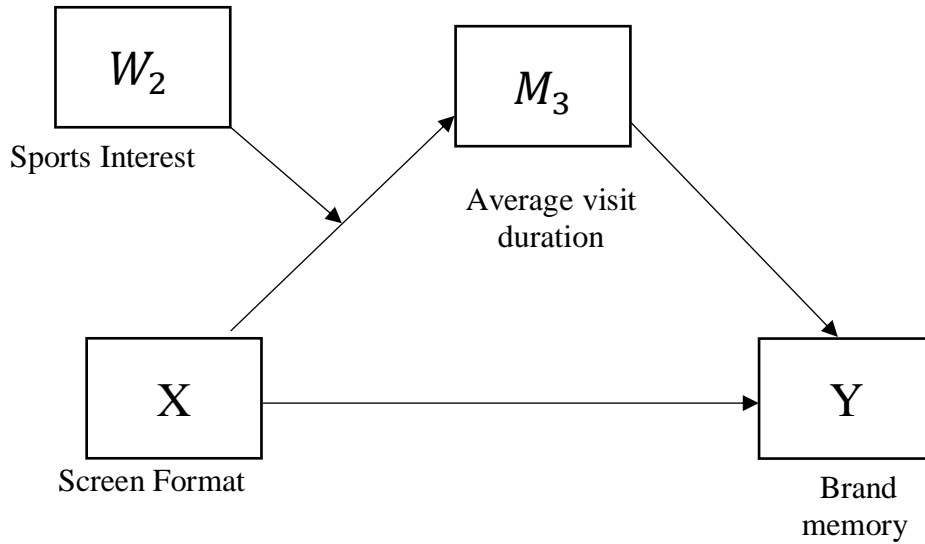
$$M_1$$

Total Fixation
Duration

a=-3.167

b=.002***

X

Screen formats

c'=.0309

Y

Brand
memory

$$M_2$$

Fixation
count

a=32.50

b=.0009***

X

Screen format

c'=-.0062

Y

Brand
memory

$a=5.272^{***}$

M_3

Average visit
duration

$b=.029^{*}$

X

Screen format

$c'=-.127$

Y

Brand
memory

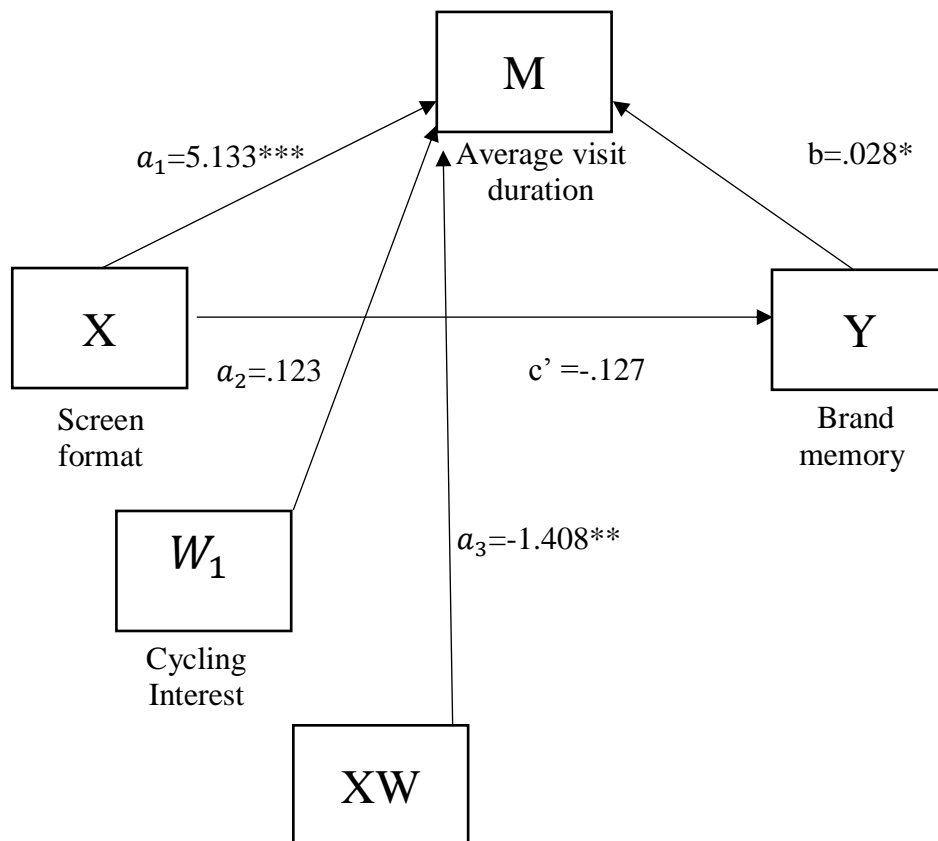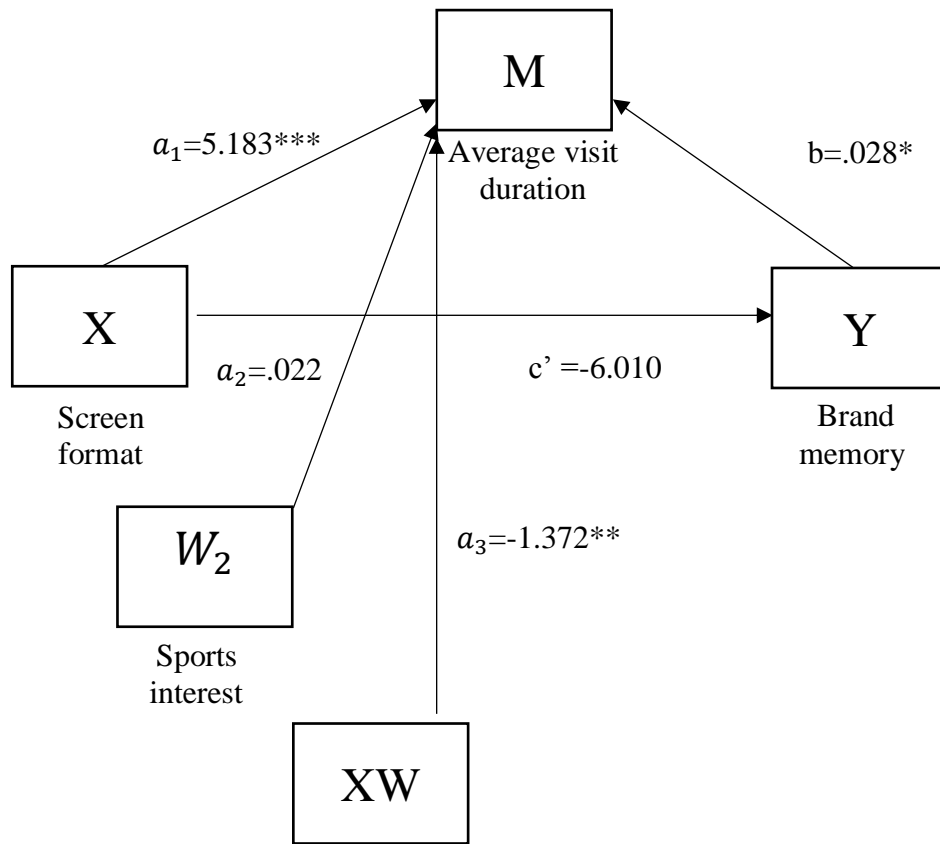*significant at $p < .10$, ** significant at $p<.05$, *** significant at $p<.01$

Appendix 2:

i)A conceptual diagram of the moderation of the mediation model with screen format as an independent variable (X), Average visit duration as mediator variable (M), Brand memory as dependent variable and Cycling interest (W_1) and Sports interest (W_2) as moderator variables.

W_1

Cycling Interest

M_3

Average visit
duration

X

Screen format

Y

Brand
memory

ii)*Statistical diagram of the moderation of the mediation model with screen format as an independent variable (X), Average visit duration as mediator variable (M), Brand memory as dependent variable and Cycling interest (W_1) and Sports interest (W_2) as moderator variables.*

$a_1=5.183***$

$a_2=.022$

$a_3=-1.372**$

b=.028*

c' =-6.010

M

Average visit duration

X

Screen format

Y

Brand memory

W_2

Sports interest

XW

*significant at $p < .10$, ** significant at $p<.05$, *** significant at $p<.01$