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SIMPLY BELLS AND WHISTLES?

Cognitive Effects of Visual Aesthetics in Digital Longforms

Esther Greussing and Hajo G. Boomgaarden

The success of digital longforms in terms of readership and viral spread promotes an optimistic perspective on innovative web journalism with regard to the attention, engagement, and subsequent knowledge acquisition of citizens when consuming news. Since empirical evidence for such effects is scant, this experimental study focuses on visual aesthetics as a signature element of novel news formats that are designed to attract attention in a highly competitive media landscape. Specifically, it draws on the theoretical framework of user engagement and shows that the presence of visual aesthetics contributes to meaningful learning from the news by initiating positive attitudes towards the interface, which in turn leads to deeper involvement with the content. However, when the presence of visual aesthetics fails to affect interface evaluation, the opposite effect occurs. Surprisingly, these effects are not found to be contingent upon individual differences such as issue involvement or issue-specific prior knowledge. Overall, our results suggest that for news organizations, it is worth investing financial and personal resources in innovative news formats in order to support knowledge gain, although they need to be carefully designed as the first encounter with the interface decides about the subsequent engagement with and processing of the news.

KEYWORDS digital longform; experiment; human-computer interaction; political knowledge; user engagement; visual aesthetics

Introduction

As conventional news media increasingly have problems to attract and retain audiences (Jandura and Friedrich 2015; Strömbäck, Djerf-Pierre, and Shehata 2013), news organizations have started investing effort and resources into the development of news formats that are not legacies from print or broadcast but use the unique affordances of the Internet to convey information (Ferne 2017). One of them is the *digital longform* article, established in the wake of the New York Times' groundbreaking project "Snow Fall: The Avalanche at Tunnel Creek" (Branch 2012). Digital longforms are text-based feature stories with a strong focus on visual elements and innovative web technology such as scroll-driven animation. They provide in-depth information on specific issues (Jacobson 2012; Steensen 2009), and their compelling visual design together with the smooth transition between different modalities creates an immersive

environment that maintains readers' attention and hides the distractions usually experienced when browsing the Web (Dowling and Vogan 2015; Hiiippala 2017; Jacobson, Marino, and Gutsche 2015). Although these features stand in contrast to the commonly fast-paced, fragmented consumption of online news (Barnhurst 2012), "Snow Fall"-inspired projects draw considerable attention and user-traffic even to complex political news stories and their parent websites (Hernandez and Rue 2016).

The success of digital longforms in terms of readership and viral spread promotes an optimistic perspective on innovative web journalism with regard to the attention, engagement, and subsequent knowledge acquisition of citizens when consuming news (Pavlik and Bridges 2013; Sizemore and Zhu 2011, yet for a critical discussion see Groot Kormelink and Costera Meijer 2015). News media exposure has been regarded as an important source of (political) information acquisition, thus contributing to a knowledgeable citizenry, which is a prerequisite for a functioning democracy (Delli Carpini and Keeter 1996). However, empirical evidence for such effects of novel news formats is scant. Except for one study (Pincus, Wojcieszak, and Boomgaarden 2017), digital longforms have been mainly discussed in terms of a changing media landscape (Dowling and Vogan 2015; Wolf and Godulla 2016) and changing journalistic roles (Steensen 2009). Moreover, the success of these projects is mostly measured in terms of page views and average visit duration (Dowling and Vogan 2015). To democratize information and contribute to a knowledgeable citizenry, however, merely attending information is not sufficient: it has to be processed and understood (Tremayne and Dunwoody 2001). Consequently, in this study, we address this gap and focus on *visual aesthetics* as a signature element of news formats that are designed to attract attention in a highly competitive media landscape. Specifically, we ask whether, compared to the absence of visual aesthetics, the presence of visual aesthetics goes beyond eye-catching sensationalism and therefore serves the goal of helping citizens to attend, process, and memorize news.

To this end, we expand existing literature on how structural features of news websites influence learning (e.g., Kruikemeier, Lecheler, and Boyer 2017; Lee and Kim 2016; Opgenhaffen and d'Haenens 2011) and draw on the theoretical framework of user engagement (O'Brien and Cairns 2016) to (1) provide a more in-depth look into the underlying process that may drive cognitive effects of visual aesthetics and (2) unveil the discrepancy that might arise among news readers' attraction to layout design, engagement with news content, and actual knowledge gain. User engagement has been mainly applied in human-computer interaction research (e.g., Hassenzahl and Tractinsky 2006; Peters, Castellano, and Freitas 2009) but has received only little attention in the context of political knowledge and learning from news. Moreover, we enrich the focus on technology-driven effects, and include issue-specific prior knowledge as well as issue involvement as a possible source of heterogeneity in the effect of visual aesthetics on digital longform exposure to get a more nuanced understanding of possible boundaries of knowledge effects. Issue involvement and issue-specific prior knowledge are promising variables in this respect since particularly low-involved and low-knowledgeable people are said to turn away from conventional news formats (Jandura and Friedrich 2015) but also to be attracted by peripheral interface features (Lee and Kim 2016; Petty and Cacioppo 1986).

Understanding the role of visual aesthetics in the reception of unconventional news formats has important consequences, because it is not only a central part of innovative news formats, but also a central stimulus to human perception, which has

the power to initiate a deeper involvement with the associated news content (Oh and Sundar 2015). Thus, it is of relevance for media organizations' design decisions when investing into new formats that allow to be distinctive in today's media environment, while still adapting to digital audiences' media habits and providing them with all the information they need as citizens.

Visual Aesthetics as a Double-Edged Concept

To provide a comprehensive examination of cognitive effects of a key feature of digital longforms, we conceptualize "visual aesthetics" in two distinct ways: as an attribute of the technology (effect-labeled media attribute) and as an attribute of the user (effect-based psychological state; Tao and Bucy 2007). For the *technology-based conceptualization*, we rely on ontological aspects that constitute visual aesthetics and thus allow us to theorize on its direct effect on knowledge acquisition as well as on its link to user engagement. For the *user-based conceptualization*, by contrast, we rely on users' self-reported perception of visual aesthetics after being exposed to the stimulus. Perceived visual aesthetics is specified as a mediator variable, initiating the indirect causal path by which users' knowledge gain may be affected. By distinguishing two distinctive, yet closely related, dimensions of visual aesthetics, the contribution of visual aesthetics can be isolated as of an objective—as opposed to perceived—feature of digital longforms, and the possibility that potential effects are caused by unaccounted individual-level differences can be ruled out (Sundar 2004).

Research on human–computer interaction suggests that besides simplicity and craftsmanship, diversity and colorfulness serve as main qualities of visual aesthetics (Moshagen and Thielsch 2010; see also Lavie and Tractinsky 2004; Sonderegger, Sauer, and Eichenberger 2014). Diversity reflects the visual richness, dynamics, variety, creativity, and novelty of an interface and is said to determine its arousal potential. Against this background, we define "visual aesthetics" in terms of static and dynamic full-screen background imagery together with an embellished typeface. The visuals fit the respective related content but they are nonnarrative i.e., they do not convey information necessary to understand the main content of the news article. In what follows, the technology-based conceptualization will be referred to as "presence (vs. absence) of visual aesthetics," the user-based conceptualization will be referred to as "aesthetic appeal."

Effects of the Presence of Visual Aesthetics on Knowledge Acquisition

Meaningful learning occurs when individuals engage in active cognitive processing, such as selecting relevant information, linking it to existing knowledge, and, ultimately, organizing it into a coherent mental model (Gyselinck, Jamet, and Dubois 2008; Mayer and Moreno 2003). Research on multimedia learning has demonstrated that adding pictures to textual information can directly assist this process (Mayer 2014; van der Molen and Klijn 2004). However, this only accounts for pictures, which represent content necessary for the learning task, while the integration of appealing but superfluous design features is supposed to rather hinder learning (Lehman et al. 2007; Rey 2012). Sundar (2000), for example, showed that participants' ability to memorize digital news content was only improved when adding pictures, whereas more complex combinations of different modalities (e.g., text, pictures, and sound) impeded this effect. Further

research confirmed this finding, arguing that a rich website design may overwhelm or even confuse users and thus lower comprehension (Bresciani and Eppler 2009; Heer and Shneiderman 2012; Tuch et al. 2009). One study has investigated effects of long-form multimedia news in particular, providing evidence that plain text without any accompanying pictures or videos may be the best format for processing and remembering information (Pincus et al. 2017).

Results of this kind are commonly explained using the framework of cognitive load theory (Sweller, Ayres, and Kalyuga 2011), which focuses on the efficiency of the human information processing system. Cognitive load theory assumes that humans possess a finite amount of cognitive resources, and that performing a complex cognitive task requires one to allocate a substantial amount of cognitive resources (i.e., cognitive load) that otherwise can be allocated to a different task. If total cognitive load is excessive (i.e., cognitive overload) in terms of processing superfluous components that are not directly relevant for learning (i.e., extraneous cognitive load), learning will be harmed. Harp and Mayer (1998) argue that “seductive details”—i.e., interface features or pieces of information that are interesting and attractive but unnecessary for the learning task—are a main source for extraneous cognitive load.

Although studies on multimedia learning tend to perceive superfluous interface features as detrimental for learning (Harp and Mayer 1998), there is recent evidence that in some cases, seductive details arouse positive emotions and situational interest, which may compensate for negative effects and even facilitate multimedia learning (Um et al. 2012). Consequently, scholars increasingly call for the integration of motivational and affective aspects when studying learning processes in multimedia environments (Heidig, Müller, and Reichelt 2015). Similarly, research on human–computer interaction started to intersect affective and cognitive dimensions of user behavior within computer-based environments by introducing the concept of user engagement (e.g., Wiebe et al. 2014). In what follows, we systematically assess such competing perspectives and introduce user engagement as psychological experience that may mediate cognitive outcomes of news media use.

User Engagement as a Mechanism for Effects of the Presence of Visual Aesthetics

User engagement is said to occur when users exceed their routine level of browsing the Internet and experience heightened cognitive and affective stimulation (O’Brien and Toms 2008). Recent conceptualizations highlight that user engagement includes both a first encounter with the interface as well as a sustained involvement with associated media content. Thus, it is represented as a continuum that begins with a preliminary assessment of the aesthetic appeal and usability of the interface, followed by a deeper absorption with the content, which finally cumulates in behavioral intentions to voluntarily re-visit the website in the future and recommend it to others (O’Brien and Toms 2008; Oh, Bellur, and Sundar 2015). In our study, we solely focus on user engagement as a psychological experience where the user appraises the quality of the interface and subsequently becomes absorbed in the content.

Interface Assessment

In a rich media environment, users first react to its “bells and whistles” by assessing their aesthetic appeal and usability (Lindgaard et al. 2011; O'Brien and Toms 2008; Oh, Bellur and Sundar 2015). Aesthetic responses occur immediately at first sight, even before consciously noticing any details of the layout design or content (Lindgaard et al. 2006). Therefore, visual aesthetics is considered as decisive trigger for engaging users in digital environments. Several studies have indicated that visually attractive layouts contribute to users' overall satisfaction, interest, curiosity, and pleasant activation (Hartmann, Sutcliffe, and De Angeli 2007; Tuch et al. 2009). Moreover, aesthetic appeal is said to improve the system's perceived usability (Moshagen, Musch, and Göritz 2009; Sonderegger and Sauer 2010).

Together with aesthetic appeal, usability is the second main component of users' interface assessment. Individuals who lose their sense of location in a website feel frustrated and disengaged, which results in declined task efficiency (Webster and Ahuja 2006). In an online news context, Eveland and Dunwoody (2001) have demonstrated that poorly designed web structures require a substantial amount of users' cognitive resources and thus hinder meaningful message elaboration. Poor graphical design, for example induced by the use of exaggerated multimedia enhancements, is said to be one of the most common causes of usability problems, particularly in novel and unconventional environments (De Angeli, Sutcliffe, and Hartmann 2006; Tractinsky, Katz, and Ikar 2000). In our theoretical model, we thus include usability as a serial mediator variable, succeeding aesthetic appeal.

Absorption

When an interface is easy to use and elicits favorable appraisals, users are prone to explore the content of a website in more detail, and they experience more fun, enjoyment, curiosity and control while doing so. They are said to progress to a stage where they might devote all available resources to the media environment (O'Brien and Toms 2008; Sundar et al. 2014). On the user engagement continuum, this stage is referred to as absorption, because users feel immersed in the content and lose track of time and the outside world (O'Brien and Toms 2008; Oh, Bellur, and Sundar 2015). In this respect, the concept of absorption shares attributes with the concepts of transportation (Green and Brock 2000) and flow (Csikszentmihalyi 1990). O'Brien and Toms (2008), however, argue that unlike flow, absorption does not require users to be intrinsically motivated—they can even have an engaging experience when using a system nonvoluntarily. Absorption serves as the third mediation variable in our serial mediation model, succeeding aesthetic appeal and usability.

Elaboration

In communication studies, the stage where users fully invest their cognitive resources to process incoming information is commonly conceptualized as elaboration (Kahlor et al. 2003). Elaboration refers to the integration of new information into already existing knowledge structures. The more thoroughly and systematically an individual thinks about new information, the more sustainable linkages between old and new structures are established. Studies have revealed a direct relationship between elaboration and knowledge acquisition, which is why in our theoretical model, we

conceptualize elaboration as the final part of the serial mediation path. This also corresponds to work by Oh and Sundar (2015, 215) who argue that absorption and elaboration have different operating principles: “Elaboration is a divergent process in which individuals bring diverse issue-related thoughts and previous experience to evaluate an argument, while absorption is said to be more convergent in that individuals would have a single, strong focus on the narrative (more generally, the content) itself.” Therefore, in line with the notion of “fun-in-doing” (Shneiderman 2004), absorption could even go together with the peripheral route of information processing and the creation of less task-related thoughts (Oh and Sundar 2015).

Taken together, we predict that the presence of visual aesthetics can pose an opportunity for learning from a digital longform article indirectly through the user engagement process:

H1: There will be a significant indirect effect of the presence of visual aesthetics on knowledge acquisition serially through aesthetic appeal, usability, absorption, and message elaboration.

Differential Effects of Issue Involvement and Prior Knowledge

Several lines of evidence suggest that news readers’ motivation as well as cognitive ability to carefully process the news is a significant predictor of knowledge effects. Dual process models such as the Elaboration Likelihood Model (Petty and Cacioppo 1986) posit two general processing strategies that reflect greater and lesser degrees of cognitive rigor: While the “central route” involves a more systematic attempt to engage with a message, the “peripheral route” relies on a more cursory examination of information, strongly guided by surface characteristics. Audiences who are less interested in the focal topic (and thus less motivated to dispense high levels of cognitive resources to process related information) are more likely to rely on a peripheral route of information processing and therefore to be affected by the “look and feel” of an interface (Geise and Baden 2014). Graphical elements embedded in an online news text have been found to serve as peripheral cues altering news perception of low-involved users (Lee and Kim 2016). Sundar (2008) argues that peripheral cues guide the readers’ experience of content by invoking modality-based heuristics such as “novelty” and “coolness,” which are conscious acknowledgements of the quality of the interface or device. Consequently, we assume that for low-involved users, the presence of visual aesthetics may be particularly impressive and, thus, serve as vehicle to intensify engagement with a digital longform article. Specifically, we predict that aesthetic appeal—conceptualized as initial trigger for the user engagement process (Oh, Bellur, and Sundar 2015)—varies in strengths, conditional on the level of issue involvement:

H2: For low involved users, the presence of visual aesthetics will increase aesthetic appeal to a greater extent than for highly involved users.

However, experiencing engagement while reading a digital longform article does not necessarily mean to learn from it as learning requires the ability to efficiently categorize separated information in order to reduce cognitive load (Eveland, Marton, and Seo 2004; Kalyuga 2014). Individuals with a more fragmented knowledge base lack the ability to easily coordinate elements within and across textual and visual representations, because they cannot activate already existing knowledge structures. As a result,

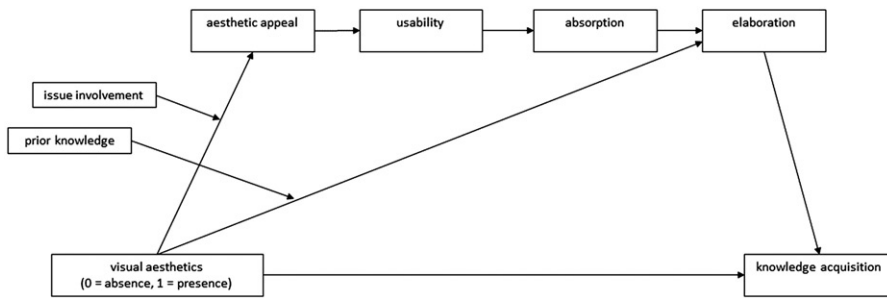


FIGURE 1
Conceptual model

their understanding of novel content tends to be limited to salient surface features (Kozma 2003) and they have greater difficulties distinguishing between relevant and irrelevant information (Cook 2006). That is, dominant visual cues may demand too much of low-knowledgeable users' cognitive resources and detract their attention from the information presented in the accompanying news article. Empirical evidence so far supports this concern (Merle, Callison, and Cummins 2014; Opgenhaffen and d'Haenens 2011; Pjesivac, Geidner, and Miller 2017). Based on these findings, we assume that for individuals with low levels of prior knowledge, the presence of visual aesthetics may hinder systematic processing of the content and subsequent knowledge uptake. Specifically, we predict that

H3: For low-knowledgeable users, the presence of visual aesthetics will decrease elaboration to a greater extent than for high-knowledgeable users.

The aforementioned theoretical frameworks and empirical results are synthesized in a coherent framework as presented in a moderated serial mediation model depicted in Figure 1.

Methods

Participants

To test the hypotheses outlined above, we conducted a web-based survey experiment among the general Austrian population aged 18–65 years, based on a sample size of $N = 187$.¹ The sample applied quotas in accordance with the Austrian population for age ($M = 42.1$, $SD = 13.8$), gender (92 females and 95 males), and educational background (16% completed upper secondary education, 12% completed tertiary education) and was recruited through the national panel of an Austrian online data collection company.

Procedure

Before being exposed to the stimulus, participants were first presented with an audio manipulation check to ensure that their speakers or headphones were switched on. Only those who passed this test were then asked questions concerning demographic data, online news use, social media use, and web experience as well as prior knowledge about, personal importance of, and interest in information about the focal topic. In addition, unrelated distraction questions were asked to hide the actual

research interest and to avoid salience of the story's topic before introducing the stimulus material. Participants were then taken to an external website to read a digital longform story. After accessing all chapters of the story, participants were able to move on to a post-stimulus questionnaire. The poststimulus questionnaire included items assessing the user engagement process, elaboration, and knowledge acquisition. In addition, participants were asked whether they had seen parts of the stimulus material before. In the end, they were provided with a short debriefing that revealed the nature and aims of the research. Participants were thanked and instructed to exit the study.

Stimulus Material

Participants were randomly² assigned to one of the two versions of a digital longform story, representing a layout design under conditions of “presence of visual aesthetics” and “absence of visual aesthetics,” respectively. The story was about the future of manual labor forces and unemployment trends in times of workplace automation, and was a modified version of a multimedia project published by the Austrian Broadcasting Corporation ORF. Relying on this high-quality project further increased the external validity of our experiment. The topic was chosen as it has repeatedly received some media attention in the science section of news outlets but is not time-sensitive or of particular local or community interest. We therefore expected participants to be rather uninformed and moderately interested, with variability ranging from high prior knowledge and issue involvement to no prior knowledge and issue involvement at all.

For the current study, the ORF logo was removed and the story was divided into three chapters discussing the fourth industrial revolution, strategies to reduce unemployment, and the idea of a universal basic income. Programming ensured that readers had to access all three, but after reading the opening sequence, they could decide for themselves in which order they would like to access them. Each chapter consisted of four to seven screens, with each screen presenting either a paragraph of written text (up to 57 words), an auto-playing video clip (up to 30 seconds), or an infographic (for screenshots of the stimuli, see Appendix A). In total, the longform story was mainly driven by written language: 12 screens featured a body of text, three screens featured video material, and one screen featured an infographic. The screens were joined together by scrolling, which means that “the previous and following screens exit and enter the display simultaneously” (Hiippala 2017, 429) and thus create the impression of a seamless narrative. The average reading time was seven minutes.

Experimental Treatment Conditions

The structure and content of the story was identical for both experimental treatment conditions; differences only referred to the layout design. In the version representing the presence of visual aesthetics, readers were presented with static and dynamic imagery. On each screen, written text was superimposed on a non-narrative (decorative) full-screen background image, related to the setting of the content. During the opening sequence, at transition points between the chapters as well as on the final exit-screen, dynamic background imagery (i.e., a non-narrative video loop showing a crowd of people moving towards the reader) and background sound was employed. In

addition, a white font backed by black background was used for written paragraphs; important terms and phrases were highlighted in yellow. Participants assigned to the version representing the absence of visual aesthetics, by contrast, were presented with a white background throughout the whole longform article. A black font (without backing) was used for written language, and important terms and phrases were highlighted in blue. Both versions of the story were created using the software Klynt (www.klynt.net). By carefully matching the two treatment conditions with all manipulations pertaining only to the layout design and not to the content, we account for the challenges that are present in a single-message design.

Measurement

Dependent Variables

The study is concerned with the acquisition of factual knowledge, which was assessed by six multiple-choice questions pertaining to factual information presented throughout the stimulus material. To avoid guesswork, a “do not know” response option was provided for each of these questions. In addition, knowledge batteries were asked after measuring variables that serve as mediators (i.e., that tap participants’ cognitive processes) to ensure that participants did not adjust their self-reported cognitive processes according to their ability to recognize information. For subsequent data analysis, the number of correct answers was summed across the six items ($M = 3.5$, $SD = 0.7$).

Cognitive Processing Variables

After viewing the stimulus, participants answered questions assessing their engagement with and processing of the stimulus article, which serve as mediators in our theoretical model. The measurement was derived from user engagement literature in a media and communication context (O’Brien and Cairns 2016; Oh et al. 2015). For all mediating variables, items were measured on a 5-point scale (1 = strongly disagree vs. 5 = strongly agree) and subsequently averaged. *Aesthetic appeal* was measured by a semantic differential with five items, including old-fashioned—innovative, unpretentious—original, and beautiful—ugly ($M = 4.6$, $SD = 1.1$, Cronbach’s $\alpha = .75$). For *usability*, participants reported on six items comprising the dimensions “ease of use” and “sense of orientation” ($M = 4.1$, $SD = .7$, Cronbach’s $\alpha = .69$). *Absorption* reflected users’ experience of focused attention, curiosity, and heightened enjoyment as well as the feeling of losing track of time and the outside world. It was measured via seven items ($M = 3.8$, $SD = 0.8$, Cronbach’s $\alpha = .89$). Following Oh and Sundar (2015), *message elaboration* was measured independently from absorption, relying on eight items taken from the message elaboration scale by Kahlor et al. (2003). Items include “I found myself making connections between the story and what I have read or heard about elsewhere,” “I tried to think of the practical applications of what I read,” and “I did not spend much time thinking about the story after I read it” ($M = 3.5$, $SD = .7$, Cronbach’s $\alpha = .77$).

Moderators

To measure *prior knowledge*, participants completed a quiz about various political issues including four multiple choice questions on labor policy, unemployment, and

automation in Austria. The summed score across these four questions served as measurement for prior knowledge about the topic. Following Lee and Kim (2016), *issue involvement* was measured via asking the agreement with the following questions: "For me personally, information about labor and social policy is ... [interesting, important, useful]" (averaged across three items). As expected, prior knowledge was rather low ($M = 2.0$, $SD = 1.2$), while issue involvement was moderately high ($M = 3.5$, $SD = 1.1$, Cronbach's $\alpha = .90$).

Covariates

We controlled for variables that may affect the other variables in the model: demographics (age, gender, and formal education level), online news use, social media use, web experience, and the duration to complete the survey. The web experience variable was to account for users' expertise and willingness to adopt new technologies, which was measured via five items based on Sundar and Marathe's (2010) and Marathe et al.'s (2007) scale. Items include statements such as "The Internet is a part of my daily life" and "I am usually rapidly familiar with the functions of a new computer program or app" ($M = 3.6$, $SD = .7$, Cronbach's $\alpha = .71$).

Statistical Analysis

To test the hypotheses proposed in this study, a moderated serial mediation analysis was performed using the SPSS PROCESS macro version 2.16.3 (Hayes 2013). PROCESS uses an ordinary-least-squares path analysis to estimate the coefficients in the model and to determine the direct and indirect effects. This procedure is ideally suited for the current research because it allows to simultaneously examine the direct and indirect effects of each variable of interest on the outcome variable, thereby assuming "a causal chain linking the mediators, with a specified direction of causal flow" (Hayes 2012, 14). The indirect effects are subjected to follow-up bootstrapping, with 10,000 bootstrap samples and 95% bias-corrected confidence intervals (Preacher and Hayes 2008).

Results

Zero-ordered correlations of all measured variables (see Table 1) revealed that absorption ($p < .05$), usability and elaboration ($p < .01$) are strongly correlated with knowledge acquisition. Particularly high positive correlations were indicated between aesthetic appeal and absorption ($b = .52$, $p < .01$), as well between absorption and elaboration ($b = .61$, $p < .01$).

Results from an initial ANOVA model with knowledge acquisition as a dependent variable suggested that no statistically significant difference existed across the two experimental conditions ($p > .05$). Thus, the total effect of visual aesthetics on knowledge acquisition was not significant. Yet a significant total effect is not a prerequisite for mediation effects (Hayes 2013). In line with the theoretical framework sketched above we thus estimated a moderated serial mediation analysis to test the relative effects of the presence (vs. absence) of visual aesthetics. Specifically, using Model 6 of the PROCESS macro (Hayes 2013), knowledge acquisition was regressed on visual aesthetics (0 = absence, 1 = presence of visual aesthetic) as predictor, aesthetic appeal,

TABLE 1Zero-order correlations of measured variables ($N = 187$)

	1	2	3	4	5	6	7	8	9	10	11
1. Knowledge acquisition	1	.133	.446**	.187**	.242**	-.076	-.140	.054	-.157*	.013	.199**
2. Aesthetic appeal		1	.164*	.519**	.265**	.006	-.015	.135	.043	-.073	-.023
3. Usability			1	.311**	.226**	-.098	.031	.073	.046	.064	.103
4. Absorption				1	.611**	.112	.101	.256**	-.018	.078	.034
5. Elaboration					1	.162*	.280**	.184*	-.201**	-.031	.066
6. Social media use						1	.381**	.359**	-.309**	.012	.103
7. Online news use							1	.205**	-.006	-.222**	.172*
8. Web experience								1	-.159*	-.084	.198**
9. Age									1	-.088	-.161*
10. Gender										1	.188*
11. Education											1

Notes. * $p < .05$. ** $p < .01$

usability, absorption, and elaboration as mediators, and issue involvement and prior knowledge respectively as moderators (i.e., as manually computed mean-centered variables and multiplied with the predictor). Demographics, social media use, online news media use, web experience, and duration to complete the survey were all controlled in this model. The results of the moderated serial mediation analysis are presented in Table 2. The path model based on the regression coefficients is illustrated in Figure 2.

Our first hypothesis concerns the user engagement process; that is the mechanism through which the influence of the presence of visual aesthetics on knowledge acquisition may be established. We expected that the presence (vs. absence) of visual aesthetics would affect knowledge acquisition serially through perceived aesthetic appeal, usability, absorption, and elaboration. Indeed, the data shows that the presence of visual aesthetics leads to a higher level of aesthetic appeal, which subsequently triggers enhanced perceived usability of the interface, which then leads to enhanced absorption with the content, which in turn is positively related to elaboration of the news content, which finally leads to enhanced acquisition of factual knowledge. As posited in H1, the conditional indirect effect when the moderators are at their mean values was significant; the 95% confidence interval did not contain zero ($b_{a1s2s3s4b4} = .003$, 95% CI = [.0005, .0132]). That is, when people are exposed to a digital longform article that incorporates visual aesthetics as structural feature of the layout, they may be able to recognize the content in a better way, in parts because of user engagement as an underlying process. However, the indirect effect is very small, and the theoretically supported user engagement path was not the only mechanism revealed by the data.

A second significant indirect effect runs from visual aesthetics to knowledge acquisition serially through aesthetic appeal, absorption, and elaboration ($b_{a1s1s4b4} = .05$, 95% CI = [.0143, .1283]), which in fact is a shortened version of the user engagement process excluding usability. A third significant indirect effect however shows that usability plays a crucial part in the learning process, because visual aesthetics and knowledge acquisition are also positively related serially through aesthetic appeal and usability ($b_{a1s2b2} = .05$, 95% CI = [.0071, .1354]). There is even a fourth significant mechanism underlying knowledge effects of visual aesthetics in digital longform articles, suggesting a negative effect of the presence of visual aesthetics on knowledge acquisition serially through absorption and

TABLE 2
Results of the moderated serial mediation analysis ($N = 187$)

	Independent variable			
	Presence vs. absence of visual aesthetics			
	Effect	SE	LLCI	ULCI
Direct effect	.26	.20	-.1284	.6492
Conditional indirect effect (issue involvement and prior knowledge being sample mean value)				
Total indirect effect	.08	.13	-.1644	.3354
Through aesthetic appeal → usability → absorption → elaboration	.003	.00	.0005	.0132
Through aesthetic appeal → absorption → elaboration	.05	.03	.0143	.1283
Through aesthetic appeal → usability	.05	.03	.0071	.1354
Through absorption → elaboration	-.05	.03	-.1469	-.0052

Notes. All analyses controlled for demographics, online news use, social media news use, web experience, and duration to complete the survey. LLCI: lower limit of confidence interval; ULCI: upper limit of confidence interval. All other possible indirect effect paths were non-significant ($p > .05$).

elaboration ($b_{a3s4b4} = -.05$, 95% CI = $[-.1469, -.0052]$). This last path does not include variables of interface assessment but directly links visual aesthetics to involvement with the content.

Accounting for all possible indirect effects in the model, the direct effect of the presence of visual aesthetics on knowledge acquisition is not significant. That is, remembering facts previously presented in a digital longform article do not seem to directly depend on the presence or absence of visual aesthetics employed to present the article. The effect of visual aesthetics is solely exerted through the conditional indirect paths when the moderators are at their mean values. Moreover, it was predicted that beneficial effects of the presence of visual aesthetics may vary as a function of the news reader’s motivation as well as ability to thoroughly process the news. However, as demonstrated in Figure 2, we did not find a significant effect for either of the two interaction terms: neither issue involvement nor prior knowledge did exert significant moderated mediation; H2 and H3 are therefore not supported.

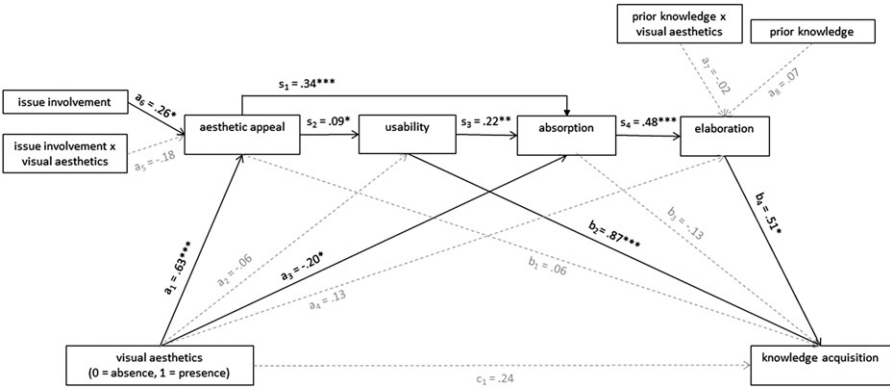


FIGURE 2
Path diagram of the moderated serial mediation

Discussion

This study focused on visual aesthetics as a signature element of innovative news formats that are designed to attract attention in a highly competitive media landscape, and examined, in line with the concept of user engagement (O'Brien and Cairns 2016), whether the presence of visual aesthetics transcends mere visual sensationalism and actually helps citizens to attend, process, and recall news content. In addition, we were interested in whether visual aesthetics may have different effects on users with different levels of prior knowledge and issue involvement, respectively, since particularly low-involved and low-knowledgeable individuals are likely to turn away from conventional news formats (Jandura and Friedrich 2015) but are also susceptible to peripheral interface features (Lee and Kim 2016). Overall, the results indicate that the presence of visual aesthetics is not directly related to knowledge acquisition but fosters learning by initiating the process of user engagement (O'Brien and Cairns 2016), represented by a *positive* serial mediation through aesthetic appeal, usability, absorption, and elaboration. However, when the presence of visual aesthetics fails to affect aesthetic appeal and usability, it hinders learning by initiating a *negative* serial mediation through absorption and elaboration. Surprisingly, these effects were not found to be contingent upon individual differences such as issue involvement or prior knowledge regarding the topic.

The dual nature of our findings highlights the complexity of the cognitive and affective processes that are at work when users read digital longform articles, and raises important questions concerning the role of (positive) attitudes towards the news interface for political knowledge and learning from news. Since all positive mediation effects on knowledge acquisition were initiated by aesthetic appeal, while the negative mediation effect bypasses interface assessment, it seems as if the crucial factor for successful learning from innovative news formats is not the objectively given differences in the interface design but rather the subjectively perceived levels of aesthetic appeal and usability. This supports the conceptualization of user reactions to digital media as a two-stage process that begins with a first evaluation of the media interface, followed by a deeper absorption with the media content (O'Brien and Toms 2008). That is, knowledge acquisition does not only depend on information presented in certain ways and modalities, but importantly is influenced by first, maybe rather ad hoc and unconscious reactions to the (aesthetic) appeal of such presentations. Models of news learning in which news consumers' content-independent reactions determine the subsequent processing of information demand further empirical investigations. The current data imply that the user engagement continuum as explicated by Oh and Sundar (2015) is a fruitful concept to study such mechanisms. In that vein, future research could also turn to other structural features of news such as perceived text complexity in order to better understand what makes it more or less likely for users to become involved.

Consistent with dual process models (Petty and Cacioppo 1986; see also Lee and Kim 2016), we assumed that static and dynamic full-screen background imagery together with an embellished typeface would particularly impress low-involved users. However, we did not find supportive evidence. This speaks against the solely optimistic idea that attractive news formats are a suitable instrument to make (political) news more appealing to people who would otherwise not pay attention (Pavlik and Bridges 2013). It needs to be kept in mind here, however, that the digital longform article under study represents a novel news format most participants in our sample were not familiar

with. Consequently, the average level of aesthetic appeal was high, possibly lacking sufficient variance for significant differences between high- and low-involved users.

This study further highlights the importance of a careful conceptualization of the independent variable that allows identifying the root cause of a knowledge effect by isolating the technological feature of an interface that accounts for positive as well as negative user reactions (Tao and Bucy 2007). Contrary to our expectation that low-knowledgeable individuals would be negatively affected by the presence of visual aesthetics at the point of message elaboration, the data reveal a direct negative relationship between visual aesthetics and absorption, regardless of prior knowledge. This points to the notion of a rich layout design as significant “seductive detail” (Harp and Mayer 1998) that causes task-irrelevant thinking and thus places additional demand on users’ limited cognitive resources. Finding the thresholds under which layout and design are placing a too high burden for information processing would be a much-needed endeavor. In our study, visual aesthetics was operationalized as a binary variable (presence vs. absence). Different levels of visual embellishment could be tested to see when and at what point in the reception process design takes away undue cognitive resources.

In sum, it is suggested that future research on cognitive effects of novel news formats takes a closer look at the contradicting mechanisms revealed by the current data, for example by including not only measurements for positive interface assessment but also for negative assessments and cognitive load. Moreover, since this study was unable to demonstrate moderated mediation, further research is needed to clarify whether there are conditions under which visual aesthetics exert differential effects.

This study is not without limitations. First, our findings are based on a stimulus article that focuses on a rather specific topic, which may not allow for strong generalizations (Thorson, Wicks, and Leshner 2012). Future research might systematically investigate whether and how different topics matter for users’ affective and cognitive reactions to novel news formats. Online survey experiments also offer no direct control over participants’ exposure to the stimulus. To gain more nuanced insights into how users engage with such formats, particularly with regard to potential confounding effects such as distraction, it would be beneficial to include thought-listing tasks or eye-tracking techniques in future work to identify which layout features exert which effects. Moreover, in our study, we only tested for the recognition of factual knowledge. To get a more comprehensive understanding of learning processes induced by novel news formats, it would be interesting to include more advanced conceptualizations of knowledge (e.g., Eveland et al. 2004). Finally, the time period between reading the stimulus article and answering the knowledge batteries was rather short (i.e., a few minutes), allowing us to only observe short-term effects.

Notwithstanding these limitations, since our study is among the first to systematically investigate digital longforms from a user perspective, it has important implications for journalism practice and civic society. In today’s highly competitive media landscape, news organizations face the challenge of offering news formats that attract attention but still adapt to audiences’ ability to process and understand the content. The contradicting results revealed in this study reflect this challenge and highlight users’ attitude towards the interface as a central factor. News organizations are thus

advised to carefully consider the target audience of innovative formats, as the first encounter with the interface appears to decide about the subsequent engagement with and processing of the news. Our results generally suggest that it is worth investing resources in innovative news formats as they have the potential to foster meaningful learning of even complex political news and thus to contribute to a knowledgeable citizenry. This claim is however limited to news organizations' aim of conveying information and adding to journalistic quality. Further studies are needed to examine whether digital longforms are also beneficial with respect to news organizations' business models. Moreover, such normative conclusions depend not only on the structural characteristics of the news format but also on the content presented. The interaction effects of structural and content features are therefore the logical next avenue for research on cognitive effects of digital longforms in light of their potential to provide more than "simply bells and whistles."

NOTES

1. Initially, 212 participants completed the survey. A total of 24 of them were excluded based on the time to complete the survey, since it was either too long or too short for a serious engagement with the survey (i.e., a duration of more than 35.5 minutes and less than 9 minutes, respectively). Since none of the participants reported technical problems when reading the news story, we assume that an excessive duration is not caused by a slow internet connection. One person who attended the stimulus material for less than 1.5 minutes was also removed, ending up with a final sample size of 187 people. The median time taken to complete the survey was 17.7 minutes.
2. An ANOVA indicated that randomization to the experimental conditions was successful. No differences were observed between the two experimental groups for age, gender, formal education, online news use, social media news, and web experience (all $p > 0.05$).

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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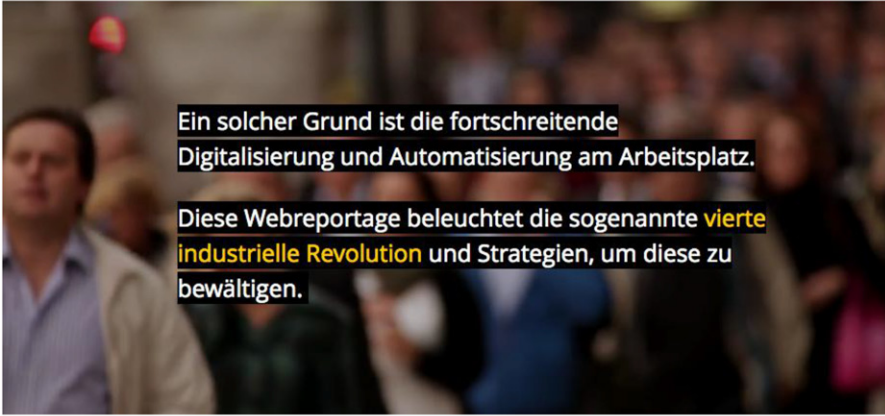
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Appendix A: Selected screenshots of the two experimental conditions

See [Figures A1](#) and [A2](#).

Presence of visual aesthetics (screen presented in the opening sequence)



Absence of visual aesthetics (screen presented in the opening sequence)

