




# EyeTracker Technology in Elderly People: How Integrated Television Content is Paid Attention to and Processed

La tecnología del «EyeTracker» en adultos mayores: cómo se atienden y procesan los contenidos integrados de televisión

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## ABSTRACT

Elderly people are major consumers of the media, especially of television, which combines conventional commercials with advertising formats included in the programme that do not break its continuity, unconventional advertising (UA). The aim of this study is to analyse how elderly adults, compared with young people, attend and process the information that appears on screen simultaneously (program and advertising). The study involved 30 elderly adults and 30 young adults. Attention to the TV screen (in terms of attention capture, heat maps and eye fixations) was analysed using the eye tracker technology. Content recognition, the level of psychological reactance to UA and channel-hopping behaviour were also analysed. The results show that the level of attention among the elderly does not differ from that of young people and depends on the integrated content. Recognition by the elderly is lower than among young people when the UA is of a high or medium level of intrusiveness. The psychological reactance of elderly adults is lower than that of young adults but both groups show the same behaviour in terms of loyalty to the television programme. The general conclusion is that cognitive ageing does not affect the capacity for attention to integrated content as much as it affects information processing skills.

## RESUMEN

Las personas mayores son grandes consumidores de los medios, especialmente la televisión (TV), donde el spot convencional se combina con formatos publicitarios introducidos en el programa que no rompen su continuidad: la publicidad no convencional (PNC). El objetivo de este trabajo es analizar cómo los adultos mayores, en comparación con los jóvenes, atienden y procesan la información que aparece simultáneamente en la pantalla (programa y publicidad). Participan en el estudio 30 adultos mayores y 30 jóvenes. Se analiza, con la tecnología del «eye tracker», la atención dispensada a la pantalla de TV (en términos de captura atencional, «heat maps» y fijaciones oculares) mientras aparece PNC. También se analizan el reconocimiento de los contenidos, la reactancia psicológica ante la PNC y el comportamiento de zapping. Los resultados muestran que la atención de los adultos no difiere de la de los jóvenes y depende del contenido integrado. El reconocimiento de los adultos es inferior al de los jóvenes cuando la PNC tiene un nivel de intrusión elevado y medio. Su reactancia psicológica es inferior a la de los jóvenes, pero ambos grupos tienen el mismo comportamiento de fidelización al programa televisivo. La conclusión es que el envejecimiento no afecta tanto a la atención dispensada a los contenidos integrados como a las habilidades del procesamiento de la información.

## KEYWORDS | PALABRAS CLAVE

Elderly people, attention, cognition, eye tracker, television contents, television advertising, neuromarketing, television habits. Adultos, atención, cognición, eye tracker, contenidos televisivos, publicidad televisiva, neuromarketing, hábitos televisivos.

## 1. Introduction and status of the issue

The elderly are an important segment of the market since they are major media consumers (Ramos & Mancebo, 2012a; 2012b), especially in the case of television (Ramos, 2014). The constant appearance of new formats and combinations of non-conventional publicity and the absence of experimental work on the processing that they trigger in viewers (Milajovic, Kleut & Ninković, 2013), especially in older adults, create the need to enquire into how these viewers take in and process the stimuli presented simultaneously on the screen. An elderly adult is considered to be an individual who is in the last stage of life; the age of the onset of this stage ranges from age 60 (WHO, 2014), 65 (Ramos & Mancebo, 2012) and 70 years. Although there are different paradigms that specify the meaning of old age, ageing is defined as a continuous, progressive, irreversible, heterogeneous, individual and social process, during which a cognitive decline appears, among other factors (Cabrera & Osorno, 2013). The objectives of this study focus on cognitive ageing.

Television content is usually presented in a sequential continuity consisting of programmes and commercial breaks. However, advertising is sometimes integrated into programming in non-conventional forms (Farré & Fernandez-Cavia, 2005) or special actions that do not break or alter the continuity of the programme. Integrated content on TV is considered to mean the simultaneous appearance of the programme together with Unconventional Advertising formats (UA in it); screen sharing, overlays and animations share the processing of the advert that the television viewer performs: they appear and disappear integrated into programming, with a high frequency and short duration:

-Screen sharing: a format during which the programme broadcast is divided into two parts, with one part showing (in a reduced size and with no sound) the continuation of the programme and the other the advertising block (with sound), which occupies most of the screen.

- Overlay or «banner»: a graphical advert in motion with text and image that appears on the screen, usually on the bottom, for a few seconds.
- Animation of visual symbols or «morphing»: a succession of images repeated sequentially that create the effect, in movement, of an image that usually corresponds to the channel logo.

The impact of these formats depends on the viewing they allow: the greatest being on the shared screen, medium in overlays and low in the animations (Añaños & Valli, 2012).

Unconventional advertising invades the screen, attempting to gain the attention of the viewers while they are watching the programme. Does it achieve its objectives? The theoretical approach for its explanation is the Flanker Compatibility Paradigm, according to which irrelevant stimuli obtain priority by activating involuntary attention by capturing attention. Lachter, Forster and Ruthuff (2004) call the processing of these stimuli (flanks) while the focus is directed elsewhere «Leakage». Flanks are processed similarly to distracting stimuli (Pedraja, Montoro & García-Sevilla, 2010) and can influence the behaviour of the subject (Pieters & Wedel 2004; 2007) according to exogenous or endogenous factors (Ruz & Lupiáñez, 2002; Botta & Lupiáñez, 2010; Santangelo, Botta & Lupiáñez, 2011; Pacheco, Lupiáñez & Acosta, 2009). Based on these authors, we consider that during the broadcast of integrated content on television, a pre-attention process is carried out in which the UA formats are captured visually as distracters while attention is focused on the programme. The level of attention capture will depend on the characteristics of the format and the subject. The attention paid will coincide with the first (pre-attention and unconscious) attention level proposed by Heath (2009) and Heath, Nairn and Bottomley (2009), with which the advert is explored. How can the effect of these distracters on attention be measured?

Visual attention is closely related to the sensory response of eye movement, and the «eye tracker» is a powerful technology for evaluating it (Altmann & Kamide, 2009; Brasel & Gips, 2008; Duchowski, 2013). Studies with older adults show that they have the same patterns of eye fixation as young people (Kemper, Crow & Kemtes, 2004) and that, although visual attention depends on the type of information focused on (Isaacowitz, Wadlinger, Goren & Wilson, 2006), by the age of 70 there is a stability of visual fixation (Kosnik, Fikre & Sekuler, 1986). The ocular fixations that older adults pay to a stimulus and to the distracters are similar to those of young people but their level of understanding is lower (Kemper, McDow & Kramer, 2006), since they are less able to recognise and differentiate between the stimulus and the distracter (Dywan & Murphy, 1996) and have greater difficulties in divided attention tasks and in those that require an inhibition of irrelevant information (Foos & Cherie, 2000). However, the sustained attention of adults is higher because they use more resources than young people (Staub, Doignin-Camus, Bacon & Bonnefond, 2014).

Unconventional advertising produces a visual

impact that is similar in young viewers and older adults, and has a pattern that is determined by the characteristics of the formats (Añaños & Valli, 2012). But what about the rest of the information that appears on the screen? To what extent do adults continue to pay attention and to process the programme when the UA breaks in on it?

Attention is the key mechanism for recognising the advertising stimuli, and this corresponds to the final level of the model proposed by Heath (2009), in which they are identified and processed consciously. Television advertising creates perceptual and conceptual effects with low attention levels (Grimes, 2006), and UA formats affect the preference for the advertised brand positively (Van-Reijmersdal, 2009). But what happens when the programme and the advertising are integrated? What elements do the older adult process?

Ageing involves physical, emotional and cognitive changes (Crespo-Santiago & Fernández-Viadero, 2011). During cognitive ageing patterns of minor damage to the nervous system have been observed, and a decrease of different cognitive domains including, in addition to the changes in divided attention tasks already commented on, a deterioration of the visual and auditory functions and perceptual processes; processing, learning and the retrieval of information, as well as problem-solving and speed of response (Cabrera & Osorno, 2013) are also seen to be impaired.

Cognitive ageing affects the executive functions (Simon, Ruiz & Suengas, 2009; Simon, 2011) that show a slow down in processing information and difficulties in making decisions (Cabrera & Osorno, 2013). According to these authors, it is possible to speak of a general neuropsychological ageing factor whose main features are: an increased slowness of the perceptual processes which generates difficulties in coding information, a psychomotor slowness in externalising the response and a deterioration in the processing and retrieval of information (Naveh & Kilb, 2014) and in the speed of response (Anstey, Butterworth, Borzycki & Andrews, 2006). This deterioration adversely affects the sensory memory, short-term memory and episodic memory (Montañés & Latorre, 2004). Semantic memories are recovered conceptually up to approximately 80 years, but the semantic access to a word

decreases (the phenomenon of having it on the tip of one's tongue), which influences tasks involving verbal fluency (Raz, Lindenberger, Rodriguez, Kennedy & Williamson, 2005; Schneider & Pichona, 2000). The ageing process is also sensitive to blocking states that reduce the processing of information (Buján, 2013). Older adults also have a deficit in the spontaneous organisation of information which, although it improves when aided, is still lower than that of young people (Montañés & Latorre, 2004).

Although there are no studies that show to what extent the older adult processes integrates content, it

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should be noted that in the transmission of the television message the viewer does not control the speed of emission, which, in adults, increases the difficulty of processing it since the required reaction time increases, and they have greater difficulty in separating the relevant information from the superfluous than young people (Ramos, 2014).

Psychological reactance (PR) is the reaction (of irritation or disgust) that appears as a response to the perception of loss of freedom, and depends on the importance of the behaviour threatened and on age (Brehm, 1989; Brehm & Brehm, 1981). Based on this, the emergence of unconventional advertising in the television programme, thereby restricting viewing, will cause an aversion in the viewer that could trigger adverse behaviour towards the advertiser or the broadcasting channel causing the restriction (Dillard & Shen 2005; Rains & Turner, 2007; Quick & Stephenson, 2008). Our own studies into television with young people show that the degree of irritability towards the UA is high and proportional to the level of

recognition; In addition, the negative behaviour triggered is proportional to the degree of irritability, although the majority of subjects ignore this advertising and continues to view the programme (Añaños, 2011a).

The main objective of this study is to fill a gap in the research into the effectiveness of the integrated content of television in older adults, by studying objectively (eye tracker) to what extent these subjects focus on and process the programme and the advertising when they appear on the screen, compared to young people. The hypotheses are:

- Hypothesis 1. There are no differences in the visual attention paid to integrated content on TV (programme and advertising) between older adults and young people.
- Hypothesis 2. The characteristics of integrated content on TV determine the visual attention paid to the programme and to advertising in both age groups.
- Hypothesis 3. The cognitive recognition of integrated content on TV is lower in older adults than in young people, and differs depending on the advertising format integrated.
- Hypothesis 4. The psychological reactance of older adults to unconventional advertising will be less than that of young people, and as a consequence their behaviour towards the advertiser will also be less negative.

## 2. Material and method

The stimuli are fragments of television programmes in which the unconventional advertising formats appear. For their selection, the occupancy percentage (in time) of overlays, shared screens and animations in the television programming on two consecutive days and in the afternoon and evening time slots were analysed. The selection criterion was that they belonged to the channel with the greatest amount of UA present, covering the two time slots and have a different level of intrusion in the programme. The stimuli selected were:

- Integration of shared screen (SS): a fragment of the programme «Fama» where, on splitting the screen, the advert for a video game appears (figure 1). Its intrusion level is high.

- Integration of overlay (O): a fragment of the programme «El Hormiguero» where the advert for «El Sandwichera» from «El País» appears (figure 2). Its intrusion level is medium.

- Integration of animation (A): a fragment of the programme «Medium» where the self-publicising advert for the TV channel appears (figure 3). Its intrusion level is low.

An «Eye tracker» (model TOBII T60) was used to analyse the visual attention based on the record of the eye movements and travel during the viewing of the stimulus. A digital recorder was also used for spontaneous recognition of the content viewed, a questionnaire on the recognition induced from the stimuli, a questionnaire on the behaviour of the viewer before the appearance of the UA, and the psychological reactance scale based on Edwards et al. (2002), in which the subject evaluated (from 1 to 7) the degree of annoyance caused to them by receiving advertising images while viewing a TV programme (Añaños, 2011a).

60 subjects, 30 older adults (between 68 and 80 years) and 30 young people (between 18 and 25 years) participated in the study. The common criterion for the selection of subjects is that they have a normal or corrected vision (with glasses or contact lenses). The young people (15 men and 15 women) are college students not enrolled in communication courses. The older adults (11 men and 19 women) are subjects who are experiencing normal ageing (not pathological), i.e. without chronic or acute diseases; they are independent, belong to cultural centres for elderly people and are regularly involved in some cognitive activity that keeps them active. The age limit of the adults participating was stipulated as 80 years, an age in which semantic memories are not stabilised and either do not allow for improvement or may worsen

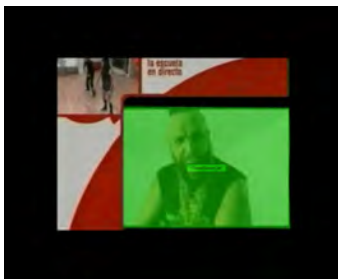


Figure 1. TV fragment where the shared screen (SS) appears.



Figure 2. TV fragment where the overlay (O) appears.

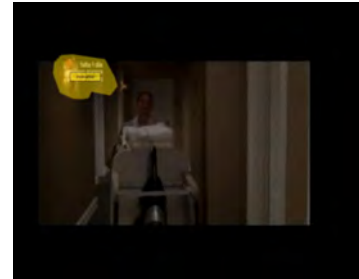


Figure 3. TV fragment where the animation (A) appears.

(Cabrera & Osorno, 2013). All the subjects voluntarily attended the experimental laboratory, signed the informed consent for research participation and received a certificate of collaboration. In the end 53 subjects participated in the study; the dropout rate (11.6%) is due to the impossibility of calibrating the gaze and obtaining eye records (4.6%) and the impossibility of obtaining 90% of these records (7%).

The dependent variables (DV) are the spontaneous recognition of the content viewed (programme or advertising); the recognition induced, in each stimulus, from the programme, the advert, the product and brand advertised; the level of psychological reactance; the behaviour towards the UA and the attention paid to the integrated contents (programme or advertising) of each format studied (O, A and SS). The levels of attention were measured with the «eye tracker» based on the characteristics of the ocular fixations bestowed on the screen:

- Fixation count (FC): number of ocular fixations.
- Fixation length (FL): length (in seconds) of the ocular fixations.
- Time from fixation (TFF): time elapsed from the appearance of the UA until the first ocular fixation (distracter effect).

The independent variables (IV) were the format of integrated content: screen sharing (SS), overlay (O) and animation (A), the age of the participants (older adults and young people) and their gender (male and female).

All subjects underwent the same experimental situation and the same stimulant conditions (SS, O, and A), presented randomly. An exploratory study was performed with a design with blocks (individuals) and random allocation to the treatment sequences (stimuli). The experimental procedure was carried out individually. In the first phase, after the welcome, explanation of the task and collection of the informed consent, the gaze was calibrated with the “eye tracker” in a way that ensured a minimum of 90% of visual records. If

the subject was suitable, the stimuli were presented and the visual behaviour recorded. In the second phase, the spontaneous recognition of the content viewed was recorded, and then the subject answered the questionnaire on the recognition induced, the psychological reactance scale and the questionnaire on behaviour towards the UA.

### 3. Analysis and results

The qualitative analysis of the «Heat Maps» shows that, during the shared screen (Figure 4), the eye fixations are concentrated (heat areas) on advertising and, less intensely, on the programme. In overlay (Figure 5) there are two heat zones, that of the ‘banner’, at the bottom, and that of the programme. During the animation (Figure 6) the hottest area is the face of the programme’s protagonist, and there is a less intense zone in the advertising area.

In order to analyse the visual behaviour quantitatively in each stimulus, the areas of interest (AOI) corresponding to areas of the screen that captured most eye fixations during the time interval in which the integrated content appeared were generated: AOI-Programme and AOI-Advertising.

A quantitative analysis was performed with the program IBM SPSS «Statistics», Version 20. The analyses show no statistically significant differences between the genders of older adults, and therefore the results were analysed without considering this variable.

On the shared screen (SS) (Table 1), the adults (Kruskal Wallis Test) directed more eye fixations (FC) towards the programme than the young people ( $p = .00421$ ), and although there were no significant differences between the two groups in terms of the FC directed towards the advertising ( $p = .0900$ ), the length of fixations (FL) was lower in the adults ( $p = .0221$ ). In both groups, the FC directed towards advertising are greater than those directed towards the programme. In the overlay (O) and (A) animation, the fixations directed towards the programme and towards the adverti-

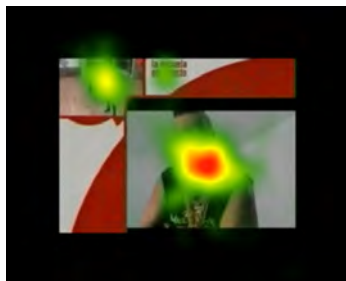


Figure 4. “Heat Map” of the Shared Screen (SS) stimulus.

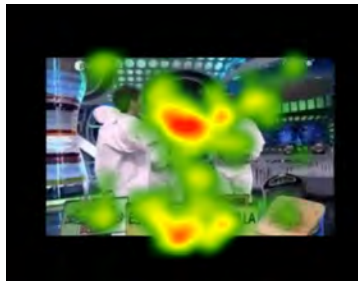


Figure 5. “Heat Map” of the Overlay (O) stimulus.

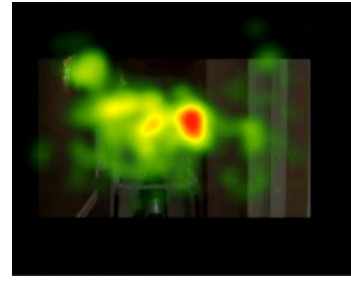


Figure 6. “Heat Map” of the Animation (A) stimulus.

**Tabla 1. Kruskal Wallis Test: medias de las fijaciones oculares (FC) y su duración (FL) de cada grupo en cada AOI y en cada formato**

Contenido Integrado en T V						
	AOI-Programa			AOI-Publicidad		
	Media FC		P-Value	Media FC		P-Value
	Adulto	Joven		Adulto	Joven	
PC	14,78	9,93	*.0421	40,27	35,03	.0900
S	4,68	5,18	.4745	11,76	9,29	.2050
A	2,73	2,63	.9189	2,58	3,59	.2423
	Media FL (segundos)		P-Value	Media FL (segundos)		P-Value
PC	0,54	0,63	.2088	0,53	0,58	*.0221
S	0,69	0,68	.4602	0,30	0,29	.5967
A	0,51	0,61	.5664	0,57	0,50	.8790

sing (FC) and their length (FL), do not differ between the two groups.

The joint analysis (Kruskal Wallis Test) of the fixations (FC) and their length (FL) directed towards the programme and towards the advertising showed that (Table 2), during the overlaying, the FC directed towards the advertising were greater than those towards the programme ( $p=.000$ ) although their length was lower ( $p=.000$ ). During the animation, there were no significant differences between the fixations directed towards the programme and towards the advertising ( $p=.491$ ) or in their length ( $p=.396$ ).

The analysis of the attention capture of the UA was performed (Kruskal Wallis Test) from the «Times First Fixation» (TFF). The results (Table 3) do not show significant differences between the two groups. However, the TFF depends on the degree of intrusiveness of integrated advertising format: being nil in the shared screen (SS), higher in the overlay (O) and much higher in the animation (A).

Spontaneous recognition of the integrated content is significantly different (Chi-Square Test) in both groups ( $p<.0001$ ): the adults recognise the programme more than young people and the advertising and the joint appearance of the programme and the advertising less (no adult does so and 40% of young people do). 61% of adults do not recognise anything compared to 4% of young people.

The analysis of the recognition induced (Table 4) shows that (Fisher's Exact Test) in the shared screen (SS) the recognition induced from the programme ( $p=.0005$ ) and from the advertising ( $p=.0001$ ) for the adults is much less than that for the young people. In the overlay (O) the adults recognise less the program-

me ( $p=.0024$ ), the advertising ( $p=.0041$ ) and the product ( $p=.0160$ ), while both groups did not differ in the recognition of the trade mark ( $p=.0982$ ), nor confuse the programme with the advertising ( $p=.0892$ ). In the animation (A) the recognition induced for the

adults does not differ significantly from that of the young people, being very low or almost nil.

The psychological reactance of the adults is significantly less (Chi-square Test) than that of the young people ( $p=.0463$ ): Unconventional advertising annoys 61% of adults and 92% of young people. The behaviour of adults towards the UA does not differ from that of young people (Chi-Square Test): almost half of the subjects ignored the UA, a quarter say they look at them and 85% of the adults do not change channel. Unconventional advertising does not provoke a negative image of the advertiser or of the TV channel.

#### 4. Discussion and conclusions

The advertising integrated into TV programmes captures the attention of adults (as it does of young people) in the sense specified by Lachter and others (2004) and Pieters and Wedel (2007), regardless of the evolutionary status, as Kosnik and others (1986) and Kemper and others (2004) pointed out, which may also be due to the fact that, since they are moving stimuli, they have a very high level of attention (Smith & Mital, 2013). The level of intrusion of the integrated format determines the extent to which older adults are paying attention to the programme when the unconventional advertising appears, as pointed out by Isaakowitz and others (2006). During screen sharing adults pay more attention to the programme than young people, while in other formats the visual atten-

**Table 2. Kruskal Wallis Test: average FC and FL directed in each AOI in each format (in all the subjects)**

		AOI-Programme	AOI-Advertising	P-Value
FC Average	Overlay (O)	4.93	10.52	**0.000
	Animation (A)	2.68	3.08	.491
FL Average	Overlay (O)	0.68	0.29	**0.000
	Animation (A)	0.56	0.53	.396

**Table 3: Averages for the TFF (seconds) for each format in each group**

	Average TFF (seconds)		Kruskal Wallis Test
	Young person	P-Value	
SS	0.00	0.00	.1786
O	0.21	0.22	.8876
A	4.78	3.19	.3003

tion of the adult does not differ from that of the young person: during overlaying, the advertising completely captures the attention at the expense of the programme, while during animation, attention is paid equally to the programme and to the advertising. Hypotheses 1 and 2 are partially met.

Older adults have a spontaneous recognition of integrated content that is far below that of young people (Kemper & al., 2006; Buján, 2013). In addition, 60% of adults demonstrate a blocking situation (compared to 4% of young people) when having to recognise the information they have just seen, as pointed out by Schneider and Pichona (2000), Raz and others (2005) and Anstey and others (2006). The induced recognition of adults is also lower (almost nil) when the unconventional advertising format has a high or medium level of disruption, which may be due, according to Ramos (2014), to the difficulty of having to separate important information (the programme) from the superfluous information (the advertising) and to the slowing down of information processing, according to Cabrera and Osorno (2013). Hypothesis 3 is fulfilled in terms of the advertising content which has a high or medium level of intrusion.

These results agree with the proposal put forward by Healt (2009), since attention is paid to unconventional advertising is to at a pre-attention or unconscious level, although it is not always identified and recognised, and it is in the process of recognition where adults are less capable.

Older adults have a high psychological reactance but lower than that of young people, which may be due to the fact that they process less advertising informa-

tion (Añaños, 2011a). However, their behaviour towards programming does not differ from that of young people: they ignore the advertising, continue watching the programme and do not show negative attitudes toward the channel or the advertised brand. These results do not support those obtained by Ruz and Lupiáñez (2010) and Pacheco and others (2009), since the elements captured attentionally have no effect on the subsequent conduct of the subject, and support those found by Añaños (2011a) with young people. Hypothesis 4 is only fulfilled on the levels of psychological reactance.

The final conclusion is that integrated content on TV is not effective in older adults since, although it captures their attention, they have serious difficulties in recognising it. This, according to Ramos (2014), is due to the difficulty they have when it comes to processing and separating the relevant information (the programme) from the superfluous (the advertising), although they do not confuse them.

The limitations of this study lie in the fact that only three formats of integrated content have been studied, and the fact that the level of the subjects' cognitive development has not been measured psychologically, since the multidisciplinary development of the subject

**Table 4. Fisher's Exact Test: percentage of subjects that recognise each element inductively**

Recognition induced	TV INTEGRATED CONTENT		P-Fisher's Exact Test
	Shared Screen (SS)		
	Percentage		
	Adult	Young person	
Programme	7.68	67.66	** .0005
Advertising	0.00	72.01	** .0001
Product	0.00	23.82	.0753
Brand	0.00	0.00	-
Programme-advert confusion	7.66	4.02	.8981
<b>Overlay (O)</b>			
Programme	22.96	80.02	** .0024
Advertising	15.02	67.62	** .0041
Product	0.00	36.21	** .0160
Brand	7.66	12.32	.0982
Programme-advert confusion	1.02	3.72	.0892
<b>Animation (A)</b>			
Programme	0.00	23.32	.0685
Advertising	0.00	3.96	1
Brand	0.00	0.00	-
Product	0.00	0.00	-
Programme-advert confusion	6.82	0.00	.3562

proposed by Pérez-Pérez and Navarro (2013) has been considered. The conclusions and limitations themselves suggest further research that would evaluate new formats of integrated content and consider the evaluation of the subjects' cognitive development, especially that of the elderly. However, the results obtained are sufficiently significant to consider the adaptation of integrated content on TV to older adults; Thus, if the aim is for them not only to pay attention (which they already do), but also to process the information, its size should be increased, especially that of the unconventional advertising, as should the exposure time; In addition, the integrated content should contain as few elements as possible.

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