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Learned effects of structural components of newscasts on viewers' information processing: The case of *Stings*

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Abstract: This article proposes that syntactic features of newscasts can act as learned motivational stimuli determining both viewers' attention and memory for information. An experiment was conducted in which we manipulated the presence of stings (a type of widely used audiovisual connector) and the arousal levels of stories, while participants' attention and recall of information were measured. The results suggest that stings elicit motivational activation among viewers; however, differences in motivational activation were observed depending on whether it was due to arousing content or to stings. These results highlight the relevance of accounting for learned motivational processes in media information processing research.

Keywords: motivation, syntactic components of newscast, attention, reaction times, memory, LC4MP, television

1 Introduction

A better understanding of the cognitive processing of television is key not only to expanding communication theory and research (Geiger and Newhagen, 1993), but also to helping television producers improve their products (e.g., Lang, 2006; Lang, Potter, and Grabe, 2003). This is especially important in the case of television news, owing to its impact on people's surveillance of reality and public opinion formation (Iyengar and Kinder, 2010). Research within the

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information processing paradigm has analyzed the effects of formal and content features on attention, emotional reaction, and memory of news (e.g., Grabe, Lang, and Zhao, 2003; Lang et al., 2003; Zhou, 2005), providing valuable knowledge of how viewers cope with information. Nevertheless, most of these studies have focused on news stories as independent units, while much less attention has been paid to the effects of the syntactic elements that articulate a program as a whole. Actual newscasts are not a mere succession of news pieces but they have a structure: Stories are grouped and ordered according to different editorial criteria, and various formal features are used to make connections between segments. Since viewers do not usually watch a single piece of news but the complete program (or at least a fragment of it) containing many stories, understanding how these news items are processed requires a thorough analysis of the effects of structural connections between news items. Although previous experiments have studied the effects of some of these features, such as bumpers or teasers (e.g., Chang, 1998; Schleuder, White, and Cameron, 1993), the effects of other syntactic attributes remain unexplored.

News blocks are usually separated by commercial breaks or special features (Stephens, 1993). Some of these features widely used in newscasts consist of a short irruptive segment of music, often accompanied by some visual feature such as computer graphics presenting the program logo or a general shot of the studio with a camera pan. This kind of connector is called a *sting*, although jargon varies amongst practitioners, scholars, media, and countries, other terms being, for example, *stab*, *sounder*, *jingle* or *ident* (Boyd, 1993; Hudson and Rowlands, 2007), can be used to refer to more or less similar features. Stings are used to give emphasis (Weiner, 1990), to help identify the program (Hudson and Rowlands, 2007), or to punctuate the program (British Broadcasting Corporation [BBC], 2013), by acting as a separator between segments. We argue here that the formal features such as stings not only have effects through relatively simple and evolutionary-based mechanisms as the orienting response (Lang, 1990), but can also acquire motivational relevance (Detenber and Lang, 2011) learned by viewers as a consequence of their experience of television. Research on media information processing has seldom addressed the possible motivational effects of structural features of programs. The present research can thus contribute to a more holistic comprehension of cognitive processing of newscasts as a whole by focusing on how elements that are not part of news pieces have incidence on their processing, and also may be helpful to practitioners in gaining better knowledge of the consequences of their stylistic decisions for how their programs are received and processed by the audience.

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2 The Limited Capacity Model for Motivated Message Processing

Much research on information processing of television has been grounded on the Limited Capacity Model for Motivated Message Processing, known as LC4MP (Lang, 2000; 2006). This view, rooted in limited capacity theories of attention (e.g., Kahneman, 1973) and in the information processing paradigm in media research (Geiger and Newhagen, 1993), describes people as information processors with a limited pool of cognitive resources, while attention is often considered as the process of allocating resources to message processing (Lang and Basil, 1998). According to LC4MP (Lang, 2006), message cognitive processing is carried out in three steps that are constantly and simultaneously occurring in the viewers' information processing system: encoding, storage, and retrieval. Encoding is the sub-process by which information available from the senses is filtered and a first mental representation of it is constructed on working memory, storage is the sub-process by which the information first represented is compared to information pre-existing in memory in order to be stored, and, finally, retrieval is the sub-process by which information previously stored is made accessible to working memory.

Resources can be allocated to each sub-process voluntarily by viewers (depending on their goals, needs, etc.), and also by means of automatic mechanisms activated by message features. One of those is the orienting response (Lang, 1990), an evolutionary-based reflex that promotes allocation of attention to stimuli containing novel or signal information (Lang, 2006). On the other hand, automatic allocation of attention can also be triggered by stimuli with motivational relevance. The motivational relevance of a certain stimulus can be defined as the degree to which that stimulus is perceived as an opportunity or threat (Detenber and Lang, 2011; Lang, 2006), and it can be either primary or secondary. Primary motivational stimuli are those representing issues evolutionarily related to survival such as, for example, food, possible sexual partners or predators, while secondary motivational stimuli are those containing information that has been learned by the subject to signal opportunities or threats (Detenber and Lang, 2011).

Research on television processing based on LC4MP has widely used experimental designs in which the participants are asked to attentively watch some stories or program segments in which the level of the independent variables are manipulated, and measures of attention and memory, among others, are collected during or after the viewing (e.g., Fox, Park, and Lang, 2007; Lang, Bradley, Park, Shin, and Chung, 2006; Lang, Park, Sanders-Jackson, Wilson,

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and Wang, 2007). In this way the level of voluntary resource allocation is considered controlled, and the observed changes in attention and memory are attributable to automatic processes.

To measure various aspects of information processing, different methods have been applied (see Lang, Potter, and Bolls, 2009). Amongst them, one widely used is the Secondary Task Reaction Time (STRT) paradigm, in which participants are asked to attentively watch contents and, simultaneously, to respond to tones inserted in the message by pushing a button as fast as possible. In the context of television watching, STRT indexes the level of *available resources* (Lang and Basil, 1998; Lang et al., 2006), which have been considered to play a central role in media information processing. This is reviewed in the following.

3 The concept of available resources

The model and methods described above have been fruitfully applied to the research on how formal and content attributes of news determine their processing. In this sense, some authors have highlighted the importance of defining media messages in terms of their characteristics as psychological stimuli (Geiger and Newhagen, 1993; Lang, 2013). Within these, a key aspect is how message attributes affect the availability of mental resources (Lee and Lang, 2013). Available resources are the difference between the resources *allocated* by the viewer to message processing and the resources *required* by the message to be processed. Therefore, in order to know how formal or content factors affect available resources, it is necessary to look at their effects on allocated and required resources.

Experimental research on this has conceptualized required resources as a function of message information density, that is, the amount of information introduced per time unit (Fox et al., 2007; Lang et al., 2006; Lang et al., 2007). The greater the quantity of information introduced, the greater the number of resources that are required to process the message (and, generally, the slower the reaction times in STRT tasks). In contrast, the overall resources allocated to message are the result of resources voluntarily allocated (which in this context are controlled by the instructions received by the participant) plus the resources automatically allocated to it (e.g., as a consequence of orienting responses).

Structural and content-related features of TV programs can affect both required and allocated resources (Lang and Basil, 1998). For example, camera

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changes introduce novel information in a sudden manner, so producing orienting responses and increasing allocated resources, but, since new information is introduced, the information density is also increased (Lang et al., 2007). Thus, depending on the amount of new information introduced by a camera change, available resources may be increased or decreased (Lang and Basil, 1998). Indeed, an increased pace of camera change increases reaction times and improves memory when resources required are relatively low (e.g., Lang, Bolls, Potter, and Kawahara, 1999). In contrast, however, if resources required are high, the increase in resources due to orienting responses is not enough to compensate the increase in information introduced, so reaction times are much slower but memory remains stable. Moreover, if resources required are high enough, overload occurs and cognitive resources are displaced to the secondary task, showing faster reaction times but poorer memory (Lang et al., 2007; Fox et al., 2007).

4 Stings as a motivational stimulus

Having considered the literature reviewed so far, to understand the effects of stings on news processing, we must first analyze them as a psychological stimulus, focusing on their physical and semantic properties and how they can affect viewers' available resources (Lee and Lang, 2013). As said above, stings in newscasts are irrupting segments of music, generally related to the program jingle, with a short duration (about two to five seconds) and accompanied by pictures such as the news set or graphics with the channel logo. All these audiovisual elements carry a very low amount of semantic information; we can thus assume that stings hardly increase required resources. Moreover, since they do have virtually no content, they cannot prime later stories as other syntactic features such as teasers or bumpers do (Schleuder et al., 1993). On the other hand, camera changes and, especially, the sudden musical tone, are likely to produce an orienting response, in turn increasing allocated resources. Therefore, at first sight, by increasing allocated resources without increasing required resources, stings should increase overall available resources, which should be reflected in faster reaction times and a better memory of the information just following a sting. Nevertheless, this view may be too simplistic, since it does not take into account how viewers may have learned to interpret stings as markers of important information, and how this can affect news processing.

The literature reviewed above often neglects a fundamental aspect of television processing: the incidence of previous experience and learning. In this

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sense, research on children's patterns of television-watching, and specifically the feature-sampling model (Huston and Wright, 1983), can provide interesting clues. This model proposes that, since salient features such as movement or camera changes elicit orienting responses, they direct gaze to the television, especially in very young children. Nevertheless, as children grow up and acquire intellectual maturity and experience with television language, they learn how to use these features to guide gazing behavior, thus developing intelligent strategies to organize gazing based on program content comprehension. Empirical evidence from research with children and adult viewers provides support to this model (Bickham, Wright, and Huston, 2001; Schmitt, Anderson, and Collins, 1999), suggesting that salient features such as motion or cuts not only attract visual attention because they elicit orienting responses, but also because they convey information (about actions, spaces, etc.) basic to program comprehension. On the other hand, the fact that screen-scanning patterns are more consistent and efficient between adults than between children (Kirkorian, Anderson, and Keen, 2012) also supports the idea that, as viewers become more experienced with audiovisual language, they develop strategies to guide their visual attention. These strategies do not need to be conscious or volitional (Bickham et al., 2001); they may in fact be automated as a consequence of repeated exposure to television, in a similar way that other high-level cognitive processes are automatically driven (cf. Bargh and Ferguson, 2000).

It seems logical to think that the strategies used by viewers to organize their visual attention to the screen could also affect how they allocate cognitive resources to its processing. Stings are often used to give emphasis or as separators between news blocks to punctuate the program (BBC, 2013; Penney, 1991). Since news within blocks are often ordered by importance (Schultz, 2005), the most important story being the first, when stings separate blocks of news they are usually followed by an *important* story (the first on the following block). Hence, it is likely that experienced viewers can have learned that stings signal important information. Viewers consume news for surveillance, entertainment, or social purposes (e.g., Beaudoin and Thorson, 2004; Rubin and Perse, 1987), among others; thus, the more important the story (i.e., the more relevant the topic, the more likely the repercussion for daily life, etc.) the more the motivational relevance it may provide to satisfy viewers' needs or interests. Therefore we argue that stories preceded by a sting, insofar as they are identified as important news, can be processed as motivationally relevant stimuli; in particular, as learned or secondary motivationally relevant stimuli, in terms of Detenber and Lang (2011).

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5 Effects of motivational relevance on attention and memory

Whether stings increase motivational relevance is an important question because motivational relevance impacts attention to and memory of contents. In this sense, in order to analyze the effects of motivational relevance on attention and memory, previous research on the cognitive processing of media has focused on a specific type of motivationally relevant attribute, namely, the emotional arousal provided by the contents. Research on this topic has shown a consistent pattern of effects of motivational contents on the allocation of cognitive resources: Compared to non-arousing stimuli, arousing contents produce an increase of the resources allocated to encoding (cf. Lang et al., 2007). This makes sense from an evolutionary perspective, since humans may benefit from investing more mental resources in processing stimuli that can involve threats or opportunities (e.g., violence or sex) than in stimuli that may not (Lang, 2006). Therefore, since more resources are allocated to encoding, there are fewer resources left for secondary tasks, so the STRT are slower for arousing stimuli than for calm ones (Lang et al., 1999; Lang et al., 2007). Hence, our first hypothesis is as follows:

[H1] Viewers will show slower STRTs when viewing arousing stories than when viewing calm stories.

If, as argued above, viewers have learnt that stings mark important stories and, consequently, viewers attribute motivational relevance to them, we can expect that stings would produce similar effects on the allocation of resources than other motivationally relevant attributes such as arousing content. Thus, our second hypothesis is:

[H2] Viewers will show slower STRTs when viewing stories preceded by a sting than when viewing stories not preceded by a sting.

The increased allocation of resources to encoding for arousing compared to calm messages not only impacts on reaction times, but leads to effects on memory of information. Some research shows that, in general, arousing information is better recalled than non-arousing information (Lang et al., 1999), although this seems to apply only to central aspects of the information, whereas the recall of non-central details of the events tends to be worse for arousing stimuli than for non-arousing stimuli (cf. Lang, 2000). This effect of better memory of

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central aspects but poorer recall of peripheral details for arousing events has been consistently observed in both real-life and laboratory contexts (cf. Levine and Edelstein, 2009). The reasons are still not well understood, but, according to Levine and Edelstein (2009), it could be related to a of narrowing of attention in emotional stimuli; that is, for emotionally arousing stimuli, the limited cognitive resources would be devoted to the processing of central aspects, leaving few resources for the processing of the peripheral information. Research on news processing has also found evidence in this sense; for example, in the experiment conducted by Grabe and colleagues (2003), they found that free recall of the news topic was better for arousing news, but cued recall of specific details was better for calm news. We hypothesize that, if stings are motivationally relevant, the effects on recall associated to arousing contents compared to calm contents should also be found when comparing stories preceded by a sting to stories that are not. One way to test it (Grabe et al., 2003) is to ask participants to recall freely the topic of the stories (i.e., the central aspect of the information in the story, whose recall should be better for arousing stories and for stories preceded by a sting), and to ask them about specific non-central details (i.e., peripheral information, whose recall should be worse for calm stories and stories not preceded by a sting). We can thus make the following forecasts:

[H3] Free recall of central aspects of the story will be better for arousing stories than for calm stories.

[H4] Free recall of central aspects of the story will be better for stories preceded by a sting than for stories not preceded by a sting.

[H5] Cued recall of non-central information will be better for calm stories than for arousing stories.

[H6] Cued recall of non-central information will be better for stories not preceded by a sting than for stories preceded by a sting.

6 Method

6.1 Design

A 2×2 experiment was conducted including two independent variables: content (arousing/calm) and presence of a sting (sting/no-sting). The measured

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dependent variables were reaction times, free recall of the news topic, and cued recall of detailed information.

6.2 Materials

Since the sting accomplishes a function as a connector, the materials used in this experiment were pairs of stories formed by a first story, which we will call *previous story* (PS), a sting, and a second story, here called *target story* (TS). A first sample of 48 pairs, 24 of them with an arousing TS and 24 with a calm TS (based on the criterion of the researchers), was selected from the evening newscast of Televisió de Catalunya (TV3), the regional broadcasting company in Catalonia (Spain), the region in which the study was conducted. This channel is the most watched one in the region (Besalú, 2013), and its newscast has had an average share of about 25 % over the last years (Vicente-Mariño and Monclús, 2009). During 2014, some of their emissions were among the most watched programs of the channel, with audience ratings of about 10 % (www.kantarmedia.es).

Every story was composed of an introduction read by the anchor, and a packaged piece consisting of a video with images of the story voiced by the same anchor. In most cases there are two anchors (male and female) present on set, while in a few cases there is just one presenter. For approximately half of the news, it is the male anchor who reads the introduction, while during the others, it is the female anchor. In some cases the original PS had a different format; in these cases it was replaced by a different calm story from the same program. All the stories had a duration of approximately 30 to 60 seconds. A pre-test was conducted with a group of seven volunteers, who rated each story in terms of how arousing it was. The pairs containing the 12 highest arousing TS and the pairs containing the 12 calmest TS were selected. In all cases, the PS obtained a low punctuation, similar to calm TS. Paired t-tests were conducted to assess that arousal ratings were statistically different between arousing and calm stories. Arousing TS contained topics such as murders, terrorist attacks, or the dramatic consequences of natural disasters, while examples of calm stories were nomination to a political office or a decision by the European Union to change some taxes. Two versions of this sample were created (A and B). In version A, six of the pairs with arousing TS and six of the pairs with calm TS (selected randomly) were edited to remove the sting between the PS and the TS, while in group B, the pairs containing stings were inverted (i.e., the pairs containing stings in version A did not contain stings in version B, and vice versa).

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The stings consisted of a sudden musical tone with the jingle of the channel, accompanied by a camera pan showing a general shot of the set, lasting about 2 seconds. It appeared at least once per program, and it is an element also commonly used in other Spanish newscasts. In fact, newscasts of the main television channels in Spain are very similar in their formal attributes (Vicente-Mariño and Monclús, 2009); thus we believe that the materials selected for the experiment are representative of the formal appearance of newscasts in Spain.

6.3 Dependent variables

STRT. Reaction times were used as an index of available resources at encoding (Lang and Basil, 1998). Eight beeps with a frequency of 1000 Hz and a duration of 200 milliseconds were inserted in each pair of stories, four of them in the PS and the other four in the TS, in pseudo-random temporal positions, controlling that there was always a beep between two and six seconds after the beginning and before the ending of each story, that there were at least two seconds between beeps, and at least 500 milliseconds between a camera change and a beep. Two versions of the position of beeps were created for each pair of stories, and they were randomly distributed across versions A and B, thus creating two subversions of each version, in which beep positions for a certain pair of stories were different.

Recall. Participants were contacted by telephone between 40 and 56 hours after the viewing. They were asked to mention, in 5 minutes, all the topics of the news they could remember, in order to evaluate their free recall of information. Afterwards, to assess cued recall, participants were asked to answer a question about specific non-central details of the information that had appeared in each TS (e.g., "What did the doctors do to save the journalist that had been shot in Israel?", "Which product will be tax-free in the European Union next year?", "What was the girl doing when she was struck by lightning?"). Answers were manually annotated by a researcher.

6.4 Participants and procedure

Thirty participants aged between 18 and 67 (half of whom were women and half men) took part in the experiment and received a gift voucher as reward. They were randomly selected from the database of a market research agency from people that had previously participated in market research studies. Half of the participants were assigned to each video group condition (versions A or

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B). Participants were instructed to carefully watch the news as their memory of it would be tested afterwards, and to push a button as soon as possible when they heard a tone. Participants watched the contents individually on a standard PC screen, and the viewing lasted about 30 minutes. The second day after the experiment, participants were contacted by telephone to respond to the free and cued recall questionnaire.

6.5 Data treatment

Reaction times. Reaction times higher than two seconds were considered outliers and dropped out of the analysis. In turn, the data from three participants who had missed more than half of the tones were also rejected. Thus, the final sample includes data from 27 participants. Mixed multilevel models (Snijders and Bosker, 1999) were used for the analysis. This method was chosen because of its advantages compared to more traditional methods such as ANOVA, including higher flexibility for dealing with missing data and for accounting for individual variability by the inclusion of random terms in the model, which increases their statistical power, among other advantages (Hoffman and Rovine, 2007).

Three different types of models were fitted: models including reaction times for TS (Models 1A and 1B, see Table 1), a model including only PS reaction times (Model 2), and a model including only reaction times from calm TS not preceded by a sting (Model 3). The approach followed was to construct a simpler model first and progressively add predictors, and compare each model with previous ones by likelihood tests (e.g., Bliese and Ployhart, 2002) to guarantee that later models fit the data better than previous ones. In the three types of models, first a null model without predictors was fitted, then a random intercept for subjects and an autocorrelation structure were successively included (Bliese, 2013), and, finally, fixed predictors were added. Model 1A included as fixed factors the type of content and the presence of a sting, while Model 1B included, in addition to the two mentioned factors, the effect of time, with four possible temporal positions (the relative temporal position of the tones within the stories). Models 2 and 3 just included the effects of time as fixed factor.

Recall. Two of the participants did not take the phone call, so the final sample for the recall data is 28 subjects. Responses to the cued recall test were coded by two researchers. For each response, they assigned 0 points if there was no answer or if it was clearly incorrect; 1 point if the answer was not right but there was some correct information in it, and 2 points if the answer was clearly right. Intercoder reliability was then confirmed (Cronbach's α = .91).

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Table 1: Models for reaction times.

	Model 1A	Model 1B	Model 2	Model 3
Fixed Terms	Coefficients	Coefficients	Coefficients	Coefficients
Intercept	346.72***	344.66***	401.00***	358.01***
Sting	26.17**	26.16**		
Content	26.02**	26.02**		
Tone		0.83	−11.03***	−4.60
Sting*Content	−13.29	−13.29		
Random Terms	*SD*	*SD*	*SD*	*SD*
Subject	89.00	89.00	90.34	87.16
Residuals	134.10	134.10	129.25	103.90
Phi Estimate	0.16	0.16	0.16	0.14
−2LogLikelihood	32,374.24	32,375.10	32,404.88	7,902.54

Note: Models 1A and 1B are based on TS data. Model 2 is based on PS data. Model 3 is based just on calm TS not preceded by a sting. Coefficients are expressed in milliseconds. For sting, 0 = not preceded by a sting, 1 = preceded by a sting; for content 0 = calm content, 1 = arousing content. Tone reflects the temporal position of the tones within the story, ranging from 1 to 4. The random terms include the SD of the between-subjects intercept and the SD of the within-subject residuals. The Phi parameter is an estimation of the autocorrelation of values. The -2LogLikelihood is a function of the models' parameters useful for comparing model fitting.
* $p < .05$; ** $p < .01$; *** $p < .001$.

Answers with 3 or 4 points were considered correct, while answers with less than 3 points were considered incorrect. In the case of free recall responses, they were codified by just one of the coders, which considered the answer as correct if the TS topic was clearly stated.

7 Results

7.1 Reaction times

Hypotheses 1 and 2, respectively, predicted that both arousing content and the presence of a sting would produce slower reactions times. Model 1A (Table 1) shows increases in reaction times associated with arousing content and the presence of a sting, providing support to [H1] and [H2]. No interaction effects were found between the presence of a sting and arousing content.

The models show an interesting pattern for the effects of time over reaction times. In PS (Model 2) time has a significant effect: As time passes, reaction

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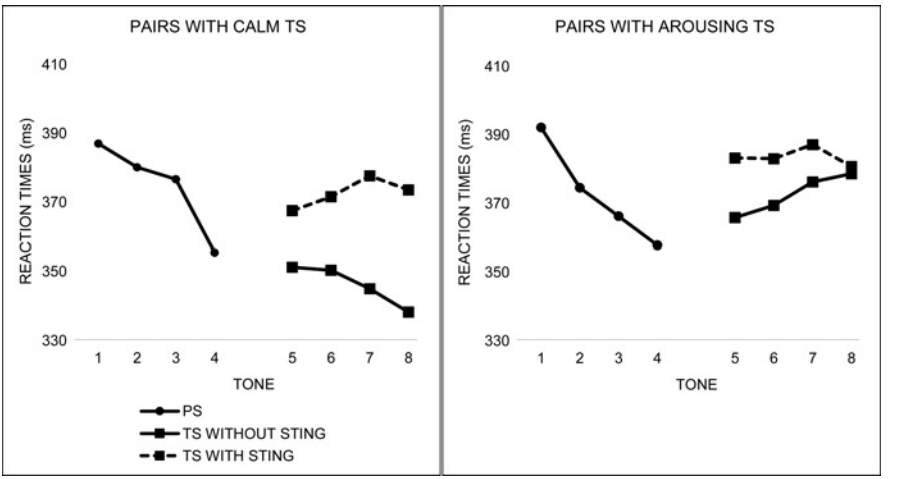

Figure 1: Average values for reaction times by type of content, presence of sting, and order of presentation of the tones.

times become faster. This effect is found in PS disregarding the type of TS they preceded (arousing or calm, preceded or not by a sting), which seems logical, since all PS were similar in terms of arousing content (see the Materials section), and they are obviously not affected by the stings that follow them. In contrast, Model 1B shows that the time is not a significant predictor of reaction times in TS. However, Model 3 and Figure 1 suggest that, just in the case of calm TS not preceded by a sting, a similar effect of faster reaction times as time passes by is present, even though it did not reach statistical significance (p = .19). Indeed, it seems that in the case of stories without motivational relevance (PS and calm TS without stings), time is associated with faster reaction times, while in the case of motivationally relevant stories (those either with arousing content or preceded by a sting), this effect of time is not found. Therefore, this indicates that the effect of the arousing content or the stings is not restricted to the first moments of the story, but that the effect spreads over the whole duration of the story.

7.2 Recall

Hypotheses 3 and 4, respectively, forecast a better free recall of news topics for arousing stories compared to calm stories, and for stories preceded by a sting compared to stories that were not. A repeated-measures ANOVA was conducted

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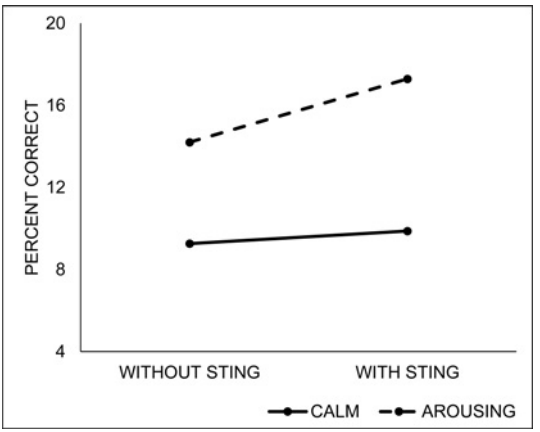

Figure 2: Average values for free recall of story topic of TS by presence of sting and content.

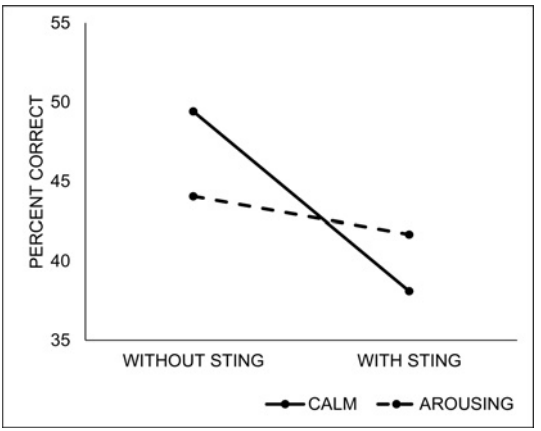

Figure 3: Average values for cued recall of specific details of TS by presence of sting and content.

taking as independent variables the kind of content and the presence of stings, and as a dependent variable the average percent of correct responses in the free recall test. Results showed a significant effect of content, $F(1, 27) = 6.68$; $p = .02$; $\eta^2_p = .21$, but no effects of stings, $F(1, 27) = 0.47$; $p = .50$; $\eta^2_p = .02$, or interaction effects, $F(1, 27) = 0.26$; $p = .62$; $\eta^2_p = .01$. As shown in Figure 2 and in Table 2, arousing news were better recalled than calm news. Therefore [H3] was supported, while [H4] was not.

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Table 2: Means and standard deviations of percent of correct answers in the free recall and cued recall tests.

		Free recall test		Cued recall test	
		Mean	***SD***	**Mean**	***SD***
Calm	No-sting	9	13	49	22
	Sting	10	16	38	23
Arousing	No-sting	14	16	44	21
	Sting	17	15	32	20

Regarding cued recall of details, Hypotheses 5 and 6, respectively, predicted a worse cued recall of details for arousing stories compared to calm stories, and for stories preceded by a sting compared to those that were not. A repeated-measures ANOVA showed a significant effect of stings, $F(1,27) = 4.39$; $p = .046$; $\eta^2_p = .14$, but no effects of the arousing content, $F(1,27) = 0.17$; $p = .68$; $\eta^2_p = .01$, while the interaction between factors was marginally significant, $F(1,27) = 3.45$; $p = .07$; $\eta^2_p = .11$. Multivariate paired comparisons with Bonferroni adjustment showed that the effect of the sting was significant for calm stories, $F(1,27) = 8.68$; $p = .007$; $\eta^2_p = .24$, but not for arousing stories, $F(1,27) = 0.31$; $p = .58$; $\eta^2_p = .01$. These results indicate that stings reduce cued recall, but just in the case of calm contents, so providing partial support for [H6], while [H5] did not find support. Nevertheless, paired comparisons also showed a marginally significant reduction on cued recall of details, $F(1,27) = 3.89$; $p = .06$; $\eta^2_p = .13$, for arousing content in stories not preceded by a sting, an effect that was not present in stories preceded by a sting, $F(1, 27) = 0.95$; $p = .34$; $\eta^2_p = .03$. This could be interpreted as reflecting that both stings and arousing content are sufficient to reduce cued recall of details, but that the effects of both variables are not cumulative. Nevertheless, given that the effect of arousal on cued recall did not reach statistical significance, we have to be cautious when making such a claim.

8 Discussion

The general idea behind this research was that stings could act as a secondary motivational stimulus, so producing effects on information processing similar to those of other motivationally relevant attributes such as arousing content. Both arousing content and stings were expected to produce slower reaction times throughout the stories, and also a better free recall of central aspects of

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the story and a worse recall of details. STRT data showed slower reaction times both for arousing stories and for stories preceded by a sting, even in the last tones presented in the story. Furthermore, a difference in temporal evolution of reaction times between PS and TS was found. While in PS reaction times became faster as the story advanced, and a similar (non-significant) pattern seemed to be present in calm TS without sting, there was not an effect of time on arousing TS and in those preceded by a sting.

The temporal decrease in reaction times in PS might be explained as following. When a story is starting, new information is presented so the viewer has to assign resources to retrieval, in order to match the new information with previously stored knowledge. As the story advances, previously stored information is already available; therefore resources required by the retrieval sub-process are fewer than in previous moments. Available resources can therefore be allocated to encoding, thus producing faster reaction times as the story advances. In contrast, in the case of arousing stories and stories preceded by a sting, motivational activation elicits a higher allocation of resources to encoding (Lang et al., 2007) and, consequently, available resources remain lower during the entire story.

Memory data showed a pattern that only partially fitted the predictions. Paired comparisons with cued recall data, even if they did not reach statistical significance for the effects of arousing contents, suggest that both the presence of a sting or arousing contents is enough to narrow the memory for specific non-central details, which is in accordance with our main argument. This effect explained that when motivational systems are activated, not only are more resources automatically allocated to encoding (Lang et al., 2007) but also the attentional scope narrowed (Levine and Edelstein, 2009) in the sense that the central (i.e., the more relevant) aspects of the story are better encoded and stored, but that there are few resources for the encoding of the non-central aspects of the story. Since fewer resources are available at encoding, information with low relevance is not encoded, so it is not stored and, consequently, cannot be retrieved (Lang, 2006).

Arousing content increased free recall of news topics, but stings did not. A possible explanation for the lack of an effect of stings on free recall could be related to the difference in the nature of the motivational character of arousing content and stings. The results of the experiments conducted by Sakaki, Niki and Mather (2012) suggested that biologically relevant stimuli (those related to survival or reproduction, such as predators, sexual partners, etc.) benefit a more automated processing than socially relevant stimuli (i.e., stimuli relevant to social life), whose effects on attention and memory require more cognitive elaboration and thus depend more on the availability of cognitive resources. It

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is easy to see the correspondence between the concepts of biological and social relevance in this experiment, and the primary motivational and secondary motivational relevance in LC4MP (Lang, 2006). Therefore, in our study, both arousing contents and stings could have been perceived as motivationally relevant, and both could have increased resources to encoding (which explains the slower STRT), so in both cases the information would have been better encoded compared to calm stories and to stories not preceded by a sting, respectively. However, since more resources had been allocated to encoding, fewer resources would have remained for storage in both cases. In the case of arousing contents, that could have not been a problem, since they benefit from a more automated (i.e., less resources-consuming) processing, so the information that has been better encoded could also have been better stored, which would explain the better results in the free recall task. By contrast, in the case of stings, the resources remaining for storage might not have been enough for a better storage of the information. This tentative explanation should be tested in further research by ensuring that actually the encoding is better for stories preceded by a sting compared to stories that are not, for example, by using information recognition tests (Lang, 2006).

A main limitation of this study is that some aspects of the effects of motivational stimuli on attention and memory were not controlled. We assumed a direct correspondence between arousal and motivational relevance, as suggested by the different processing of different types of motivational stimuli, but further empirical research is needed to confirm such an assumption. We did not check whether stings elicited arousal, or whether arousal was a mediator of the effects of motivational relevance on information processing, neither did we control for stimulus valence. Research has shown that arousal plays a major role in the focal enhancement of memory, and that this effect is stronger for stimuli with negative valence than for positive ones (Kensinger, 2009). In our experiment, most of the 12 arousing news items narrated topics likely to be perceived as emotionally negative (e.g., terrorist attacks, murders), while, in contrast, there is no reason to think that stings should have a negative valence. Further research should take into account all these aspects in order to deeply analyze how innate and learned motivations configure information processing. Moreover, while the present study only explored the motivational effects of stings, future experiments should also explore the effects of other attributes and their interaction with content.

Although our results show effects of stings on cognitive resource allocation (e.g., slower reaction times) and those effects are similar to the effects of other motivationally relevant attributes such as arousing content, there is a more direct index of motivational relevance that we have not used and which could

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provide stronger evidence of the motivational relevance of stings. Indeed, psychophysiological measures (e.g., electrodermal activity, heart rate) can provide information about the activity of human motivational systems (e.g., Wang, Lang, and Busemeyer, 2011) and therefore could be helpful for understanding how this activity mediates the effects of stings (and other components of television programs) on attention and memory.

Another important limitation of this study is that, whereas we claim that the motivational effects of stings are learnt (i.e., secondary motivational relevance), we did not actually control for variables that may predict the learned motivational relevance of stings (e.g., previous experience with newscasts) and which could provide stronger support for such a claim. The rationale underlying our assumption that the motivational relevance of stings is learned is that, according to the reviewed literature (e.g., Detenber and Lang, 2011; Lang, 2006), the motivational relevance of a certain stimulus can only be innate due to biological reasons (such as, for example, the motivational relevance of food, sexual stimuli, or predators) or learned. Since there are no reasons to think that a formal attribute such as a sting may have innate motivational relevance, we assume that it needs to be learned. In this sense, we also reviewed evidence that some basic aspects of the psychological processing of media are learned by experience (e.g., Kirkorian et al., 2012; Schmitt et al., 1999). However, in order to reinforce the argument that motivational relevance of structural features of television programs can be learned, future research should test how variables related to learning, such as previous experience of consumption, may mediate the motivational effects of structural attributes such as stings.

Finally, another important limitation of the study is the size of the sample of participants. While the sample size was relatively small compared to other studies on similar topics (e.g., Grabe et al., 2003), it proved enough to provide statistically significant evidence of some clear moderate-size effects of arousing contents and stings on cognitive resource allocation. However, it is possible that our sample was not large enough to find evidence of other smaller-size effects (e.g., regarding the effects of stings on free recall). Anyway, the results obtained allow the present research to be seen as a first exploratory approach to the topic, encouraging further research with larger sample sizes that overcomes this limitation.

9 Conclusions

This study provides support to the idea that structural components of programs (with no content) can act as motivational stimuli, thus affecting attention and

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memory of the contents. Research on media information processing based on LC4MP, despite acknowledging the existence of learned motivational processes, has generally neglected them and has focused on more primary motivations (namely, arousing content). This is understandable since such motivations are common to different people, so the individual variability related to them is smaller and they fit better with research into the general principles of media information processing. Nevertheless, as evidenced in this article, although learned motivational inputs can largely vary between viewers, some common features can be learned in a similar way by viewers and determine consistent patterns of effects in the audience. Research on media information processing must also account for these effects in order to develop more comprehensive models that allow making more accurate predictions on how a message will be processed.

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