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Affective Storytelling for Video News: Introducing and Testing Batman Affective Structure in the Age of Streaming

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ABSTRACT

The transition from traditional flow television to streaming services has created a media landscape in which traditional news outlets are in intense competition with entertainment content. This paper argues for optimizing news for streaming through the affective structure of news narration. We compared flow TV news with a novel narrative structure, the Batman Affective Structure (BAS). The BAS strategically places an emotional peak at the news message's start and one at the end to enhance emotional impact and attention. In an experiment, six real news videos from major Danish broadcasters were re-edited by professionals to align with the BAS. Viewer responses were measured using skin conductance for arousal and self-reported assessments for arousal, attention, and news appreciation. The results showed that the BAS elicited higher physiological arousal and adhered to the expected double-peak arousal pattern, while flow TV news followed an unexpected s-shaped pattern. Additionally, media habits played a moderating role, with the BAS performing the best among viewers with high media use but low news interest, a group that holds great potential for increased news exposure. This study highlights the potential for the BAS to help news adapt to the challenges of the streaming era.

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Introduction

The transition from flow television as the primary news source to on-demand viewing (Ofcom 2023) has resulted in declining audiences for flow TV news. At the same time, media companies are struggling to retain these news audiences on their streaming services resulting in people consuming less news (Newman et al. 2023; Nielsen and Sarnbrook 2016). The decrease of news consumption presents a challenge as news exposure has positive effects on political tolerance, political participation, political knowledge, and more careful information search (Andersen et al. 2021; Lawrence, Cook, and Delli Carpini 2004; Lecheler and de Vreese 2017; Mutz 2006).

On streaming services, news is in intense competition for attention with other types of content as people need to make active choices on what to watch because all content on

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the service is available at any time. In such a competitive environment the relevance and financial survival of news media working with video formats depend on creating content that is better able to command and retain attention, preventing viewers from abandoning news mid-message in favor of other content. One way to retain attention is by creating arousing messages. Arousal is an integral part of the broader concept of affect that refers to the intensity or magnitude of the emotional response (Barrett and Russell 1999; Schiller et al. 2022). Entertainment and fiction strategically manipulate emotion and in particular arousal peaks in the storytelling structure to attract audiences (Keating 2006; Nabi and Green 2015; Tan 2013). Despite the proven efficacy of this approach, it has only to a more limited extent been part of the strategy for fact-based news-narratives (Wahl-Jorgensen 2020).

Building on the potential indicated by the use of arousal in entertainment content, we argue that working strategically with arousal in news content can address the challenge of the limited news audiences on streaming services. We theorize and test a novel narrative structure for news in a streaming context, the Batman Affective Structure (BAS) for news videos. The BAS optimizes emotional arousal of viewers to increase audience retention and engagement, thereby posing a potential solution for the intense competition of the streaming environment. Drawing from research from communication science (Zheng, Lang, and Ewoldsen 2021) and the psychology of emotion (Barrett and Russell 1999; Schiller et al. 2022), the BAS places the most emotionally intense segments (i.e., most arousing) of the news where there is a greater risk of disengagement (i.e., moving away from the message), namely at the beginning and at the end of the message. We test the BAS in a preregistered, experimental study that combines a psychophysiological measure of arousal, namely skin conductance, with self-reported measures tapping on arousal and other dimensions of message engagement. Doing so allows us to compare the BAS to the industry standard news narrative in terms of emotion, attention, and news appreciation. To increase the ecological validity of the study, we collaborated with two Danish broadcasters who each selected three news stories that followed a standard television news narrative and re-edited them to follow the BAS news narrative. The results indicate that the BAS positively affects news engagement as indicated by the different measures employed, and that it does elicit an affective trajectory in the viewer different from traditional television storytelling.

Storytelling News in TV Flow vs. Online

Video viewing online differs from flow TV in some fundamental ways that impact the reach and success of any given news message (Leiner and Neuendorf 2022). In flow TV, viewing within a channel is predetermined, linear, and identical for everyone. By scheduling news adjacent to entertainment content and sometimes even in primetime media organizations created favorable opportunity structures for news. These opportunity structures lead to increasing news audiences due to spill-over effects from entertainment to news shows, especially for those people with less interest in news (e.g., Andersen, Skovsgaard, and Pedersen 2019; Iyengar 2017).

On streaming services, viewers can select among all the available content and can just as easily move away from the selected content at any given time. The viewer experience is unique to each viewer which highlights the significance of individual preferences and

choices which reduces the likelihood of large scores of inadvertent news audiences. For all sorts of content online, algorithms cater personalized content based on engagement metrics from both the user themselves and from other users (Cools, Van Gorp, and Opgenhaffen 2021), which in a streaming context includes seconds spent on video, likes, comments, and shares. The significance of individual preferences and choices in combination with the algorithmic content recommendation creates an extremely competitive environment where content that fails to show good metrics right away is doomed to disappear in the wealth of content available at any time. This high-choice environment is a challenge for all sorts of content, but it is particularly exacerbated for news, which is extremely time-sensitive as interest in a specific message dies out as time goes on (Leiner and Neuendorf 2022).

Entertainment and non-news content are crafted to captivate viewers with engaging visuals and storytelling techniques, ideal for streaming platforms. In contrast, news follows a formulaic approach reminiscent of traditional television, which may not either attract or retain streaming audiences as effectively. Journalism scholars have called for innovation in storytelling to increase the appeal of news already before the audience migration from flow TV to streaming services, but this transition has accentuated the urgency. Traditional storytelling models such as the inverted pyramid, a gold standard in the industry (Kulkarni et al. 2023) have been the object of criticism, with scholars increasingly advocating for news storytelling to become more “narrative” (Johnston 2007; Kleemans, Schaap, and Suijkerbuijk 2018; Knobloch et al. 2004; Kulkarni et al. 2023). Although opinions vary regarding what narrative news should look like, calls for narrative news tend to focus on the chronological structure, which in the inverted pyramid is shuffled or even backwards. A common proposal is to build instead a chronological chain of events similar to fiction narratives (Kleemans, Schaap, and Suijkerbuijk 2018; Kulkarni et al. 2023). Importantly, those critical voices have neglected the role of arousal, in line with a general trend in journalism studies that disregards the topic of emotion altogether (Wahl-Jorgensen 2020).

In this article we turn towards the affective structure of new storytelling rather than a linear time structure of news storytelling. In doing so, we subscribe to what some authors have described as an emotional turn in journalism studies (Wahl-Jorgensen 2020), namely the idea that, for citizens to want to actively seek news, they need to be emotionally engaged with the news (Soroka, Fournier, and Nir 2019; Soroka and McAdams 2015; Unz 2011; Wahl-Jorgensen 2020). Our focus on the affective structure is not necessarily at odds with the chronological and linear storytelling which can sometimes also work through affective mechanisms (Knobloch et al. 2004), but we push emotion to the foreground as a crucial factor in capturing and retaining audience attention, engagement, and appreciation of the news.

In the following section we first present a theoretical framework for the study of emotion in the news and propose an affective structure for building news stories optimized to foster engagement in an online environment, the Batman Affective Structure.

Emotional Arousal and the Batman Affective Structure for News Messages

Our proposed storytelling model Batman Affective Structure (BAS) is derived from a dimensional approach to emotion (Barrett and Russell 1999), a major theoretical approach

within emotion psychology. It defines all affective experience as being made up of two basic dimensions: valence (i.e., negativity, positivity) and arousal (i.e., emotional intensity) (Barrett and Russell 1999; Schiller et al. 2022; Yik et al. 2023). This theoretical perspective has proven very fruitful in media psychology and political communication research (Carbone, Soroka, and Dunaway 2024; Zheng, Lang, and Ewoldsen 2021). Of those two dimensions, the BAS focuses on arousal. Arousal has been directly linked to liking of news (Hendriks Vettehen, Nuijten, and Peeters 2008) and competitive pressure in televised news has been linked to more arousing news overall across different markets (Hendriks Vettehen et al. 2012), presumably because viewers prefer arousing news. In an experimental study, Lang and colleagues (2005) found that electrodermal activity, a physiological index of arousal, decreased right before viewers changed channel, suggesting that low arousal correlates with disengagement. In a body of work, Soroka and colleagues have explored the negativity bias in the news and demonstrate that negative news generally yields higher levels of arousal (Soroka, Fournier, and Nir 2019; Soroka and McAdams 2015) and increases demand for this type of news (Robertson et al. 2023; Trussler and Soroka 2014). Recent work suggests that physiological arousal may play a complex role, acting as an indicator of heightened attention, but possibly also of news avoidance for some news users (Carbone, Soroka, and Dunaway 2024).

In the context of social media, emotional intensity has been found to be a main driver of user engagement (Schreiner and Riedl 2019). Nelson-Field and colleagues (2013) observed that high arousal, but not valence in itself, significantly increased video ad sharing, while Yu (2014) found that arousing brand posts were more likely to be shared or liked than calmer ones. The findings that arousal is positively related to attention, appreciation, and information processing indicate that including arousing information is likely to make news better equipped in the competition with other content on streaming services. Drawing on these insights from research, we introduce the Batman Affective Structure (BAS), a model for storytelling inspired by recommendations in the industry (Heiselberg and Viskum Ebbesen 2021) that optimizes the structure of arousal throughout the message to foster user engagement in an online environment.

The BAS builds on the notion that it is key to hook the viewer at the onset and the end of the news story through content features and formal aspects that strategically increase emotional arousal at these points in the storytelling (Detenber, Han, and Lang 2021; Lang 2017; Unz 2011; Zheng, Lang, and Ewoldsen 2021). Arousing content can be visual stimuli that is motivationally relevant to the viewer (Bradley et al. 2001), or exemplars who are emotionally affected by a problem covered in the news story (Andersen et al. 2017; Heiselberg and Skovsgaard 2021).

Besides content, formal aspects of the video message itself can also increase arousal. Camera movement and the distance or the angle between the camera and the scene have been found to impact the emotional response to pictures and videos (Bálint, Klausch, and Pólya 2018; Cores-Sarría, Hale, and Lang 2021; Cores-Sarría 2022; Mutz 2007), and faster pacing or cutting rate of shots increases both arousal and attention (Lang et al. 1999; 2000). Other formal aspects with similar emotion-triggering effect include for instance the use of music, sudden noises or sound effects (Dillman Carpentier and Potter 2007; Potter and Choi 2006).

Placing this type of arousing content and formal features in the very beginning and end of a news story in the BAS-model results in a shape resembling the ears of the

mask of the well-known superhero Batman (see [Figure 1](#)). The high arousal in the left “ear” of the BAS coincides with the beginning of the message, when streamers are the most likely to disengage from the video. Video skipping is also a problem in flow TV, but it is much more frequent online because the offer of content is unbounded, while TV viewers have a limited channel available. Consequently, in an online high-choice environment it has become increasingly important to catch the attention of the audience within the first few seconds of the message ([Hickman 2021](#); “Beware of the 3-Second Rule”, [2023](#); “The Three Seconds Social Media Rule”, [2021](#)).

The first ear of the BAS is followed by a lowering of emotional intensity in the middle part of the message. This creates space for contextualizing information, which is necessary because an excess of arousal can hinder information acquisition ([Brosius 1993](#); [Lang et al. 1999](#)) and can even lower the liking of a news message ([Hendriks Vettehen, Nuijten, and Peeters 2008](#)). Lastly, the right “ear” of the model is positioned at another determining moment, the end of the message. This second arousal peak is less pronounced because skipping is not as much of a threat anymore, but a small boost in emotion is still important. Attention naturally wanes over the course of a message due to fatigue ([Lang et al. 2005](#)), so a boost in arousal towards the end might help to recover the viewer’s attention and nudge them to interact with the message by liking, sharing or commenting. Those metrics, which prior research has found to be increased for messages that show higher arousal ([Yu 2014](#)), boost the visibility of the video and increase the likelihood of news being shown to the viewer who engaged with the content. Furthermore, an exciting end to the message could also encourage news viewing in streaming services that are organized in the form of libraries (e.g., the on-demand homepage of a TV broadcaster) where the viewer actively chooses the next content.

Importantly, our proposed BAS model differs from the typical news affective structure. News messages in a flow TV bulletin are characterized by a formulaic intro-outro composition where a news anchor in a studio introduces and closes the news story with a neutral, dispassionate and fact-based approach. Linguistic information tends to be less

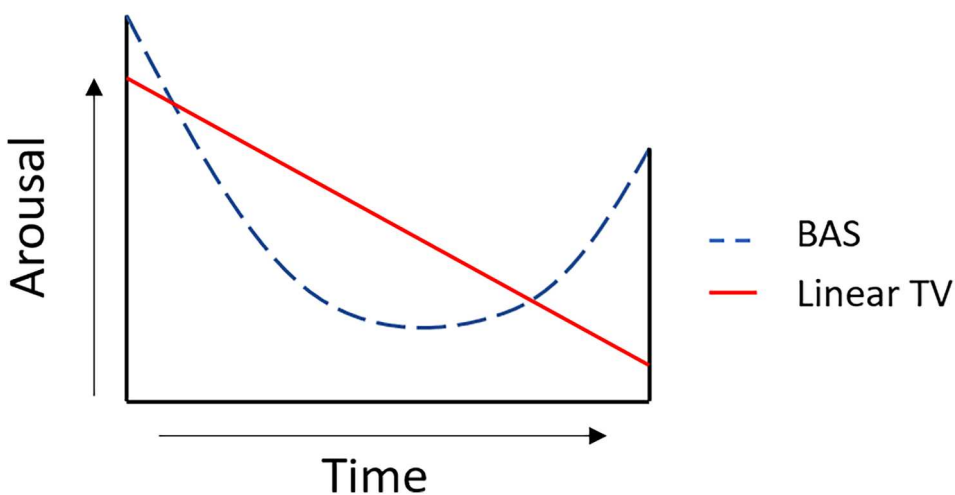


Figure 1. Visual schema of the Batman Affective Structure (blue, dashed line) compared to the expected affective structure of flow TV storytelling (red, continuous line).

emotion triggering than the visual presentation of the events (Lang, Bailey, and Connolly 2015), so this approach should dull the intensity of the emotional response at the end of the message. Both models start high in arousal, given that the onset of new video content tends to cause a peak in arousal in the viewer (Lang et al. 2000). However, we expect that the traditional TV news structure will be less arousing than the BAS in the beginning because the studio introduction by the host is less exciting than a straight jump *in media res*. Furthermore, the TV news structure will cause much lower arousal at the end of the message because arousal is known to decrease over the course of the message (Lang et al. 2005) and this model accentuates this downwards trend by closing with the outro by a host, whereas the BAS reverts it by ending with an exciting beat. Thus, the BAS should trigger more arousal overall thanks to its distinct double-peak arousal shape, while the traditional model will follow a more linear, descending trajectory:

H1. News stories in a BAS will elicit more arousal, as indicated by higher skin conductance level (SCL) (*H1a*) and greater self-reported arousal (*H1b*), compared to news stories in flow TV style.

H2. News stories in BAS will cause a u-shaped, quadratic trend of arousal over time (*H2a*) while news stories in flow TV style will cause downwards linear trend (*H2b*), as measured by skin conductance level (SCL). (see Figure 1)

Because emotional arousal is closely connected to cognitive processing, the BAS should positively affect attentional processes. Motivationally relevant stimuli receive preferential attention than less arousing stimuli (Bradley et al. 2001; Lang 2017) and structural aspects of audio and video that increase arousal are also known to increase attention via an orienting response mechanism (Lang 2017; Potter and Choi 2006). The BAS optimizes the use of emotion when loss of attention is the most likely—especially towards the end, where attention might wane from fatigue (Lang et al. 2005). Thus, we hypothesize:

H3. News stories in a BAS will elicit more attention, as indicated by lower self-reported mind wandering, than news stories in flow TV style.

A key question of interest for journalists and media is whether news engagement does not stop at the message level but spills into over subsequent viewing behavior. Shifts in emotional arousal are known to create post-message involvement (Nabi and Green 2015). While this study focuses on underlying psychological mechanisms and does not directly test for behavioral changes regarding viewing, we do expect that the predicted effects of the BAS on emotional and attentional processes will positively impact viewing intentions, nudging the audience towards seeking related content. If the BAS intensifies attention and emotion, this should increase the interest on the content of the message which in turn would result in a greater intention to seek related messages:

H4. News stories in BAS will elicit more interest in the topic, as indicated by (a) greater intention to continue watching similar messages and (b) to learn more about the topic of the story.

A possible concern is that the BAS could lead to negative perceptions because it differs from traditional news storytelling and might be perceived as more sensationalist than the flow TV news storytelling. Sensationalism is not only a matter of content (e.g., treatment of topics such as violence or gossip) but also concerns the use of formal aspects.

Grabe et al. (2000) found that news messages built with sensationalist style were evaluated as less believable and informative than the original stories, while Kleemans et al. (2017) found that it decreased trust in the message for young and middle-aged viewers. At the same time, the so-called sensationalist style in TV news improves liking (Hendriks Vettehen, Nuijten, and Peeters 2008), stimulates viewing time when viewers can freely choose what to watch (Hendriks Vettehen and Kleemans 2018), and news tend to become more arousing in competitive media markets (Hendriks Vettehen et al. 2012), which suggests that they are preferred by viewers. Based on this, the use of narrative structure, and of form and content in the BAS could be perceived as sensationalist, negatively impacting the perception of the news message as a good source of information. But this negative perception might in turn be counteracted by the positive effect of arousal on viewing preference:

RQ1. Compared to news stories in flow TV style, do news stories in BAS increase or decrease news appreciation of the message?

Closely related to this matter is whether the characteristics of the viewer determine the effects of the affective structure. To that regard, some research has examined whether viewer age can affect processing and evaluation of emotional news. Kleemans and colleagues (2014) found that arousal had the most positive effect on enjoyment of television news for the younger viewers while in subsequent experiment they observed that middle-aged and young viewers judged arousing news as lower quality compared to calm news, while older viewers evaluated both types of news equally (Kleemans et al. 2017). Other researchers have examined how the education level of the viewer might influence whether emotional treatment of news has a positive impact. Bas and Grabe (2015) found that the gap in knowledge acquisition between high and low educational groups can be narrowed when the news is presented in a more emotional way. When the news included an emotional testimony, high and low educational groups exhibited similar levels of learning, while this gap was widened when the news story was presented only as hard facts, in favor of the higher education level group.

Instead of focusing on the age or the education level of the viewer, we focus on the media habits and preferences of the viewer as an individual trait that might influence the effectiveness of the BAS. Because the BAS is a strong divergence from flow TV news storytelling, we think that the media viewers are used to and prefer to consume might influence reception of the BAS. Flow TV news storytelling could be preferred by people who already have a great interest and exhibit high levels of news consumption, either because it is the style they are used to or because they are appealed by less emotional storytelling. Research has demonstrated that scheduling entertainment shows adjacent to news shows on flow television is effective in reducing the gap in news watching between the least and most interested (Andersen, Skovsgaard, and Pedersen 2019). We would expect that the BAS would be the most effective among people who have little interest in news or whose media diet is mostly made up of entertainment, as the BAS is designed to be competitive against that type of content. In other words, it is possible that the BAS is not a one-size-fits-all solution. Based on this, we ask:

RQ2. Does the effectiveness of the BAS regarding emotion, attention, topic interest, and news appreciation depend on the type of media profile of the viewer?

Methods

Our hypotheses and research questions were tested with an in-lab experiment where participants watched a series of news videos constructed following both BAS and standard flow TV storytelling. The study was pre-approved by the Research Ethics Committee and the GDPR board at University of Southern Denmark and the design and measures were preregistered on 14th March 2023, two days before data collection started. The pre-registration document can be found at <https://osf.io/amv6r/> together with another document explaining the deviations from the original plan. The data and the R code used for analysis can also be found at the OSF repository. Because of proprietary reasons the stimuli are not publicly available but researchers interested in the video material are welcome to contact the corresponding author.

Design

This experiment used a 2 (Style: BAS vs. TV flow) x 2 (TV broadcaster: DRTV and TV2 Fyn) x 3 (Stories) mixed design. Each TV broadcaster selected three original news stories they had produced in a standard flow TV style, and constructed a second version following a BAS style, resulting in 6 unique stories each of them produced in a standard flow version and a BAS version. Condition was both a within-subject and a within-story variable, but no subject watched the same story in both conditions. Because the DRTV stories were too long for one experimental session, each subject saw all three stories from TV2 Fyn and two out of the three DRTV ones. Condition was counterbalanced so that each subject saw half of the videos in the flow version and half in the BAS version. The order of presentation of the videos was randomized but blocked by TV broadcaster.

Stimulus Materials

To develop the stimulus material, we hosted a workshop with industry partners: two Danish TV stations, the Danish Broadcasting Corporation (DR) and a regional TV station, TV 2 Fyn. During the workshop, two of the authors introduced the BAS and gave directions for creating a BAS version of an existing news story. That is, the professional journalists in the news organizations did all the editing to increase ecological validity and ensure that the BAS versions met the standards at these established newsrooms. The industry partners delivered the two versions, along with a document outlining their decisions and how the two versions differed based on a questionnaire with open-ended questions from the researchers. The videos from DR averaged 11 min. of length and the videos of TV2 Fyn averaged 3 min. (see Appendix for video-specific information). There were three main differences between the BAS versions and the flow versions. First, the flow versions include an intro by the host, whereas the BAS versions do not, instead they begin in media res with emotional and dramatic content. One example is "Organ donation" where the BAS version starts with an introduction to the main character, Berit, telling how she said goodbye to her dying daughter. Second, the flow version endings are characterized by finishing with an "outro", a perspective presented by a reporter or a host in the studio, while the BAS versions end with an emotional climax putting the perspective part of the news message somewhere in the middle of the online news video. For example,

in the video about the Arctic, the BAS version ends in Greenland focusing on the death of a polar researcher, Konrad Steffen, while the flow version ends in the studio with the host referring to climate change. Third, in terms of formal features, the BAS versions sometimes included background music while most of the flow versions do not. More information about the stories and their length can be found in the Appendix.

Participants and Recruiting Strategy

A goal of 50 participants was set based on financial limitations and prior research using psychophysiological measures in within-subject designs. A sensitivity analysis with G*Power indicated that our sample could reliably detect a small effect size (see Appendix for more details). Participant recruitment was conducted by the polling company Norstat, based on specific criteria: Danish-speaking people under the age of 50 who engage in weekly television streaming. The age cut was set to target audiences that are most likely to be found in on-demand services, as younger people are more likely to stream (Dohrmann 2023). To ensure diversity, Norstat made sure to include participants of varying gender and age. A total of 50 participants were successfully enlisted. Age ranged from 18 to 49 years, with an average age of 30 years. Participants received an incentive of 300 DKK (\$42) in exchange for their participation. In case of no-shows, Norstat recruited a substitute participant. As data from some participants had to be dropped due to technical challenges in the collection of skin conductance (see appendix), we chose to supplement the sample with six university students. The final sample consisted of 32 men and 24 women.

Procedure

Participants arrived at [blinded for review] and completed consent forms, washed their hands, and put their phone on flight mode. They were then guided to a lab with three computer stations. The experiment was run on Tobii Pro Lab software. Shimmer 3 skin conductance sensors were attached to the index and middle fingers of their non-dominant hand. After calibration and signal checks were performed, they put on headphones. They first answered the media habit questions and then watched the five videos, with a calming short clip shown between videos to avoid spill-over effects. Post-video evaluations were collected afterwards. All survey questions and instructions were presented to participants in Danish. Finally, participants were thanked and offered refreshments in an open area. Information regarding the hardware and software used for data collection and analysis can be found in the Appendix.

Dependent Variables

Arousal - Electrodermal activity (EDA). Changes in electrodermal activity were collected for each participant during viewing. EDA is a measure of sympathetic nervous system activation, which is an indicator of the intensity of an emotional response. When EDA is measured as an average slowly changing over time the course of a message it is called skin conductance level (SCL), with higher SCL indicating greater arousal (Potter and Bolls 2012). The raw EDA signal for each subject exported as a time series with 1-second intervals. Detailed information on the strategy for data cleaning and the criteria for data exclusion can be found in the Appendix. The cleaned data was transformed into change scores by

subtracting from each datapoint the value of the first second after message onset, a common practice to reduce the impact of inter-subject variability (Potter and Bolls 2012).

Arousal – Self-reported. Participants were asked to evaluate how they had felt while watching the video, from 1 (*not at all aroused, not at all excited, not at all awake*) to 5 (*extremely aroused, excited, awake*). This was extracted from the self-assessment manikin (SAM), a widely used dimensional emotion scale (Bradley and Lang 1994).

Self-reported attention. Participants were asked to evaluate their agreement with the following question, “*I had a hard time keeping my mind on the news story*”, from 1 (*Not at all how I felt*) to 5 (*Very much how I felt*), extracted from Busselle and Bilandzic’s (2009) narrative engagement scale.

News appreciation. An adapted version of the Du, Zhu, and Cheng (2019) news appreciation scale was used here. Participants were asked to evaluate their agreement, from 1 (*Strongly disagree*) to 5 (*Strongly agree*) with statements claiming that the news report was interesting, hard to understand, important, objective, enjoyable, boring, and trustworthy. After reversing negative items and calculating a correlation matrix, “enjoyable” was dropped due to its mixed correlations. The remaining six items reached were combined and scaled into one news appreciation measure (Cronbach’s alpha = 0.82).

Interest in the topic. To assess the interest in watching similar content and learning more about the topic, participants were asked to evaluate their agreement, from 1 (*Strongly disagree*) to 5 (*Strongly agree*), with the following sentences: “*I would like to watch more videos on the same topic*” and “*I would like to learn more about this topic*”.

Individual Differences Variables

Media habits and viewer profile. The media habits of the participants were measured with several scales where they were asked to express how well the sentences described them. The interest and preference for news was measured with a 4-item scale from Andersen et al. (2022), containing items such as “*I am not interested in news about politics and society*” or “*I try to follow news about politics and society as much as I can*”; after reverse coding two of the items, they were combined into one measure. Third, following Andersen, de Vreese, and Albæk (2016) we created our own media use list-frequency scale where people were asked to report how often they use streaming services, print newspapers, online newspapers, TV news, TV entertainment, and radio news, from 1 (*Never*) to 5 (*Daily or almost daily*). As recommended by Andersen, de Vreese, and Albæk (2016), we created a composite measure by adding up all the items. Because our goal in this study was to explore the effectiveness of the BAS for different types of viewers based on their media habits, we created a *media profile* categorical measure by combining the news appreciation and the media use measures based on a mean-split. Participants who scored below the mean in both measures were categorized as “Non-users” (18 people), those who scored low in media use and high in news interest were “News users” (10 people), the opposite group was categorized as “Entertainment users” (12 people), and those who scored high in both measures fell in the “Heavy media users” category (15 people).

Analytical Strategy

All hypotheses were analyzed with cross-classified mixed-effects models with separate random intercepts for subject and story, using the R package *lme4* (Bates et al. 2015).

Degrees of freedom were calculated with the Satterthwaite method of approximation. RQ2 was addressed by updating previously ran models to include an interaction between condition and the media profile categorical variable. For the self-reported data, the random intercept of story was nested within the random intercept of TV. For the physiological data, only participant and story intercepts were included because the models failed to converge with the more complex nested structure; a random slope for time was included on both intercepts. Furthermore, after visualizing the raw skin conductance data, both quadratic and cubic time trends were included in the analysis. The code and datasets can be accessed at https://osf.io/amv6r/?view_only=4147bf55e9f64f87b39b5b288b6f0081.

Results

H1-Overall Arousal. As predicted by H1a, news messages in BAS elicited higher skin conductance level ($M = -0.44$, $SE = 0.10$) than news messages in flow TV style ($M = -0.47$, $SE = 0.10$; $F(1, 82,660) = 68.77$, $p < .001$) (see Table 1). For the H1b prediction on self-reported arousal we do observe a pattern that is in the expected direction with higher levels of arousal in the BAS ($M_{BAS} = 3.03$, $SE_{BAS} = 0.65$) compared to flow condition ($M_{Flow} = 2.81$, $SE_{Flow} = 0.65$). We note that this difference is not statistically significant ($F(1, 222.12) =$

Table 1. Physiological arousal.

Predictors	Skin conductance level							
	H1a				H2			
	Estimates	CI	p	df	Estimates	CI	p	df
(Intercept)	-0.46	-0.69 – -0.23	0.001	10.33	-0.55	-0.78 – -0.32	<0.001	10.33
Condition	0.02	0.01–0.02	<0.001	82660.41	0.01	0.00–0.02	<0.001	82640.97
Time	-0.07	-0.18–0.04	0.18	7.77	0	-0.11–0.11	0.97	7.73
Time ²					0.09	0.09–0.10	<0.001	82629.73
Time ³					-0.04	-0.04 – -0.04	<0.001	82630.24
Cond. * Time					-0.06	-0.07 – -0.05	<0.001	82661.17
Cond. * Time ²					0.01	0.00–0.01	<0.001	82631.29
Cond. * Time ³					0.02	0.02–0.02	<0.001	82631.33
Random effects								
σ^2		0.28				0.27		
τ_{00}		0.17 Participant 0.04 Stim				0.17 Participant 0.04 Stim		
τ_{11}		0.02 Participant.Time 0.01 Stim.Time				0.02 Participant.Time 0.01 Stim.Time		
ρ_{01}		0.50 Participant 0.78 Stim				0.51 Participant 0.78 Stim		
ICC		0.47				0.48		
N		50 Participant 6 Stim				50 Participant 6 Stim		
Observations		82742				82742		
Marginal R ² / Conditional R ²		0.010 / 0.476				0.026 / 0.491		

Note: Cross-classified linear mixed-effects model fit by REML with Satterthwaite approximation testing the hypothesis on physiological arousal. Measurements are simultaneously nested in stimuli and individuals, with a random slope for time. Note: σ^2 : variance of residuals; τ_{00} : variance of random intercept; τ_{11} : variance of slope intercept; ρ_{01} : random slope–variance correlation.

3.36, $p = .07$) at the preregistered cut-off ($p < .05$, two sided) but perhaps this is due to the relative underpowered nature of this comparison - an issue we return to in the discussion (see [Table 2](#)). H1 was partially supported.

H2-Arousal trend. H2 predicted that the trend of skin conductance level over time would be different for the two conditions, such that BAS would follow a u-shape quadratic trend (a) and flow TV would follow a downward linear trend (b). The interactions between condition and cubic time were statistically significant ($F(1, 82,631) = 73.26, p < .001$), indicating that the effect of time on skin conductance was different between the two conditions (see [Table 1](#)). Given the complexity to interpret the beta coefficient of an interaction with a non-linear variable (Franzese and Kam 2009), H2 was further probed with a visualization of the estimated values for the higher-order significant polynomial (see [Figure 2](#)). As it can be seen in [Figure 2](#), news messages in the BAS condition followed the u-shaped quadratic trend predicted by H2a. Specifically, messages in BAS elicited the highest level of skin conductance in the beginning of the message, followed by a drop in the middle of the message, and a subsequent raise towards the end of the message. Conversely, the flow TV condition did not follow the linear trend predicted by H2b. Instead, it exhibited a more complex cubic s-shape such that skin conductance was highest in the beginning of the message and dropped dramatically, it raised in the second half of the message and finally dropped again at the end (see [Figure 2](#)). H2 was partially supported.

H3-Attention. No statistically significant difference ($F(1, 223.25) = 2.08, p = .15$) in self-reported attention was found between BAS ($M = 3.75, SE = 0.27$) and flow TV ($M = 3.56, SE = 0.27$), although the trend was in the expected direction (see [Table 2](#)). H3 was not supported.

H4-Interest in the topic. As predicted by H4a, interest in watching more similar videos was higher for news messages in BAS ($M = 3.31, SE = 0.5$) than in flow TV ($M = 3.04, SE = 0.5$) ($F(1, 221.46) = 4.58, p = .03$). H4b, which predicted more interest in learning about the topic of the video for the BAS compared to flow TV, was not significant ($F(1, 220.99) = 2.92, p = .09$), although the means were in line with hypothesis ($M_{BAS} = 3.23, SE_{BAS} = 0.59; M_{Flow} = 3.03, SE_{Flow} = 0.59$) (see [Table 2](#)). H4 was partially supported.

RQ1-News appreciation. In response to RQ1, no differences in news appreciation were found between the two conditions ($F(1, 218.2) = 2.59, p = .11$), with news messages in BAS ($M = 3.87, SE = 0.31$) exhibiting similar levels of news appreciation than news messages in flow TV ($M = 3.76, SE = 0.31$) (see [Table 2](#)).

RQ2-Moderation of media habits of the viewer. RQ2 asked whether the media habits of the viewer moderate the effect of the BAS on the variables tested for in this study. This moderating effect was found to be statistically significant for all variables (for brevity, omnibus tests and follow-up by post-hoc tests are not reported in-text but can be found in [Table 3](#)). First, the strongest support for the hypothesized advantages of BAS over flow TV was found for heavy entertainment users with low news interest (“entertainment users”). For this group, news messages in BAS fared significantly better than those in flow TV by all measures except attention, where there were no differences between the two conditions. Notably, entertainment users were the only ones for which messages in BAS received significantly more news appreciation than messages in flow TV. Second, for viewers who expressed high interest in the news but low media use (“news users”), BAS had the expected effect on physiological arousal and attention, while no other differences between conditions were found. Third, for viewers who both used entertainment media

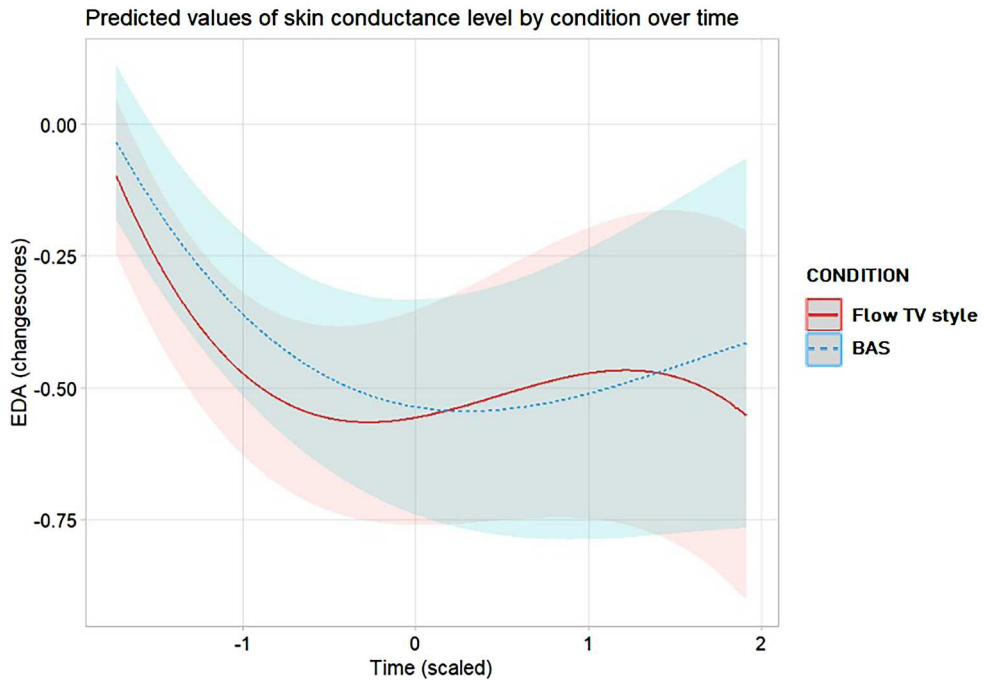


Figure 2. Predicted skin conductance for the interaction between condition and cubic time, across all videos and participants. Time is scaled per video (mean centered and divided by standard deviation) to account for differences in video length.

heavily and were highly interested in news (“heavy media users”), the BAS condition had the predicted positive effects on attention, interest in watching similar videos and interest in learning more about the topic. However, heavy media users were the only group of viewers that exhibited higher physiological arousal while watching news messages in flow TV than in BAS. Lastly, BAS fared the worst for viewers with limited media consumption and low interest in news (“non-media users”). For this group, the only positive effect of BAS was found on physiological arousal. Conversely, news messages in flow TV fared better for non-media users across all other variables with the exception of news appreciation, which was not significant ($t(1,202) = 1.81, p = .07$) but still scored higher for flow TV messages ($M = 3.99, SE = 0.33$) than for BAS messages ($M = 3.78, SE = 0.33$).

Discussion

This study compared the traditional storytelling in flow TV news against our proposed Batman Affective Structure (BAS), a model that we derive from the psychological study of emotion and communication science. The BAS strategically shapes the arousal structure of a message to help address the challenges news content faces in audience retention and engagement within streaming environments. Specifically, the most arousing (i.e., most emotionally intense) aspects of the message are placed in the beginning and end of the message, two points where audience engagement is most critical, especially in a streaming context. By measuring electrodermal activity throughout message viewing,

Table 3. RQ2 Moderating effect Media Profile.

Measure	Fixed Effects	Sum.Sq	Mean.Sq	NumDF	DenDF	F	p	Media Profile	Mean diff. (std)	t	p
EDA	Condition	24.37	24.37	1	77900.75	84.52	<.001	High MU-Low NI	-0.06 (0.01)	-5.78	<.001
	Time	0.64	0.64	1	8.02	2.24	0.17	High MU-High NI	0.03 (0.01)	4.38	<.001
	Profile	0.84	0.28	3	43.04	0.97	0.42	Low MU-High NI	-0.1 (0.01)	-10.79	<.001
Arousal	Cond. x Profile	40.13	13.38	3	77899.62	46.39	<.001	Low MU-Low NI	-0.03 (0.01)	-5.23	<.001
	Condition	4.47	4.47	1	211.96	5.05	0.03	High MU-Low NI	-0.74 (0.26)	-2.84	<.001
	Profile	2.89	0.96	3	46.28	1.09	0.36	High MU-High NI	-0.45 (0.25)	-1.78	0.08
Attention	Cond. x Profile	8.93	2.98	3	206.96	3.37	0.02	Low MU-High NI	-0.19 (0.28)	-0.67	0.5
	Condition	4.63	4.63	1	211.51	4.68	0.03	Low MU-Low NI	0.24 (0.2)	1.19	0.23
	Profile	0.42	0.14	3	46.82	0.14	0.93	High MU-Low NI	-0.28 (0.28)	-1	0.32
Watch Topic	Cond. x Profile	17.19	5.73	3	207.16	5.79	<.001	High MU-High NI	-0.73 (0.27)	-2.73	0.01
	Condition	6.07	6.07	1	210.68	7.07	0.01	Low MU-High NI	-0.65 (0.29)	-2.22	0.03
	Profile	2.17	0.72	3	46.83	0.84	0.48	Low MU-Low NI	0.51 (0.21)	2.37	0.02
Learn Topic	Cond. x Profile	18.4	6.13	3	205.97	7.14	<.001	High MU-Low NI	-0.75 (0.26)	-2.93	<.001
	Condition	4.01	4.01	1	210.4	4.87	0.03	High MU-High NI	-0.86 (0.25)	-3.44	<.001
	Profile	2.7	0.9	3	46.43	1.09	0.36	Low MU-High NI	-0.14 (0.27)	-0.51	0.61
News Appreciation	Cond. x Profile	12.08	4.03	3	205.95	4.89	<.001	Low MU-Low NI	0.42 (0.2)	2.11	0.04
	Condition	1.25	1.25	1	207.63	4.56	0.03	High MU-Low NI	-0.67 (0.25)	-2.68	0.01
	Profile	0.25	0.08	3	46.77	0.31	0.82	High MU-High NI	-0.5 (0.24)	-2.08	0.04
News Appreciation	Cond. x Profile	3.42	1.14	3	203.68	4.16	0.01	Low MU-High NI	-0.3 (0.27)	-1.12	0.27
	Condition	1.25	1.25	1	207.63	4.56	0.03	Low MU-Low NI	0.4 (0.2)	2.04	0.04
	Profile	0.25	0.08	3	46.77	0.31	0.82	High MU-Low NI	-0.4 (0.15)	-2.72	0.01
News Appreciation	Cond. x Profile	3.42	1.14	3	203.68	4.16	0.01	High MU-High NI	-0.2 (0.14)	-1.43	0.15
	Condition	1.25	1.25	1	207.63	4.56	0.03	Low MU-High NI	-0.21 (0.16)	-1.36	0.17
								Low MU-Low NI	0.2 (0.11)	1.81	0.07

Note: Cross-classified linear mixed-effects model fit by REML with Satterthwaite approximation exploring the moderating effect of the Media Profile variable asked by RQ2. Degrees of freedom for post-hoc tests are calculated with Kenward-Roger method. MU = Media Use; NI = News Interest.

we demonstrate that the two types of storytelling do result in different arousal trends over time, with the BAS exhibiting the predicted double-peak structure in the beginning and the end of the message. Additionally, compared to the flow TV style, the BAS elicited higher physiological arousal overall, indicative of greater emotional engagement, and yielded positive effects beyond the message itself, eliciting more viewer interest for seeking similar videos. At the same time, the BAS fared either equally or better than the flow TV style by the other measures of the study – a discussion on the near significant findings is addressed in the limitations section. Taken together, these findings indicate that the BAS has advantages over traditional strategies that might be beneficial in a streaming environment, which are of practical use for journalists working with video news.

Exploratory tests showed that the effectiveness of the BAS was found to be somewhat dependent on the media habits of the viewer, as it had the most positive effects for entertainment users with low news interest. This finding indicates a great potential for increasing news use among a group of people where the added value of increasing news exposure is high. They have low baseline levels of news use, and they can also be easily targeted by news organizations, as they are already using streaming services for other purposes. Conversely, the only group where the BAS seemed to fare worse than flow TV storytelling was for non-users of either entertainment or news, which is not a major drawback because optimized strategies in streaming services can only be effective for people who use the services in the first place. Such a moderating role of the media habits of the viewer on the effects of the BAS could be explained by contextual or learning effects. The BAS follows a structure similar to the entertainment content that surrounds news in streaming services, which could explain why it would be more effective for viewers that are exposed and familiarized with this kind of narrative structure. Further investigation into the moderating role of media habits is needed to confirm this.

Contrary to hypothesis, the flow TV style did not follow the predicted linear, downward effect on arousal but an s-shape with a peak of arousal in the beginning and another one in the second half of the message, followed by a low arousal ending. This suggests that flow TV news storytelling already incorporate a form of double-peak arousal structure, which we did not foresee. However, the s-shape of the flow TV condition differs from the u-shape prescribed by the BAS in that it starts with a smaller arousal peak and ends with a downward arousal trend. This is likely because traditional news storytelling relies on a less dynamic use of content and form at the beginning and end of the message (e.g., host intros and outros, saving exciting footage for later on, minimal editing, lack of music). In contrast, the BAS optimizes the double-peak structure by eliminating the slower start and calmer ending, which in turn seems to result in greater emotional engagement with the message overall and other positive effects, especially for entertainment media users with low news interest.

As a lab experiment, this study has some limitations. The viewing session was long and involved a forced sequential presentation of news messages, meaning it did not directly measure audience engagement and retention but instead used arousal as a proxy. A follow-up study should explore the effects of the BAS in a more naturalistic setting representing real-world streaming, where users get to freely select which video to watch and for how long, and where news are mixed with entertainment content. This would allow us to causally explore the connection between arousal and audience engagement and

retention predicted by the BAS. Another consideration is that the experiment was possibly underpowered for the survey side, as self-report results in less measurements than psychophysiological methods. While we did not find significant effects of the BAS for attention, self-reported arousal and news appreciation measures at the pre-registered $p < .05$ cut-off (two sided), the means suggested a positive effect of the BAS in line with the other significant results. Additionally, once some variance was controlled for by including the moderating effect of the media habits variable, these measures showed significant results in the expected direction, and only in the opposite direction for the non-user group.

Despite the limitations, an important strength of this study is its generalizability to the real-world news consumption. Stimuli in media experiments often pose a zero-sum balance between employing naturalistic messages already made, where a lot of variables cannot be controlled, or creating messages ad-hoc, where confounding aspects are more controlled for but where the messages are less representative of real messages in terms of style and content. In this study, we collaborated with experts from the news industry to obtain messages where the control was real messages broadcasted on live TV, while the manipulation was created according to our guidelines but by the same professionals using the same stories. Our study offers a very good example of what would happen if the BAS was taught in workshops and journalists implemented it in their work. The fact that we have sound findings despite not having had direct control on the creation of the stimuli highlights the positive practical impact of the BAS.

While this study has demonstrated the strengths of the BAS compared to traditional storytelling in terms of psychological processes, future research should include more interactive and behavioral measures. The ultimate goal of the BAS is to feed the algorithm-driven logic of streaming services with an emotionally engaging news message that results in positive user interaction metrics—i.e., seconds spent watching, liking, sharing. The expectation is that these metrics will nudge the viewer towards seeking more news content while simultaneously increasing the likelihood that the news message is shown to new viewers, two outcomes that work towards the goal of increasing news exposure online and, ultimately, a more informed citizenship.

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Author contributions

CRedit: Conceptualization (LCS, LH, MS, BNB); Data curation & Formal Analysis (LCS); Funding Acquisition (LH & MS); Investigation (LCS, LH, MS); Methodology (LCS, LH, MS, BNB); Project Administration (LH); Resources (LH & MS); Writing Original Draft (LCS); Writing-review & editing (LCS, LH, MS, BNB).

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Grammarly, ChatGPT-3.5, and ChatGPT-4 were used exclusively to improve language and grammar in the manuscript. No AI tools were used for content generation.

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