May I have your attention please? An Eye Tracking Study on Emotional Facebook Comments

Abstract

Research shows that online comments can have great influence on how people perceive the news. Especially for comments on social media such as Facebook, which is increasingly used for news reading, this influence rises concerns. Since comments on Facebook have been shown to often be uncivil and emotional, it is pointed out to possible negative effects on deliberative political discussions. Concurrently, to affect readers, comments need to get attention in the first place: Facebook users are constantly confronted with a massive amount of information so that comments need fight for attention. Following selective attention theory, emotional content is highly salient and we therefore expect that emotional comments are of particular importance in the Facebook news environment. Using eye tracking and recognition tests, we compare visual attention towards and recognition of emotional comments. On the basis of negativity bias and cognitive-functional model of the effects of discrete negative emotions, we argue that differences appear between positive and negative as well as angry and fearful comments. Results of our pre-registered laboratory eye tracking study (n=155) show that negative comments lead to higher attention, but no better recognition; but anger shows to impact visual attention and recognition. We further differentiate heuristic and systematic processing style with an experimental intervention of time limit, aiming to take into account that Facebook users adapt heuristic strategies to process information. Results show that the different processing modes lead to different emotion attention. This research contributes to a better understand of the role of emotions in user comments as a gateway for information transmission influencing topic perception and opinion formation.

Keywords: Information Processing, Negativity Bias, Discrete Negative Emotion, Visual Attention, Recognition, Eye Tracking

Introduction

When people comment on the news online, they do not only express personal opinion towards topics. In comments, users bring together personal opinions with sometimes strong emotions. How emotional user comments are differs thereby between platforms (Su et al., 2018). On Facebook, Ben-David and Soffer (2018) found that comments convey emotional expressions feelings such as sadness, anger, and grief, but also cheer or enchantment more often than on original news websites. In particular comments that use verbal aggression or hate speech to express anger are publicly discussed with concerns. Studies indicate, for example, that such "uncivil" comments decrease perceived quality of journalistic content (Prochazka, Weber, & Schweiger, 2016; Weber, Prochazka, & Schweiger, 2019) and diminish trust in news information (Graf, Erba, & Harn, 2016). How people give judgmental contributions and evaluations in the form of comments leads to measurable media effects that may lead recipients to form certain viewpoints (Sikorski & Hänelt, 2016). Therefore, it is questioned and pointed out that in particular negative comments can have deliberative effects on rational and political discussions (Rowe, 2015; Su et al., 2018); as well as opinion formation, participation, and decision-making (Schweiger, 2017; Ziegele, 2016).

However, even though ongoing research cited above describes comments as tools of "overpowering" influence (Waddell & Sundar, 2017), it needs to be taken into account that users are constantly confronted with a never-ending flow of new posts and comments. Facebook, which is increasingly used for news reading (Newman, N., Fletcher, R., Kalogeropoulos, Levy, & Nielson, 2018), is also the largest database of social information (Koroleva, Krasnova, & Günther, 2011). Readers, who need to select information for processing, get attracted by those which are of highest personal relevance. The process of attraction has a selective function. By attraction, certain

information is included, some is excluded from processing. Only after attraction first, comments can be to be attended to and read, influence opinions as well as further actions and behavior (Bucher & Schumacher, 2006).

In order to attract attention, *emotions* are crucial: People unconsciously attend to emotional cues before non-emotional and it takes less mental effort to process emotions (Reeck & Egner, 2015; Yiend, 2010). This makes emotions of particular importance when readers receive information in a complex digital media environment. On Facebook, 510,000 comments are posted every minute (Noyes, 2019), To efficiently perceive lots of information and to quickly form judgments about complex news issues, emotions are used es orientation cues and trigger the use of heuristic processing.

Despite the importance of selective attention in social media and the high prevalence of emotional comments on Facebook, there has been little investigation on the influence on such comments on selection processes yet. We argue that emotions lead users' attention towards particular emotional comments, which are in turn selected for encoding and influence how reader perceive news. The leading research interest of this study is: *How do readers of Facebook News Posts read information from emotional user comments, and to what extent does that different depending on the information processing mode?*

Distinguishing the encoding process into *attention and memory*, we assume that emotional information attract more attention, receive higher priority in processing and persist longer in working memory (Ferré, 2002). We thereby specify emotions by arousal and valence, as well as distinguish the two important discrete negative emotions *anger* and *fear*. To measure attention, we apply eye tracking in an experimental setting. With eye tracking, we are able to measure unconscious effects of comments.

Finally, we used pre-registration to guarantee high research standards and contribute to open science. To our knowledge, this study is the first pre-registered eye tracking study in communication science. With the study we aim to a better understanding of the role of emotions in user comments as a gateway for information transmission, topic perception, and opinion formation in our times, in that more than 50 percent of Internet users get the latest news articles via social media and thereby in average spend 15 seconds or less to read them (Matsa & Shearer, 2018).

User comments influencing news perception

"Commenting on online news articles is considered (one of) the most popular form(s) of public online participation" (Ziegele, Springer, Jost, & Wright, 2017) and recent research seems to agree on the fact that user comments strongly can influence readers. Reich (2011) claims that comments are "no less interesting and informative than the main journalistic texts to which they relate or respond" (Reich, 2011) and Su et al. (2018) argue that information from comments can be even more important for reading the news than the article itself. Prochazka et al. (2016) further emphasize that user-generated comments are used as a cue in judgments of professional content (Prochazka et al., 2016) and because comments are "interpersonal public communication" (Ziegele et al., 2017), it is claimed that they might have a stronger influence on readers than professional, journalistic content.

Therefore, it is not surprising that it has been investigated in a number of studies researching on *comment features* that influence user perception of news. *Reasoning* (Prochazka et al., 2016), *argument quality* (Sung & Lee, 2015), *interaction between users in comments* (Hwang, Kim, & Kim, 2018) as well as *valence of opinions* (Hsueh, Yogeeswaran, & Malinen, 2015; Kramer et al., 2017; Sikorski, 2016), *degree of incivility* (Kalch & Naab, 2017; Prochazka et al., 2016) and *predisposition* (Anderson,

Brossard, Scheufele, Xenos, & Ladwig, 2013; Ziegele et al., 2017) are just some of them (see Ziegele et al., 2017 for a comprehensive overview).

Results accentuates negative effects on variables such as the perceived news quality (Hsueh et al., 2015) or behavioural effects such as the likelihood to response (Rösner et al., 2016).

Emotions as Expression in User Comments

Even though emotional expressions are partly intertwined with some of the explored comment features, for example incivility or argument quality, to our knowledge, there are no studies on how specifically emotions as comment feature effect news reading. An emotional comment is an expression of a writers' experienced emotional state. A typical example is: "*Trump has always debased and corrupted everything he touches. I think he is stupid and I feel dirty with him as president*". In such comments, emotions are often connected to a personal opinion ("*I think he is stupid"*) and/or an information (*Trump has always debased and corrupted everything he touches*). Bolls, Lang, and Potter (2001) define content to be *emotionally* or *emotional toned* when a topic is addressed fundamentally emotional or its verbal, non-verbal, and paraverbal language used is emotional. Thus, emotions are expressed on a topic, but also on a linguistic level.

Processing emotional user comments

Emotions are crucial, and sometimes also mentioned to be problematic, when reading the news. Because emotions are part of opinion building processes on one side (Korte, 2015), but have fundamental biological character on the other side (Christianson, 1992), they are conceptualized as opposite of rational and as not logical. Emotions influence people "fast, nonconscious, independent of context, independent of processing resources" (Christianson, 1992). This differentiates emotions from other comment

features such as reasoning or argument quality: While these concepts are connected to rational thinking, emotions effect readers unconsciously, automatically and preattentively (Christianson, 1992), and thus, on a more fundamental level. In the following, it should be argued, how the processing of emotional is different from rational information and how this might influence news perception.

Selective Function of Emotions

Human cognitive resources are limited such that individuals cannot fully process all aspects of their environment (Lang, 2000, 2006). To reduce the complexity of environments, individuals use strategies that allow them "to select and focus on particular input for further processing while simultaneously suppressing irrelevant or distracting information" (Stevens & Bavelier, 2012). This selective process is referred to as *selective attention*. According to selection attention (Yiend, 2010), the salient nature of emotional information, their "inherent value and biological or personal relevance to an individual" (Reeck & Egner, 2015) makes them more preferable compared to non-emotional information. In order words, people are attracted more by emotional than by not emotional information.

From this perspective, emotions are highly relevant when researching on comments, because they not only might explain *how* comments can influence them, but on a more fundamental base, *what* comments are actually selected to pay attention to and to are in turn become a basis for news perception and evaluation.

Attention and Recognition towards Emotional User Comments

As a consequence of attraction, readers show more attention and following Kensinger and Corkin (2003), this attention in turn results in an enhanced likelihood of processing in memory. *Attention* refers to a process by which users decide which aspects of the

news they find worth reading (Duchowski, 2007). It is a first indicator for further information processing and storage in memory (Ferré, 2002). Memory is a basic source for knowledge (Tucker, 2018) and fundamental for building opinions or perceptions. Therefore, attention and information storage in memory are underlying processes of knowledge generation; which in turn is the basis for news perception, judgements and evaluation.

In this study we use the concepts of attention and memory to examine how emotions affect news reading by the way, they are processed compared to non-emotional information. To apply the concepts, we focus similar to Kruikemeier, Lecheler, and Boyer (2018) on *visual attention* towards comments and *recognition*. "Visual attention to news content is an observable predecessor and likely predictor of news processing and learning." Recognition refers to the association of an event with one previously experienced, and involves a process of comparison of information with memory. It is known to be a largely unconscious process and is used to refer to both a memory measurement and an encoding process (Tajika, 2001).

Heuristic and Systematic Processing of Emotional Content

To describe information processing in social media and in particular on Facebook, it needs to be taken into account that specifically on Facebook, information rate is rather high compared to other media formats. This in turn might affect the *style of information processing*. Koroleva et al. (2011) found that onliners for example to mainly apply *heuristic encoding* when using Facebook. Heuristic processing is a quick and efficient way to process information. Heuristics are mental shortcuts, used in order to form judgments about complex issues when only limited cognitive resources are available. Oppositely, *systematic processing* can be applied when resources are available to process messages exceed what the message effectively requires (Kao,

2011). The two concurrent modalities of information processing are described by the model of heuristic and systematic processing (HSM) by Chaiken (1980). Systematic processing is relatively effortful and time-consuming in the pursuit of an analytic and comprehensive treatment of relevant information (Chaiken, 1980; Griffin, Neuwirth, Giese, & Dunwoody, 2002) while heuristic processing needs less cognitive capacities (Kao, 2011). Heuristic processing is triggered by cues, which are "salient and easy comprehended" (Todorov, Chaiken, & Henderson, 2007). Cue triggered information is chosen to encode, store, and retrieve (Lang, 2000). Because emotions are salient cues, we believe that, if people rely on heuristic processing, the effects of emotions on unconscious selective attention are even stronger than when they rely on systematic processing. This effects in turn, that they might form judgments about complex news issues on Facebook in a heuristic manner, on the foundation of emotions.

Taken together the theoretical contributions above, we see the role of emotions in processing user comments as twofold: Emotions are a cue information that firstly are preferably selected compared to non-emotional content (due to its personal relevance) and secondly trigger heuristic processing (because they are easy comprehended). For this reasons, emotional comments might influence readers differently than rational comments. We hypothesize that:

H1: Under heuristic processing compared to systematic processing, (a) user comments with emotional tone receive more (visual) attention and (b) can be better recognized than comments without emotional tone.

Differentiations of Emotions

Comments cannot only be emotional or non-emotional. Comments can be negative and positive, like "*I like the way she is dancing. She is the most successful ballerina in our*

country"; or angry, and also hopeful, happy or fearful, like "*I am afraid when too many refugees will come to Europe within the next years*". Emotions can vary strongly and different emotions can have different effects on attention and memory. In the following, we will extend our research aim by specifying the effects, emotional comments can have on attention and memory. We use a dimensional and a discrete approach to distinguish emotions. In the dimensional approach, which is introduced in Russells' (1980) circumplex model, emotions vary in arousal (emotional or not) and valence (negative or positive). In the discrete approach based on Izard (1993), discrete (primer) emotions are interest, joy, surprise, sorrow, anger, disgust, contempt, fear, shame and guilt. In the following, concrete predictions are made on the effects of the emotions.

Emotional Valence: Negative vs. Positive Comments

Positive and negative emotions do not influence information processing in a same way. While the positivity bias claims that positive forms of authenticity are favoured over the presentation of negative aspects (Reinecke & Trepte, 2014), negativity bias claims *negative* is more causally efficacious than *positive* information (Corns, 2018). Attending to negative more than to neutral and positive information is said to be the result of a tendency to attend to negative/threatening as compared to positive/save situations (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001). Negative stimuli are hypothesized to carry greater informational value than positive stimuli, and to thus require greater attention. Waddel and Bailey (2017) compared the influence of positive and negative Tweets on a funny video to see, if the comments affect viewers' perceptions of audience sentiment. They showed that individuals are more likely to attend to, recall, and be persuaded by negative rather than positive Tweets. Similar thereto, Unkel and Kümpel (2019) found a stronger effect of negative

compared to positive valenced user comments on individuals' quality perceptions.

Compared to positivity bias, negativity bias is a more widely accepted psychological principle and also in comment research, there is evidence that negativity leads to stronger effects. Therefore, we hypothesize:

H2: Under heuristic processing compared to systematic processing, (a) user comments with negative emotional tone receive more (visual) attention and (b) can be better recognized than comments with positive emotional tone.

Discrete Negative Emotions: Anger vs. Fear

Most comment research investigates in incivility or anger when researching on negative valenced comments (Borah, 2013; Hwang et al., 2018; Rains, Kenski, Coe, & Harwood, 2017). Other negative *discrete* emotional expressions often remain unobserved, such as fear or sadness. This might be due to the relevance of anger: Following the cognitive-functional model of the effects of discrete negative emotions (CFM) of Nabi (1999), anger is a so called *approach emotion*. Approaching means that it is believed to "mobilize and sustain high levels of energy for the purpose of defending oneself, defending one's loved ones, or correcting some appraised mistakes" (Nabi, 1999). Anger has an action tendency and is energizer and organizer of behaviour. Consequently, it might more lead readers to deliberative actions than *fear*. Fear is an *avoidance emotion* and stems from perceptions of imminent physical danger (Lazarus, 1991). It causes that people to rather not deal with an information. Nabi (2003) found fear to differentially affect selective attention compared to anger: Humans are supposed to be more likely to encode attributes indicative of a threatening emotion "in order to recognize the warning signs, when a future event has the potential to become dangerous" (Mickley & Kensinger, 2008). Anger also promoted deeper information

processing than fear (Nabi, 2003). Therefore, we hypothesize that:

H3: Under heuristic processing compared to systematic processing, (a) user comments with angry emotional tone receive more (visual) attention and (b) can be better recognized than comments with fearful emotional tone.

Method

Procedure

To test the hypothesized effects of emotional comments on attention and memory, a quantitative laboratory eye tracking experiment was conducted at a Dutch university in September 2019. Participants were exposed to three Facebook News Posts with manipulated comments of different emotional tone (emotional vs. not emotional, positive vs. negative, angry vs. fearful). The participants were randomly assigned into either a heuristic or systematic processing group, being forced to either read the posts in only 30 seconds or to take as much time as needed to read carefully. While being exposed to the stimulus material, the eye movements of each participant are measured using a SMI Red 500 Eye Tracker. According to the eye mind assumption, movements of the eye allow access to current contents of processing (Orquin, Ashby, & Clarke, 2016). After a short distraction task using the first two questions out of the cognitive reflexion test [ref], recognition was measured using multiple-forced-choice recognition questions in a subsequent survey. The participant further completed a pre-survey on a tablet containing controls such as on Facebook use, familiarity with the online newspaper *The Independent* (which serves as example case in the study) and one's *Need for Cognition (NC)*.

Participants

The participants were all students recruited via an online website of the university. For their participation, the students received either 7,50 € or two research credits. The average age of the total sample of 155 participants was 20 years (SD=4.3) and 81 percent have been female[1]. The lowest educational attainment was high school and 11.6 percent had a bachelor degree. The sample is further characterized by a highly international variety. The participants were from 40 different nationalities[2]; the majority from The Netherlands (35.5 %) and Germany (12.9 %). Corresponding, the most spoken native languages were Dutch (37.4 %), English and German (each 16.8 %) See Table 1 for further sample descriptions.

To determine the sample size, no statistical methods were used but we aimed to arrive at a larger than those reported in previous publications that used eye-tracking. To determine a sample size we rely upon the review by King, Bol, Cummins, and John (2019) who collected all published studies between 2005 and 2015 in the top 25 communication science journals that employed eye-tracking. King et al. (2019) show that the average study relied upon 82 participants (min=10, max=248). The total number was conditional upon the resources and availability of participants in the lab during the period in which we conduct the study.

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[1] In total, 169 students participated in the study (78.4 % female; mean age 20.21 years, SD=4.32). For the analysis of gaze behaviour, 14 students were excluded due to the pre-registered plan.

[2] Multiple answers possible.

To guarantee ethical standard, the ethical review board of the university approved the study (2019-CS-11020) and participation was only possible after reading and signing an informed consent.

Treatment Groups: Information Processing Mode

The mode of information processing was involved into the study as experimental intervention. Heuristic processing is provoked by reducing cognitive resources by a time limit of 30 seconds to read each Facebook News Post. Reducing the amount of time in that subjects have to perform a task shortens the window of opportunity for cognitive processing (Rand, 2016). The systematic treatment had no time limit and was asked to read everything carefully. The treatment affiliation is coded as dummy variable with 1 (heuristic group) and 0 (systematic group).

Stimulus Material and Manipulation Check

Both treatment groups were exposed to the same stimuli (all stimuli are available online). The stimuli were two artificial Facebook News Posts (referred to as "Stimuli 1" and "Stimuli 2"). Each contained four user comments, which were manipulated by emotional tones. The comments were presented in a set order. The posts were shown singularly and successively on a desktop screen. Before the actual stimuli, an additional post was shown ("Stimuli 0") which involved no systematic manipulation and is not part of the analysis so that the participants could get used to the lab situation.

Next to the emotional manipulation of the stimuli, the design of the Facebook News Posts was created to be less likely to influence the outcome variables attention and memory so that effects can be attributed better to treatment variables of the study. Therefore, the news topics were chosen to have a low chance to be familiar to the participants or of personal interest. They report about regional incidents which

happened in Great Britain, namely “'Total wanton destruction': Model railway show trashed by vandals” and “Over 40 sparrow chicks removed from nests by workers sparks police investigation”. The artificial Facebook news are posted by the English news provider *The Independent*, which again is supposed to be not familiar to the participants of the study. All posts go along a picture showing the word “NEWS” on a dark black background, which is typically used by *The Independent*. The news posts are in English language.

The comments were artificially developed as reactions to the reports and are expressions in varying emotional tones. The display of the emotions served as the independent variables. The stimulus was manipulated in three steps, oriented to Kalch and Naab (2017), Sung and Lee (2015) and Kramer et al. (2017). First, sentences from the news articles were selected, which contained story details and served as neutral basis comments. In a second step, the comments were emotionally manipulated using specific verbal (emotion words and linguistic markers) and nonverbal cues (paralinguistic cues) for each emotional tone on the theoretical basis of Harris and Paradice (2007). Because attention patterns are mainly driven by visual cues (Bucher & Schumacher, 2006), each two emojis were part of a comment. They aim to stronger express an emotion and represent the specific emotions, e. g. 😥 for fearful, 😠 for angry, and 😶 for neutral (Hauthal, Burghardt, & Dunkel, 2019). In a third step, the layout of the comments was adjusted so that all comments are comparable in length, number of likes and comment authors information (e.g. all names were chosen to be gender-neutral and typical English and the profile pictures were blurry and shot from a distance.

A pretest study was conducted to test the intended emotional tone. In an online questionnaire, 57 participants rated in total 50 manipulated user comments in terms of

emotional arousal (1 “not emotional at all” to 7 “very emotional”), valence (1 “very negative” to 7 “very positive”) and degree of the discrete negative emotion (1 “angry” to 7 “fearful”) on bipolar axes. Those comments which were rated to most precisely present the emotions intended were chosen. The manipulation check was repeated in the actual study, remaining an overall fit of how people experienced comments and how they were supposed to be.

Measurements

All hypotheses, procedures, stimulus material and the data analysis plan which will be presented in the following were pre-registered before data collection ended. The frozen pre-registration (registered on September 27, 2019) can be obtained from the OSF repository[3].

Dependent Variable 1: Visual Attention

Visual Attention was measured as visual attention using eye tracking. Dwell time, which is the sum of all dwells (including fixations and saccades and revisits) falling within an area of interest during a trial, was used as indicator for visual attention (Orquin & Holmqvist, 2018).[4] Areas of interest (AOI) are selected regions of a displayed stimulus. Our stimulus contained five AOIs, one on each of the four comments and one on the Facebook posts (see Figure 1). The AOIs of the user comments were of same size and

[3] Link to repository: https://osf.io/9c7u5/?view_only=4227da22935a483d887332bb6aa3da8f.

[4] Even though Orquin and Holmqvist (2018) do not recommend to use Total Dwell Time as a dependent variable, we decided to use it. In particular in the time pressure condition, fixation times sometimes very low so that statistical calcuations were more difficult. However, to test the stability of the evaluations, we used fixation times

the news post is of the size of the sum of all comments aiming the dwell times to be comparable.

To measure the participants eye movements, a SMI Red 500 Eye Tracker, attached to a 22-inch computer screen was used. The SMI Red is a stationary eye tracker and uses a sample rate of 120 Hz. The data was recorded with iView X and SMI Experimental Center 3.7.60. The participants sat in a distance of about 60 centimetres from the eye tracker for optimal results. Calibration and validation were performed before each measurement. The researcher kept a logbook to note incidents. Participants or trials were removed if the calibration fails due to eye problems (e. g. if people are crossed-eyed) or if unexpected events of distraction happen during the experiment (e.g. third person enters lab, loud noises).

Dependent Variable 2: Recognition

In this study, recognition was measured as story detail recognition similar to los Santos and Nabi (2019). Every comment contained one key aspect of the news story (los Santos & Nabi, 2019; Wise, Bolls, Myers, & Sternadori, 2009). For each comment, the participants were asked to answer a multiple-forced-choice question with four possible answer items about the key aspect (eight questions in total for each comment in Stimulus 1 and 2). To measure recognition, the response to each question was scored as either a 1 (correct) or 0 (wrong). The participants also had the option to click “I do not know” (0). To test the hypotheses, a *recognition success score* was calculated. The recognition success score is a count of all correct answers. In order to answer the research questions, the score was compared for the opposing emotions.

Covariates and Control

Next to sociodemographic controls (namely gender, age, education and nationality as

well as native language(s)), several covariates were collected which may have an effect on the dependent variables. These variables are Facebook use frequency, familiarity with the news provider (The Independent) and the news reports shown in the stimuli, as well as need for cognition score and self-reported information processing. As preregistered, the covariates were tested for randomization across the groups. No significant differences were found for age ($\chi2$=9.07, p =.77), gender ($\chi2$=1.97, p =.16), degree ($\chi2$=2.92, p =.23), national language ($\chi2$= 155, = 1.3, p =.51), origin ($\chi2$= .012, p =.91), need for cognition (F= 1.29, p = .94), Facebook use frequency, (F = 1.45, p = .22) or familiarity with The Independent (F = .01, p = .95). Topic interest was only equally randomized for the first (F = 0.28, p = .60) but not for the second stimuli (F = 7.90, p <.01). To test the stability of the effects, all analysis were tested including this variable, but revealed no significant influences (on dwell time b=-2.79***, Std. Error =0.60; on recognition; b=-1.84**, Std. Error=0.61).

Results

Descriptive Results on Visual Attention and Recognition

Before testing our hypotheses, we shortly describe viewing patterns. Looking at the dwell times, we see that people in the systematic treatment spent, in average, 69.4 seconds (*SD*= 25.6s, *range* = 2.1s – 133.5s) reading the Facebook News Post. This duration is more than twice as long as the induced 30 seconds in the heuristic treatment. As one would expect, participants in the systematic treatment spent relatively more time reading the comments (56.5 %; mean=38.9s, SD=15.2s min=.7s max=93.8s) than in the heuristic treatment (45.3 %; mean=13.6s, SD=9.6 min=.0 max=74.4). This difference might indicate that if people are forced to decide between information due to reduced capacities, they stronger focus on the article compared to the comments. The dwell time

on each comment are shown in Table 2, Part A.

With regard to recognition, for both treatment groups, the participants answered 54 percent of the questions correctly; 66.7 percent in the systematic and 40.7 percent in heuristic treatment. This difference is significant (Chi^2=84.4, p<.001, n=1240). An additional t-test shows that increased dwell times significantly predicted higher recognition success (t=-10.4, p<.001, n=1240). In other words, we find that people who spend more time reading the comments are more likely to remember them better. Looking at recognition scores of the single comments (Table 2, Part B), the results show that, on average, the participants were more likely to answer the questions about the first Facebook Posts correctly (Vandals) compared to the second (Sparrows). The difference is significant (t=2.59, p<.05, n=1240).

Influence of Emotions on Attention and Recognition

Modelling Strategy

With our data, we collected in total eight dwell time and eight recognition measurements per participants on four comments in two Facebook Posts. Because we collected more observations per participant, the data is nested and consequently we used multilevel regression analyses for dwell time as outcome variable, and multilevel regression (H1b) as well as multilevel logistic regression (H2b, H3b) for recognition success score.

The pre-registered hypotheses stated that in both conditions (heuristic and systematic), the emotional (H1), negative (H2) and angry (H3) comments draw more visual attention (a) and have higher recognition rates (b) than their opposed comments (not emotional, positive and fearful). Therefore, our outcome variables dwell time and recognition success score were compared in the heuristic and systematic treatment,

whereby the systematic treatment was used as reference category. We included processing mode, emotion, and the variables interaction as random effects. Thus, with the MLE, we estimate the impact of emotions on visual attention/recognition comparing processing mode; heuristic and systematic. A positive significant b-coefficient for the interaction indicates more attention towards/recognition of the hypothesized emotion compared to their opposite in the heuristic compared to the systematic mode. In the multilevel logistic regression analyses, the coefficient is to be interpreted as the (unobserved) probability that the event coded with 1 will occur, i.e. that the negative or angry comment will be recognized.

In other words, we include an interaction effect because this allows us to compare the different processing modes when testing our hypotheses. In Table 3 (attention) and 4 (recognition), the results of the multilevel (logistic) regression analyses show the impact of emotional arousal (H1; model 1), valence (H2; model 2), and discrete negative emotions (H3; model 3) on visual attention (a) and recognition (b). Further margin plots are used to visualize the effects (Figure 2 and 3).

Emotional Arousal (H1)

With regard to arousal, the results show no significant differences between (a) dwell times and (b) recognition on emotional compared to not emotional comments within the treatment groups (Table 3 and 3, Model 1). This result implies that there is no influence of arousal on visual attention or recognition (see Figure 2 and 3 for a visualization of the results, Panel A). Thus, with our data, we find no evidence for H1a and H1bEmotional Valence (H2)

Emotional Valence (H2)

For the impact of valence on attention (a), we found a positive significant effect for the

interaction of the negative valanced comment and heuristic processing (b=1.33, p<.01, Table 3, Model 2). This indicates longer dwell times on negative comments in the heuristic processing mode. In other words, when people had reduced time to read the comments, they more likely to read the negative than the positive comment. For recognition scores (b), the estimates were not significant (Table 4, Model 2). Our results therefore support H1a but not H1b, and thus give evidence for negativity bias only for attention, but not for recognition.

Discrete Negative Emotion (H3)

Interestingly, the interaction of anger and heuristic processing shows a significant negative effect on both (a) dwell time (b=-2.79, p<.01, Table 3, Model 3) and (b) recognition (b=-1.83, p<.01, Table 4, Model 3). This implies different effects than preregistered: The angry, compared to the fearful comment, leads to more attention and recognition, but only in the systematic treatment. Under the heuristic processing, the fearful comment had longer dwell times (see Table 2, Part A(2)). This shows that when the participants had little time to read the comments, they were more likely to read the fearful instead of the angry comment. When they had more time, they were more likely to read and recognize the angry compared to the fearful comment.

In the two processing modes, the compared emotions lead to different preferences in attention. This effect only very slightly applies for recognition (see Table 2, Part B(2) or Figure 3, Panel C). However, the confidence intervals of the margin plots (Figure 2 and 3, Panel C) show to be overlapping in the heuristic, but not in the systematic treatment. These results indicate stronger effects of anger in the systematic than fear in the heuristic treatment.

In sum, for H3, our results do not support our expectations that people focus more on angry compared to fearful comments under heuristic processing but shows support for the proposed effect in the systematic treatment. If people take time to read comments, anger drives attention.

Discussion

To what kind of user comments people pay attention to in Facebook News Posts can impact how they perceive news information. If some comments easier catch attention than others, they are more powerful to emphasize viewpoints of a news articles and set frames on issues. Because emotions are omnipresent in user comments towards news on one hand; and emotional content influences people in their information processing in an already preattentive, unconscious phase on the other, this study aimed to research on the impact of emotions in comments on attention and memory.

We like to discuss two key findings. First, we found that people showed more attention towards negative emotions in comments. This result is in line with previous studies and supports negativity bias. This result holds true only for the heuristic, but not for the systematic treatment. Before interpreting this effect, it should be addressed that it the *order effect* plays a crucial role. Previous research shows that the order of the comments in a comment section influences what comments are chosen to attend to (Unkel & Kümpel, 2019). As we could not change the order of the comments due to needed power, we could not control for its influence. Comparing the dwell time on comments in terms of their order in the posts (see Table 1), it becomes evident that in the heuristic mode, dwell time is lower with lower order position. Dependent t-test shows the time differences between the first and the second ($t=6.50$, $SD=.79$, $p<.001$), second and third ($t=12.12$, $SD=.1.20$, $p<.001$), and also third and fourth comment

(t=9.33, SD=.75, p<.001) to be significant for the first stimuli (and also for the second, but no test results presented here). The significant differences in dwell times indicates that the participants were more likely to explore a post from top to bottom. This could be an evidence therefore, that order overrules the effect of emotions. However, this effect was not found in the systematic treatment: If people were asked to read carefully, order did not overrule. We used scan paths to further explore the viewing behaviour (see Figure 5, [missing here but will be presented in the presentation]), we see that the participants indeed did read a post from top to bottom also in the systematic mode, but they went back to specific comments to read them again. Testing the influence of order on the results of recognition, interestingly, there is again no evidence for an effect. Thus far, the results of the systematic treatment and recognition success give evidence that we can find an order effect only on dwell time and only as consequence of putting people under time pressure. With this, we can not guarantee that an order effect does not additionally amplify the effect of the negative comments on attention in the heuristic mode.

As the second key finding of our study, we like to emphasize that in the systematic condition, the participants significantly dwelled longer on the angry comment than on the fearful, and also recognized its story details better. This supports the idea of the CFM, in which anger was found to promote deeper information processing of the news story than fear. However, this finding only applied in the systematic mode. Taken the gaze paths again to further explain the result, the viewing behaviour might indicate that the participants read all comments first, but if they have time, they read the angry comment again. That the effect did not appear in the heuristic treatment could either be explained by an overruling order effect or by the theory: They

did not invest energy and/or had no time remaining to go into action (reading again/thinking about it).

Both key results of our study suggest that comments with negative, or more specific, angry cues might dominate selective attention and overrule other emotional comments. Because both comments and kinds of emotions showed textual cues for incivility, our results highlight the importance of ongoing research in this field. Our results build on this research with the outcome, that incivility might be dangerous because it is so closely connected to emotion and due to that it already catches attention in a preattentive processing phase, it overrules other comments.

However, that only the angry comment only was preferred in the systematic treatment, leads to question the basic idea that emotions catch attention in a preattentive phase. There is evidence that the choice to "fight" negative emotions is more conscious than expected.

Based on the studies cited in the introduction, comments have a strong influencing power and thus, what people post on the internet can be spread to a wide range of readers, without rational arguments or by lacking in facts. This can have dangerous effects for a working democratic society by (next to others) building anti-deliberative public spheres characterized by incivility, homophily, and polemics (Anderson et al., 2013) or supporting increased negative emotions toward opposing opinions, more closed-mindedness and more expression of disagreement (Hwang et al., 2018). Our results show that uncivil comments are not only dangerous in its effects itself, but also because of its overruling role within a discussion. A negative emotion attracts more attention than a positive, and has therefore a stronger impact. So, from this point of view, our findings support a rather pessimistic view of comments influence on

news reading. It does not support ideals of deliberative democracies where people can participate constructively in a public debate (Habermas, 1982).

Limitations and Future Research

As with all research, this study has several limitations. To begin with, eye-tracking studies are always limited in that they are artificial in their research setting (King et al., 2019). Due to economic decisions, we were for instance not able to test comments in changing order. Also, we were unable to use more than one example comment for the comparison between positive/negative and angry/fearful. This would also have allowed us to vary emotional triggers such as emojis, capitals and words (e.g. capitals compared to emojis compared to only emotional words). Also comparing more emotion groups would have brought an added value, such as positive discrete emotions. It must also be considered that we investigated only on specific news topics. For other topics, the results might differ; for example, the influence of emotions in comments is probably stronger if someone is more familiar with a topic. The use of a convenience sample of students, who are homogenous in many ways, in general is a limitation. However, it is often argued that younger people are more likely to use social media and online news and are therefore somewhat appropriate (Kruikemeier et al., 2018).

Taken together the limitation of research variety due to the experimental character of the study, future studies should explore a more complex construct involving different predictor variables such as order, higher variety in emotions and emotional cues, and level-2 predictors such as topic familiarity or sociodemographic differences. Eye tracking also goes along with several limitation in terms of interpretability of the data. What it means, where

At last, connecting to ongoing discussion about the question how long-lasting results on experimentally generated news media effects are (Lecheler & Vreese, 2016), also in our study, the way we asked for recognition only after a short distraction period unables to figure out how long lasting the memories to the information were. Future studies could use longitudinal experimental designs, where memory is tracked over time (Baden & Lecheler, 2012).

However, experimental designs are still commonly used and necessary as they give important insights into psychological processes. One way to tackle limitations that appear due to the experimental design is pre-registration. Pre-registration requires detailed planning and reporting of a study and goes along with high transparency of research (Yamada, 2018). The pre-registrated documents of our study lay the foundation for replication and reproduction of analyses open to researchers at all levels (Allen & Mehler, 2019).

Appendix

Table 1

Sample Description in %

Variables	Percentage of Total Sample
Gender	
Female	81.3
Male	18,7
Age	
17-20	74.2
21-30	23.2
>30	2.4
Educational attainment	
High School Graduate	85.8
Bachelor Degree	11.6
Master Degree	1.9
Nationality[a,b]	
Dutch	35.5
Germany	12.9
Italy	5.2
Romania	3.2
Peru	2.6
Belgium	2.6
China	2.6
Native Language[a,c]	
Dutch	37.4
English	16.8
German	16.8
French	7.8
Chinese	5.7
Italian	5.2
Spanish	4.5

Note. Percentages missing to 100 are "others" and missing values, n=155. [a]Multiple answers possible, [b]40 different countries were mentioned in total, [c]31 languages were mentioned in total.

Figure 1

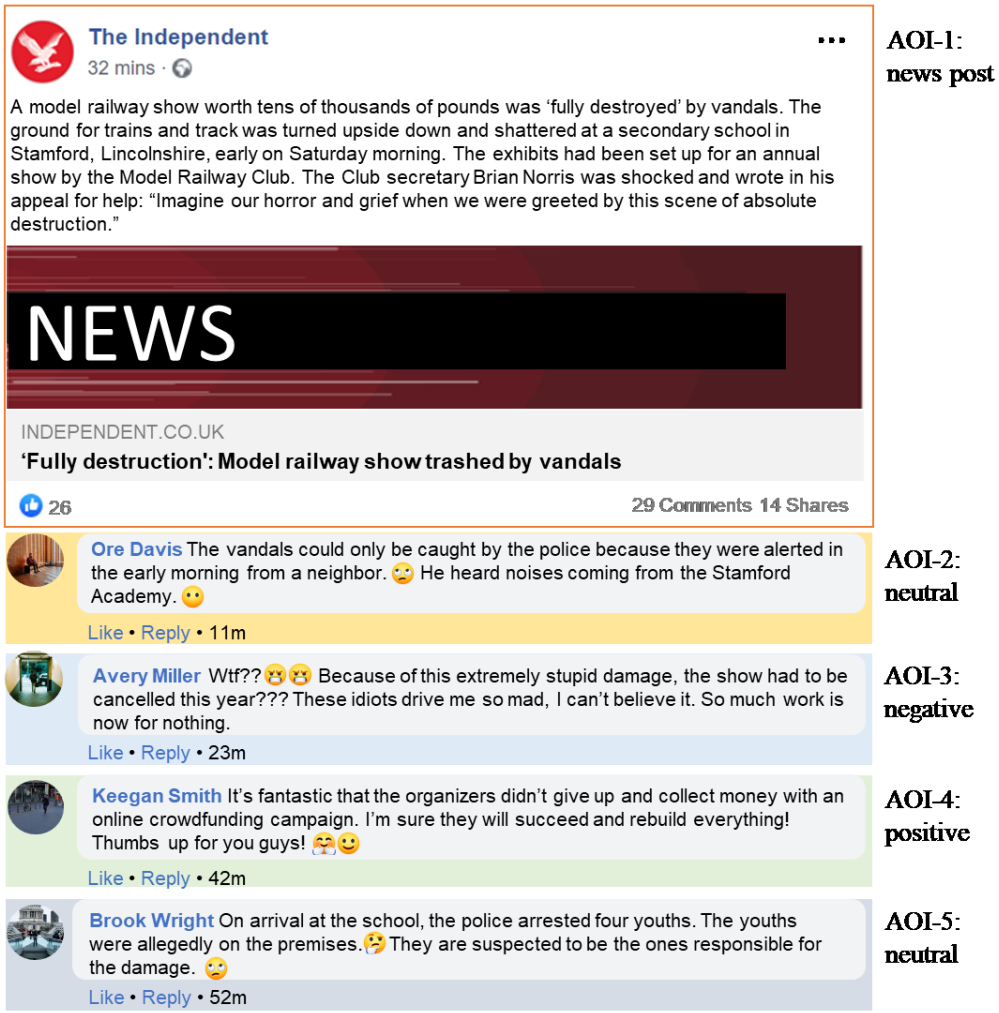

Figure 1. Defined Areas of Interest on the Example of Stimuli 1

Table 2

Mean Dwell Times and Recognition Success Scores for Treatment Groups (Heuristic and Systematic) and Stimuli (Facebook News Posts)

	Part A: Dwell Time in Seconds[a]		**Part B:** Recognition Success Score[b]	
	Heuristic Treatment	Systematic Treatment	Heuristic Treatment	Systematic Treatment
(1): Means (SD) for Facebook News Post "Vandals"				
Total	29.0 (9.7)*	67.9 (25.9)	.40 (.27)	.68 (.28)
News Article	15.7 (5.84)	32.7 (14.1)	-	-
Neutral	4.7 (3.6)	10.1 (5.2)	.32 (.47)	.61 (.49)
Negative	3.9 (2.6)	8.4 (3.1)	.50 (.50)	.65 (.48)
Positive	2.7 (2.6)	8.6 (4.6)	.44 (.50)	.77 (.43)
Neutral	2.0 (2.5)	8.1 (4.4)	.40 (.49)	.70 (.40)
(2): Means (SD) for Facebook News Post "Sparrows"				
Total	29.3 (11.2)*	70.9 (26.0)	.41 (.30)	65 (.26)
News Article	15.4 (5.37)	28.3 (12.1)	-	-
Neutral	5.0 (3.5)	10.8 (5.9)	.63 (.49)	.82 (.39)
Fearful	4.1 (3.8)	9.8 (4.7)	.36 (.48)	.48 (.50)
Angry	3.2 (2.9)	11.7 (5.2)	.34 (.48)	.77 (.43)
Neutral	1.6 (3.3)	10.3 (6.8)	.27 (45)	.55 (.50)
(3) Mean (SD) for combined categories				
Emotional comments	3.5 (2.5)	9.6s (3.5)	.41 (.32)	.67 (.30)
Not emotional comments	3.3 (2.6)s	9.8s (4.5)	.40 (.26)	.67 (.29)

Note. N ranks from 77 (systematic treatment) to 78 (heuristic treatment), [a]Dwell Times ranks from 0 (min) to 266.9 (max) seconds, Recognition Success Score ranks from 0 (wrong answer) to 1 (correct answer), *Time is not equal 30 seconds, because some white space was part of picture but not coded as AOI.

Table 3

Estimates (Std. Error) of Multilevel Regression Analyses for Dwell Time

	Model 1 Arousal	**Model 2** Valence	**Model 3** Discrete Negative
(Constant)	9.82*** (.39)	8.55*** (.38)	9.82*** (.48)
Processing Mode[a]	-6.50*** (.54)	-5.83*** (.53)	-5.70*** (.68)
Emotional Arousal[b]	-.20 (.26)		
Emotional*Heuristic	.37 (.36)		
Negative Valence[c]		-.13 (.34)	
Negative*Heuristic		1.33** (.48)	
Discrete Anger[d]			1.85*** (.42)
Anger*Heuristic			-2.79*** (.60)
Log Likelihood	-3362.40	-778.51	-850.39
Adjusted ICC	.466	.581	.612
Num. obs.	1240	310	310
Num. groups:	155	155	155
Variation Participant (Intercept)	8.94	6.40	11.10
Residual	10.25	4.62	7.04

Note. [a] Dummy-coded: 1 = heuristic, 0 =systematic, [b] Dummy-coded: 1= emotional, 0 = not emotional, [c] Dummy-coded: 1= negative, 0=positive, [d] Dummy-coded: 1= angry, 0=fearful, ***p<.001; **p<.01; *p<.05

Figure 2

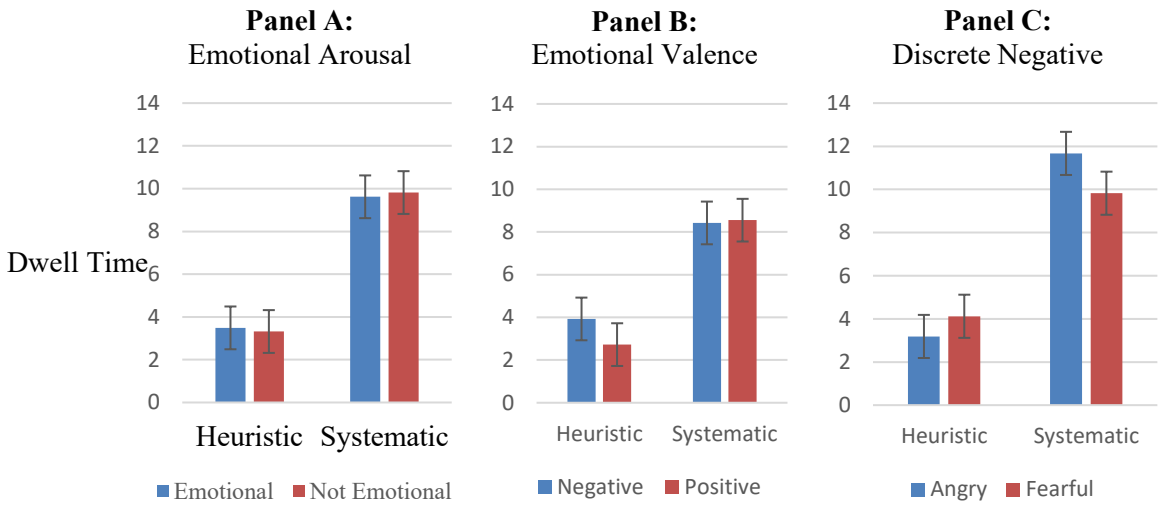

Figure 2. Margin Plots with Confidence Intervals comparing Dwell Time in Second by Processing Mode (Heuristic and Systematic) and Emotion (Arousal, Valence and Discrete Negative Emotions).

Table 4

Estimates (Std. Error) of Multilevel (Logistic) Regression Analyses for Recognition Success

	Model 1: Arousal	Model 2: Valence	Model 3: Discrete Negative
(Constant)	.82 ***	1.22 ***	-.12
	(.17)	(.29)	(.32)
Processing Mode[a]	-1.27 ***	-1.49 ***	-.70
	(.23)	(0.38)	(.46)
Emotional Arousal[b]	-.02		
	(.18)		
Emotional*Heuristic	.05		
	(.25)		
Negative Valence[c]		-.59	
		(.37)	
Negative*Heuristic		.85	
		(.49)	
Discrete Anger[d]			1.76***
			(.46)
Anger*Heuristic			-1.83**
			(.61)
Log Likelihood	-784.83	-199.14	-191.01
Adjusted ICC	0.298	0.189	0.037
Num. obs.	1240	310	310
Num. groups:	155	155	155
Variation Participant (Intercept)	.77	.13	1.89

Note. [a] Dummy-coded (1 = heuristic, 0 =systematic), [b] Metric-coded (0= no correct answers on emotional comments, 1=one correct answer 2=two correct answers, 3=three correct answers, 4=four correct answers), [c] Dummy-coded (1= negative, 0=positive), [d] Dummy-coded (1= angry, 0=fearful), ***p<.001; **p<.01, *p<.05

Figure 3

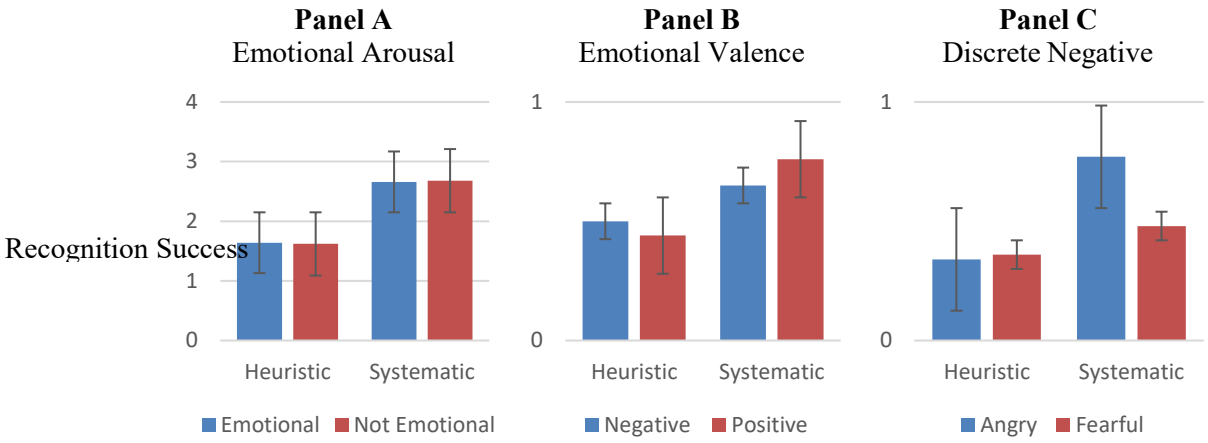

Figure 3. Margin Plots with Confidence Intervals comparing Recognition Success by Processing Mode (Heuristic and Systematic) and Emotion (Arousal, Valence and Discrete Negative Emotions) ranking from 0 to 4 for emotional arousal; and from 0 to 1 for emotional valence and discrete negative emotion.

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