Selective Exposure to Information on the Internet: Measuring Cognitive Dissonance and Selective Exposure with Eye-Tracking

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Studies on selective exposure to information on the Internet often ask participants to select between an equal number of mock articles consistent with or opposed to their attitudes. These studies represent neither ordinary online searches nor ordinary online articles. In addition, studies on selective exposure have mainly used Festinger's concept of cognitive dissonance as an implicit framework without examining whether selective exposure is a way of coping with cognitive dissonance. Therefore, the present eye-tracking study (N = 98) (1) examines selective exposure as a result of cognitive dissonance, (2) combines self-reports and physiological measures of affect to operationalize cognitive dissonance, and (3) differentiates three levels of selective exposure when searching information on the Internet. We found no support for an effect of cognitive discrepancy on eye blinks or discomfort. In addition, regression analyses did not confirm selective exposure for searching, selecting, and viewing online information about self-driving cars.

Keywords: selective exposure, cognitive dissonance, observational laboratory study, eye tracking, Internet browsing

Searching for information on the Internet is an active endeavor. Users can perform online searches to find (new) information; they can revise their search terms, select between a multitude of sources, and read information on diverse websites. These sophisticated search opportunities have enhanced users' possibilities of selectively exposing themselves to attitude-consistent opinions and avoiding counterattitudinal opinions (Garrett, 2009b; Iyengar & Hahn, 2009). When applying the concept of cognitive dissonance (Festinger, 1957) to the study of selective exposure to online information, most studies have

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used Festinger's (1957) theory as an implicit framework, *assuming* that individuals selectively expose themselves to a specific content to prevent or avoid cognitive dissonance (Metzger, Hartsell, & Flanagin, 2015; Tsang, 2019). Furthermore, although several studies have examined selective exposure in naturalistic settings by analyzing users' Internet-browsing behaviors (Cardenal, Aguilar-Paredes, Cristancho, & Majó-Vázquez, 2019; Dvir-Gvirsman, Tsfati, & Menchen-Trevino, 2016; H. S. Kim, Forquer, Rusko, Hornik, & Cappella, 2016), most experimental studies have asked participants to select among an equal number of mock articles consistent with or opposed to their initially stated attitudes (Hastall & Wagner, 2018; Knobloch, Carpentier, & Zillmann, 2003; Knobloch-Westerwick, Johnson, & Westerwick, 2013). These studies rely on captive audiences (Druckman, Fein, & Leeper, 2012) and represent neither ordinary online searches nor ordinary online articles. The current study advances research on selective exposure by relaxing the captive audience problem (Druckman et al., 2012), allowing users to actually search the Internet, and by examining whether selective exposure is a way of coping with cognitive dissonance.

Cognitive Dissonance as a Cause for Selective Exposure

The tendency of people to expose themselves to mass communication that aligns with their existing attitude(s) and to avoid counterattitudinal information has been termed *selective exposure* (Klapper, 1960). Recent meta-analyses have found empirical support for this effect; however, its magnitude is moderate (D'Alessio & Allen, 2007; Hart et al., 2009). Although people expose themselves selectively to online information that aligns with their own opinions, it seems that they do not systematically avoid counterattitudinal information (Garrett, 2009a, 2009b; Matthes, 2012). Thus, seeking attitude-consistent information appears to be a more powerful predictor of selective exposure than avoiding counterattitudinal information (Garrett, 2009b). While these studies focus on demonstrating *that* selective exposure occurs (or does not occur), few studies have discussed *why* selective exposure occurs (Metzger et al., 2015).

Among the causal explanations for selective exposure to online information, the most recognized explanation is Festinger's (1957) theory of cognitive dissonance (Tsang, 2019).[2] According to Festinger, cognitive dissonance arises when an individual holds two cognitions (i.e., ideas, beliefs, opinions) that are inconsistent. Because dissonance is presumed to be unpleasant, Festinger's theory predicts that an individual will strive to reduce dissonance, by adding new consonant cognitions or by changing one/both cognitions. For example, individuals may selectively search for new attitude-consistent information, engage in counterarguing, ignore the counterattitudinal information, or even adapt their attitudes. Most certainly, they do not passively accept the unpleasant state (Garrett, Carnahan, & Lynch, 2013). However, as Donsbach (2009) pointed out, only the search for attitude-consistent information can logically follow from the experience of dissonance, because only the active search can reduce the unpleasant state. Furthermore, following an argument by Mills (1999), cognitive dissonance can arise through the anticipation of an action's consequence and not the actual action. Thus, individuals may anticipate that they will experience cognitive dissonance and therefore selectively expose themselves to attitude-consistent information (Donsbach, 2009).

[2] Proposed alternative explanations for selective exposure include the informational utility model, social identity theory, social comparison theory, mood management, and information credibility (Knobloch-Westerwick, 2015). However, people's motivation for cognitive consistency remains a commonly studied causal mechanism in current selective exposure research (Harmon-Jones, Harmon-Jones, & Levy, 2015).

Festinger (1957) pointed out that cognitive dissonance is a form of psychological discomfort that is associated with negative affect. E. Harmon-Jones, Harmon-Jones, Fearn, Sigelman, and Johnson (2008) specified why dissonance between cognitions evokes an aversive state and distinguished two different concepts: *Cognitive discrepancy* refers to the inconsistency between cognitions, *cognitive dissonance* refers to the unpleasant emotional state that is aroused when an individual holds contradictory cognitions. When measuring cognitive dissonance, studies have mainly applied measurements of physiological arousal after exposure to information, such as heightened electrodermal activity (Elkin & Leippe, 1986; E. Harmon-Jones, Brehm, Greenberg, Simon, & Nelson, 1996) or self-reported discrete emotions (Elliot & Devine, 1994; C. Harmon-Jones, 2000; Metzger et al., 2015; Taddicken & Wolff, 2020; Tsang, 2019). The later studies have shown that participants reported increased negative affect after eliciting cognitive discrepancy. Hence, cognitive dissonance refers to the psychological discomfort that is experienced after being exposed to a discrepant stimulus (Tsang, 2019). We can therefore conclude, first, that when individuals are exposed to an incongruent online article, they should experience both inconsistency between their cognitions (cognitive discrepancy) and negative emotions (cognitive dissonance), and second, that these experiences motivate them to engage in discrepancy-reduction strategies, such as selectively exposing themselves to attitude-consistent online information (E. Harmon-Jones et al., 2008; E. Harmon-Jones et al., 2015; Metzger et al., 2015; Tsang, 2019).

However, when applying the concept of cognitive dissonance to the study of selective exposure to information, previous studies have hardly examined whether selective exposure is a way of coping with cognitive dissonance. Exceptions include a study by Tsang (2019), who tested whether being exposed to an incongruent message made participants feel angry, frustrated, disgusted, and/or irritated and expected that this negative affect would mediate the relationship between participants' cognitive discrepancy and their intention to seek additional arguments. However, the results did not support the predicted mediating role of cognitive dissonance. Participants who experienced negative emotions after having read an incongruent blog post did not report an increased desire to seek more confirming information. In addition, a study by Metzger and associates (2015) examined the role of both cognitive dissonance and the perceived credibility of news sources and news stories as causal mechanisms for selective exposure to partisan online news. The results showed that news consumers did indeed experience greater cognitive dissonance when exposed to counterattitudinal news sources, though they were equally likely to select balanced and attitude-consistent news sources and judged both as more credible than counterattitudinal news sources. Thus, these studies question the role of cognitive dissonance as a causal mechanism for attitude-consistent information searches. However, neither study observed participants' actual online search behaviors, but solely assessed their behavioral intentions. Furthermore, instead of physiological measures, self-reports were used to measure cognitive dissonance. Therefore, Tsang (2019) called for research to verify the findings through physiological measures of affect. This underlines the importance of discussing novel ways to measure cognitive dissonance when studying selective exposure to online information. Combining psychological and physiological measurements allows for testing whether being exposed to counterattitudinal information actually does produce an unpleasant state that is associated with negative emotions (Donohew & Palmgreen, 1971). Thus, in the present study, a combination of self-reports and physiological measures of affect is applied to measure cognitive dissonance.

Among the dimensional measures of emotion, one of the most widely used scales is the Positive and Negative Affect Schedule (PANAS). Physiological dimensional measures of emotion assume that an emotional experience is related to an underlying activation in the appetitive motivational system (associated with a positive emotional experience) or the aversive motivational system (associated with a negative emotional experience; Lang & Ewoldsen, 2010). Among other automatic physiological responses to a stimulus, spontaneous eye blinks have been identified as a physiological indicator of emotional valence (Maffei & Angrilli, 2019; Tecce, 1992). Eye blinks are characterized by a closure of the eyelids that occurs automatically without external stimulation (Maffei & Angrilli, 2019). A relaxed person blinks 15–20 times per minute, on average (Andreassi, 2013). This also holds true for spontaneous eye blinks when reading from a computer monitor (Chu, Rosenfield, & Portello, 2014). While eye blinks systematically restore the thin tear film that protects the cornea, they exceed the purpose of keeping the eye moist. Research suggests that spontaneous eye blinks are related to cognitive processing and emotional states (Andreassi, 2013; Maffei & Angrilli, 2019; Tecce, 1992). As stated in the hedonia-blink hypothesis, an increased blink frequency generally reflects negative affect, whereas positive affective states are accompanied by a decreased blink frequency (Tecce, 1992). One explanation for this is that blink suppression minimizes information loss caused by the interruption of the visual information stream; thus, spontaneous blinking is inhibited when being confronted with pleasant stimuli and is increased in response to unpleasant stimuli (Maffei & Angrilli, 2019).

Measuring the frequency of study participants' eye blinks as they are being exposed to a stimulus and asking them to report their affect following stimuli exposure is a novel measure of cognitive dissonance. By this means, we can test whether individuals actually *feel* cognitive dissonance when exposed to counterattitudinal online information (Donohew & Palmgreen, 1971; Metzger et al., 2015). Thus, combining self-reports and physiological measures of affect is a further step to empirically validate cognitive dissonance as a form of psychological discomfort (Elliot & Devine, 1994). Hence, we examine whether users differ in (a) their number of eye blinks and (b) self-reported discomfort depending on the type of information to which they were exposed. The following two hypotheses were tested:

H1: *The more cognitive discrepant the content users are exposed to is, the more they will blink.*

H2: *The more cognitive discrepant the content users are exposed to is, the more psychological discomfort they will report.*

Measuring Selective Exposure to Information on the Internet

Besides testing whether being exposed to counterattitudinal information actually does produce an unpleasant state that is associated with negative emotions, this study examines whether cognitive dissonance motivates individuals to engage in discrepancy-reduction strategies—namely, to expose themselves selectively to attitude-consistent online information. To assess selective exposure to information online, researchers initially relied on self-reports (Garrett, 2009b; Stroud, 2008; Tsang, 2019), but have recently turned to behavioral measurements such as log file analysis (Dvir-Gvirsman et al., 2016; Garrett, 2009b; Hastall & Wagner, 2018; Knobloch-Westerwick & Meng, 2009, 2011) or eye tracking (Marquart & Matthes, 2019; Schmuck, Tribastone, Matthes, Marquart, & Bergel, 2020). In a typical experimental research design, called the *mock-website paradigm* (Clay, Barber, & Shook, 2013), participants are first asked to report their attitudes about a topic. They can then browse a mock website that usually presents an equal number of mock articles consistent with or opposed to the initially stated attitude. The number of clicked attitude-consistent versus counterattitudinal headlines, as well as the time spent with each article, is logged (unobtrusively) and serves as a measure for selective exposure. These experimental studies not only allow researchers to design the messages to which participants are exposed but also facilitate the correct assessment of participants' exposure times and content (Hastall & Knobloch-Westerwick, 2013). However, this research design has several limitations because using captive audiences in experiments ignores how users operate in an information-rich online environment (Clay et al., 2013; Druckman et al., 2012). First, participants are restricted to the content provided by the researchers, as opposed to the unlimited options available online, thus diminishing the studies' ecological validity. Second, restricting participants to preselected articles may amplify selective-exposure effects by providing only information relevant to the assumptions of selective exposure (i.e., participants can select only attitude-consistent or counterattitudinal, but no irrelevant or neutral information; Clay et al., 2013). Third, participants are restricted to one-sided mock websites arguing for or against the topic being examined. While most scholars agree that the Internet provides niches for polarized and one-sided opinions, this does not hold true for the online environment as a whole (Gentzkow & Shapiro, 2011; Prior, 2013).

Most studies that follow the mock-website paradigm find evidence for selective exposure (e.g., Hastall & Wagner, 2018; Knobloch et al., 2003; Knobloch-Westerwick et al., 2013; Knobloch-Westerwick & Meng, 2009, 2011). While these studies contribute to examining selective exposure to information online, they represent neither ordinary online searches nor the diversity of online information. The present observational laboratory study attempts to address some of these methodological shortcomings by observing participants' actual online searches via eye-tracking.

Combining Eye Tracking and Content Analysis of Users' Online Searches

Eye tracking is an apparative, reception-accompanying observation method that records eye movements and fixations. Fixations are spatially stable gazes in which our eyes are focused on a particular area (Balatsoukas & Ruthven, 2012; Lorigo et al., 2008)—for example, when reading articles. Our eyes typically fixate on a focus area about which we wish to acquire information; this process occurs unconsciously and automatically. Therefore, both the number and length of fixations are indicative of the cognitive load required to process it, with more important and more complex focus areas receiving more attention (Strzelecki, 2020). Because eye tracking enables to capture both intentional and nonintentional eye movements, it is regarded as a precise and objective observation method that helps to gain deeper insights into users' online searches. Particularly, the recording of users' eye movements provides information about which and how often Internet search results and components of a website have been viewed (Balatsoukas & Ruthven, 2012; Kessler & Guenther, 2017; Lorigo et al., 2008; Strzelecki, 2020).

Since the early years of research, eye tracking has been applied as a research method for measuring selective exposure (Donohew, Parker, & McDermott, 1972; Olson & Zanna, 1979). The specific research procedures of recent studies vary remarkably in terms of the time interval that participants could view the presented content and the level of detail with which the viewed content was analyzed (Kessler & Zillich, 2019; Marquart & Matthes, 2019; Schmuck et al., 2020).

Browsing the Internet to solve information-based problems is a complex task that requires several skills (van Strien, Kammerer, Brand-Gruwel, & Boshuizen, 2016). While previous research on selective exposure to online information has focused on the level of website choice and content selection, we assume that cognitive dissonance also determines selective exposure at the level of search terms and search results. Importantly, before reading information on specific websites, users usually enter search terms first and then decide what search results to click on. When searches fail, users often reformulate their search and run another search (Hsieh-Yee, 2001). Entering search terms and evaluating the relevance of the presented search results especially occurs in situations in which users try to find new information, compared with the habitual use of specific websites. At the level of search results, a predictive judgment happens—users predict the relevance of the presented search results of a search engine, while the evaluative judgment occurs when users interact with the actual website to decide on their relevance (Balatsoukas & Ruthven, 2012). Hence, entering search terms and selecting search results are preconditions for exposure to websites and their content (van Strien et al., 2016) and should thus be included in research on selective exposure. Therefore, the following three levels were taken into account:

(1) *Search terms:* On the first level, the words participants enter into a search engine and their evaluation (positive, neutral, or negative) can be coded. This level refers to the step of searching online information. Search terms can serve as indicators of selective exposure by expressing attitude-consistent or counterattitudinal searches of information.

(2) *Search results:* On the second level, the search results that are viewed and either selected or rejected can be coded, along with their evaluation. Users typically view several search results before deciding which one to click on, leading them to a specific website. This level represents the step of selecting online information. Selected search results can serve as indicators of selective exposure by their attitude-consistent or counterattitudinal nature.

(3) *Articles:* Often, a website comprises several articles that focus on specific aspects of the website's overall topic. These articles may differ in their evaluation of the topic. Users need to scan selected websites to achieve an overall impression of the presented articles and to judge their relevance (van Strien et al., 2016). Therefore, on the third level, the viewed articles for each website can be coded, assessing the evaluation of the articles and the time spent reading the articles. This level constitutes the step of viewing online information and most closely mirrors previous research on selective exposure and the mock-website paradigm. However, while previous studies have focused on the selection of a website or article, we also take the level of the actual reception process into account. Users not only select articles but also paragraphs or sections addressing different statements, to which they can expose themselves for shorter or longer periods of time (Marquart & Matthes, 2019). Hence, selective exposure can be measured as the exposure to and the time spent with attitude-consistent versus counterattitudinal articles and statements.

We therefore argue that tracking and coding search terms, search results, articles, and statements that users have actually used and viewed when searching the Internet is particularly well suited for studying selective exposure to online information. In line with previous research, we assume that users search for, select, and view more attitude-consistent than counterattitudinal information on the Internet. These observations lead to the following hypotheses:

H3: Users experiencing more cognitive dissonance will enter more attitude-consistent than counterattitudinal search terms into a search engine.

H4: Users experiencing more cognitive dissonance will select more attitude-consistent than counterattitudinal search results.

H5: Users experiencing more cognitive dissonance will view more attitude-consistent than counterattitudinal online articles.

H6: Users experiencing more cognitive dissonance will spend more time viewing attitude-consistent online articles than counterattitudinal ones.

H7: Users experiencing more cognitive dissonance will view more attitude-consistent than counterattitudinal statements of an online article.

However, because the abovementioned limitations of the mock-website paradigm may amplify selective-exposure effects (Clay et al., 2013), relaxing the captive-audience problem might lead to weaker selective-exposure effects. Studies that have examined selective exposure in naturalistic settings by analyzing users' Internet-browsing behaviors (Cardenal et al., 2019; Dvir-Gvirsman et al., 2016; Garrett, 2009a) found that although users seek support for their attitudes online, they are not averse to counterattitudinal information, but wish to maintain awareness of diverse perspectives.

Method

Study Design

The present study was designed as an observational laboratory study that included three surveys, recordings of participants' eye blinks, and eye tracking of participants' Internet searches. One hundred and twenty-three students (M_{age} = 22.7 years, *SD* = 3.0 years, 49% female) were recruited in a German university town (Jena) in 2018 (see Figure 1). Because of common technical problems and insufficient calibration (e.g., when wearing black-rimmed glasses or heavy eye makeup) in eye-tracking studies, 25 participants had to be excluded from the study, resulting in a final sample of 98 participants. Of these participants, 49 (50%) were male. On average, the students were 23 years old (*M* = 22.68 years, *SD* = 3.12 years); they studied more than 35 different scientific disciplines.

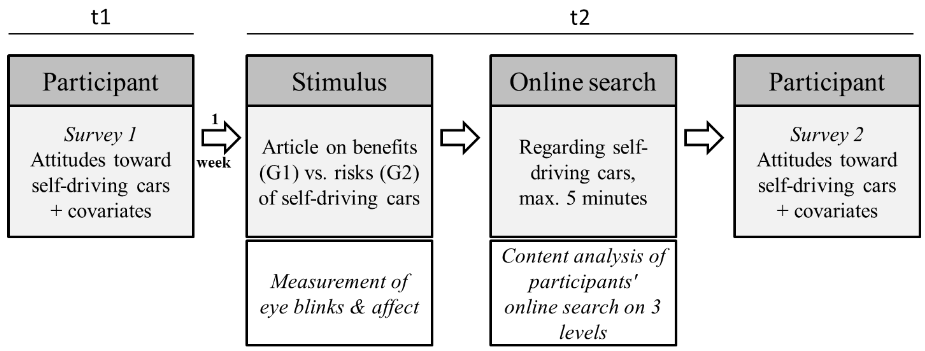

Figure 1. Study design.

In the first session (t1), participants responded to a paper-and-pencil survey that measured attitudes and covariates. At least one week after this survey, the second session (t2) took place at the researchers' media laboratory with individual appointments. After arriving at the laboratory, participants were randomly assigned to one of two groups (Gs) and were seated in front of a stationary remote eye tracker from SensoMotoric Instruments (iView X Red, 120 Hz). Data collection started after the correct focus of each participant's eyes had been calibrated. For each participant, the validation values were within an acceptable range (derivation x: M = .66, SD = .31; derivation y: M = .55, SD = .30). To induce cognitive dissonance, participants were then randomly exposed to either a positive or a negative stimulus article about self-driving cars, the topic chosen for this study.

Self-driving cars are vehicles that drive completely autonomously, reaching destinations without the intervention of a human driver (Fraedrich & Lenz, 2015; Heß & Polst, 2017). In Germany, the topic of self-driving cars is seen as a politicized scientific topic, because the population is divided about the new technology (Fraedrich & Lenz, 2015; Heß & Polst, 2017). Furthermore, our pretest with 59 first-year students (M_{age} = 20.3 years, SD = 2.2 years, 85% female) showed that the topic of self-driving cars was seen as a timely topic and the most controversial among the eight controversial scientific topics presented.

While participants read the article about self-driving cars, a webcam recorded their eye blinks. Following stimuli exposure, participants completed a short online survey regarding their affect to measure cognitive dissonance. After participants had completed this survey, they could surf the Internet to inform themselves about self-driving cars while the eye tracker recorded their online search. As Google is the most widely used online search engine, google.de was set as the home page for the Internet browser. The following task was given: "We kindly ask you to inform yourself about self-driving cars on the Internet. When you have finished, please close the browser." This task represents an interpretive task that often leads to selective and goal-oriented behavior (J. Kim, 2009) and should therefore trigger selective exposure. Participants had five minutes to search for information; however, this limit was not communicated to them. After Internet browsing, participants took part in a second online survey repeating the measurement of attitudes and covariates; these findings will not be reported here. After completion, the participants were debriefed and thanked for their participation. Because Google search results are dependent on personal search history, the stored cookies, site data, and cache were cleared after every participant. No personal accounts were used.

We acknowledge that the design of our study is not a full relaxation of the captive-audience problem, because participants received an article to read and were then asked to inform themselves on the Internet about self-driving cars. Yet it still dramatically differs from previous experimental designs on selective exposure, as participants were not restricted to the content provided by the researchers but could freely search the Internet for information, allowing them to rephrase their search terms, run several searches, and not only select attitude-consistent or counterattitudinal but also neutral information. Thus, the current study is a relevant approach in relaxing the captive-audience problem in selective exposure studies. As Druckman and colleagues (2012) anticipated, this results in a more complex study design.

Stimulus

To induce cognitive discrepancy, participants were randomly assigned to one of two Gs. In G1, the participants (n = 48) read an online article about the benefits of self-driving cars; in G2, the participants (n = 50) read an article about the risks of self-driving cars. A manipulation check confirmed that the groups did not vary regarding participants' gender, $\chi^2(2, N = 98) = 2.22$, $p = .33$; age, $F(1, 96) = 0.07$, $p = .79$; attitudes toward self-driving cars, $F(1, 96) = 1.57$, $p = .21$; the importance of the topic, $F(1, 96) = 1.81$, $p = .18$; interest in the topic, $F(1, 96) = .91$, $p = .34$; knowledge about the topic, $F(1, 96) = 1.87$, $p = .17$; and trust in the technology, $F(1, 96) = 2.33$, $p = .13$, confirming successful randomization.[3]

The articles were based on authentic journalistic articles that were published in various online media. Both articles started by telling readers that German politicians were meeting to discuss the benefits (G1) or risks (G2) of self-driving cars. Next, both articles listed five arguments supporting the benefits or risks of the technology regarding safety, driving experience, economic consequences, and ethical concerns; both articles ended with a statement that self-driving cars will be relevant for Germany's future and were 592 words long.

The researchers informed the study participants that the manipulated article was a real article that had appeared in *ZEIT* online, a weekly German newspaper that is considered politically neutral. A pretest with 79 first-year students (M_{age} = 20.48 years, SD = 2.28 years, 77% female) revealed that the students did not discern any differences regarding the articles' credibility, topicality, or comprehensibility. As intended, they saw a difference in argumentation, with the article for G1 arguing for the benefits (M = 1.35, SD = .58, on a 10-point Likert-type scale) and the article for G2 arguing for the risks (M = 7.69, SD = 1.54), $t(79) = -24.087$, df = 48.301, $p < .001$, of self-driving cars.

Measures

Attitudes Toward Self-Driving Cars

While thus far no established scale testing attitudes toward self-driving cars exists, the researchers designed a scale informed by the surveys of Fraedrich and Lenz (2015), Heß and Polst (2017) and Eimler

[3] We also tested whether there were differences between the groups of the study and the 25 participants that we had to exclude, finding no significant differences.

and Geisler (2015) using 12 items on a Likert-type 5-point scale, with 1 = *do not agree* and 5 = *agree*. The items measured cognitive (e.g., "The rapid responsiveness of self-driving cars can prevent accidents"), affective (e.g., "I look at developments for self-driving cars with enthusiasm"), and conative (e.g., "For fear of data misuse, I do not want to use self-driving cars," reverse coded) aspects of self-driving cars; they were used in a mean index (t1: M = 3.40, SD = .7, ω = .86).[4] The researchers also surveyed attitudes toward migration and politics, so that study participants did not immediately identify the study topic.

Cognitive Discrepancy

We created a variable for cognitive discrepancy based on attitudes toward self-driving cars and exposure to the stimulus article: We reversed the attitude scores of participants in G1 (benefits). Consequently, on the resulting continuous variable, higher scores represent more cognitive discrepancy.

Cognitive Dissonance

Cognitive dissonance was measured using two indicators. First, while participants read the article about self-driving cars, a webcam recorded their eye blinks. To assess the blink rate, the number of apparent lid closures was counted. To increase the reliability of the observation, several training sessions were conducted (Tecce, 1992). Second, after stimulus exposure, study participants were asked to state their affect on a Likert-type 5-point scale, with 1 = *not at all* and 5 = *very much*, using the German version of the PANAS (Breyer & Bluemke, 2016); the PANAS had been used in previous studies on cognitive dissonance to measure negative affect (C. Harmon-Jones, 2000). To more closely assess the psychological discomfort associated with cognitive dissonance, its 20 items were expanded by the three items "confused," "confirmed," and "irritated." These items align with the research literature on cognitive dissonance (Elliot & Devine, 1994; Tsang, 2019). The positive affect items of the PANAS were included as filler items, although past research showed that cognitive discrepancy did not elicit positive affect (Elliot & Devine, 1994). An exploratory factor analysis with varimax rotation (Kaiser–Meyer–Olkin test = .734, df = 190, p < .001), after the exclusion of three items based on insufficient anti-image correlation ("guilty," "jittery," and "irritable"), revealed that five factors can be distinguished. Items that reached a factor loading of ≥.50 were combined in a mean index: negative arousal (M = 1.45, SD =.55, ω = .76; based on upset, hostile, distressed, afraid, scared), positive arousal (M = 2.26, SD = .85, ω = .75; based on enthusiastic, proud, excited, inspired), involvement (M = 3.34, SD =.62, ω = .67; based on interested, active, attentive), activation/consonance (M = 2.31, SD = .75, ω = .70; based on strong, determined, alert), and discomfort/dissonance (M = 1.38, SD = .46, ω = .68; based on confused, irritated, nervous). Consequently, we used the discomfort/dissonance index as an indicator of cognitive dissonance.

[4] When predicting selective exposure, previous studies have mainly relied on categorical representations of initial attitudes (e.g., Knobloch-Westerwick & Meng, 2009, 2011), allowing for creating a selective exposure dependent variable (i.e., coding exposure to negative online content as counter-attitudinal for persons with a positive attitude). However, categorial measures are regarded to be a poor predictor of a specific behavior: Examining selective exposure by measuring initial attitudes at a general level may result in inflated error variance and may be less sensitive to detect effects (Clay et al., 2013). Thus, we measured attitudes using a scale consisting of several items and refrain from dichotomizing our attitudinal variable.

Selective Exposure

Selective exposure was conceptualized as the type of information (attitude-consistent, counterattitudinal, or neutral) that users searched for, selected, and viewed about self-driving cars on the Internet. Therefore, participants' online searches were recorded via eye tracking and were subsequently coded in a content analysis, focusing on three different analytical levels. Only words that were actually viewed by the participants were coded. On the first level, we assessed the duration of participants' Internet browsing and the number and evaluation (positive, neutral, or negative) of the search terms entered by participants. On the second level, we coded the number of search results, their selection (whether the participants clicked on a search result and selected it or not), and their evaluation (positive, neutral, or negative). For a search result to be coded, at least 50% of the search result had to be viewed by the participants. On the third level, the source of the viewed websites, the number of viewed articles, the length of article reception, the article evaluation (positive, neutral, or negative), and the number of viewed positive, neutral, and negative statements of an article were coded. A website was classified as "viewed" if the participant had viewed at least two lines of content in one piece. Correspondingly, an article was considered to have been "viewed" if at least two lines in one piece had been indicated by the eye-tracking point. These criteria were established to ensure that only content that was very likely viewed and thus read and processed by study participants was coded (Kessler & Guenther, 2017; Kessler & Zillich, 2019; Zillich & Kessler, 2019).

For each level, guiding examples illustrated which content had to be classified as positive (e.g., advantages, opportunities, benefits), neutral (e.g., value-free terminology such as self-driving cars, technology, definitions, Germany), or negative (e.g., disadvantages, risks, problems). Three coders coded the recorded online searches. Intercoder reliability was assessed using 15 sample clips. Applying Cohen's kappa, the coders agreed to a successful extent because all values were between $\kappa = .64$ and .94.

Based on the coded selective exposure variables, we created new variables indicating the "search valence" on each level. We subtracted the number of negative search terms (search results, online articles, time spent with articles, and statements, respectively) from the number of positive search terms (search results, online articles, time spent with articles, and statements, respectively). The variable can take negative values (i.e., exposure to negative content prevails), positive values (exposure to positive content prevails), or be zero (balanced exposure).

Results

Regarding H1, we examined the number of eye blinks while reading the stimulus article. During reading, participants blinked an average of 12 times per minute ($M = 12.42$, $SD = 9.19$). For H1, we tested whether cognitive discrepancy affected the number of eye blinks per minute. In a regression analysis, there was no significant effect, $\beta = .01$, $t(1) = .14$, $p = .888$; hence, H1 was rejected.

In a second regression analysis (H2), we tested the effect of cognitive discrepancy on self-reported psychological discomfort, again with no significant effect, $\beta = -.01$, $t(1) = -.07$, $p = .948$, rejecting H2.

Although we failed to confirm Hs 1 and 2, for H3–H7, we still tested the effect of our two cognitive dissonance indicators, cognitive discrepancy, and group on selective exposure. We first report descriptive and average findings on users' Internet searches for each analytical level and then present the results for the hypotheses associated with this level. On average, study participants browsed the Internet for four minutes and 40 seconds (in seconds: $M = 279.83$, $SD = 45.26$) looking for information about self-driving cars. They tended to start two searches ($M = 2.21$, $SD = 1.39$), look at nine search results ($M = 8.71$, $SD = 4.36$), open three websites ($M = 3.02$, $SD = 1.48$), and view three articles ($M = 2.94$, $SD = 1.48$), on average. For each hypothesis, we conducted a hierarchical linear regression with "search valence" as the dependent variable. Eye blinks and self-reported psychological discomfort—our two indicators for cognitive dissonance—were entered at Stage 1. "Cognitive discrepancy" was entered at Stage 2. "Group" (i.e., exposure to the stimulus article about benefits or risks of self-driving cars) was entered as a control variable at Stage 3. The cognitive dissonance and cognitive discrepancy variables were entered in this order as it seemed theoretically plausible given that cognitive dissonance should motivate users to selectively expose themselves to either positive or negative online content, whereas cognitive discomfort should stimulate cognitive dissonance. Given the specific combinations of search valence, cognitive discomfort and discrepancy as well as group, we were able to test for attitude-consistent and counterattitudinal selective exposure. For instance, when users who have read the stimulus article about risks of self-driving cars experience cognitive discrepancy and cognitive dissonance (measured via eye-blinks and self-reported psychological discomfort) enter positive search terms into the Google search, their search can be interpreted as an attitude-consistent search.

Regarding the search terms ($n = 217$), in most cases, the search term was "self-driving cars" ($n = 87$; 40.1%), followed by "self-driving cars Germany" ($n = 19$; 8.8%) and "self-driving cars Tesla" ($n = 10$; 4.6%). As a result, there was little variation regarding the evaluation of search terms: 202 search terms (93.5%) were neutral, 11 (5.1%) were identified as negative, and three (1.4%) were identified as positive. A regression analysis failed to find significant effects, as neither eye blinks, $\beta = .09$, $t(4) = .90$, $p = .370$; self-reported discomfort, $\beta = .03$, $t(4) = .30$, $p = .763$; cognitive discrepancy, $\beta = -.01$, $t(4) = -.06$, $p = .955$; nor group, $\beta = .01$, $t(4) = .03$, $p = .973$, predicted the valence of the search terms used, disproving H3.

Regarding the search results that were viewed ($n = 850$), 64% ($n = 540$) of the search results were viewed only, and 36% ($n = 309$) were viewed and clicked on. Focusing on the evaluation, 740 search results (87.2%) were neutral, 94 (11.1%) were identified as negative, and 15 (1.8%) were identified as positive. When focusing on the search results that were clicked on ($n = 309$), 266 (86.1%) were neutral, 36 (11.7%) were negative, and seven (2.2%) were positive. The tested regression did not confirm that eyeblinks, $\beta = -.02$, $t(4) = -.17$, $p = .866$; self-reported discomfort, $\beta = .04$, $t(4) = .40$, $p = .695$; cognitive discrepancy, $\beta = -.09$, $t(4) = -.50$, $p = .617$; or group, $\beta = -.12$, $t(4) = -.69$, $p = .492$, predict the valence of search results. Thus, there was no support for H4.

Regarding the websites that were viewed ($n = 250$), most sources were classified as journalistic media ($n = 154$; 61.6%). A minority were lexica ($n = 38$; 15.2%), economic ($n = 25$; 10%), or scientific sources ($n = 21$; 8.4%). On these websites, 284 articles were viewed by the study participants. There was slightly more variance regarding evaluations: 213 articles were classified as neutral (75%), 59 (20.8%) as negative, and 12 (4.2%) as positive. However, the tested regression failed to confirm that eye blinks, $\beta = -.04$, $t(4) = -.42$, p

= .674; self-reported discomfort, β = .12, $t(4) = 1.15$, $p = .254$; cognitive discrepancy, β = −.01, $t(4) = -.07$, $p = .946$; or group, β = −.10, $t(4) = -.537$, $p = .592$, can predict article valence, disproving H5.

Regarding the duration of viewing online articles, on average, neutral articles were viewed for two minutes and 17 seconds (in seconds: $M = 137.42$, $SD = 77.16$), which exceeds the amount of time spent on negative articles ($M = 42.02$, $SD = 62.19$) or positive articles ($M = 10.89$, $SD = 35.17$). In this case, the regression analysis also did not support H6. Neither eye blinks, β = .01, $t(4) = 07$, $p = .930$; self-reported discomfort, β = .10, $t(4) = .97$, $p = .336$; cognitive discrepancy, β = .02, $t(4) = 09$, $p = .930$; nor group, β = −.08, $t(4) = -.46$, $p = .649$, predicted time spent with valenced articles.

On the websites, a total of 3,102 statements were viewed by study participants, with most of them being neutral ($n = 2.437$; 79%), some negative ($n = 457$; 18%), and a minority positive ($n = 208$; 7%). Repeating the regression analysis, we also failed to observe that eye blinks, β = −.03, $t(4) = -.31$, $p = .759$; self-reported discomfort, β = .08, $t(4) = .73$, $p = .466$; cognitive discrepancy, β = .01, $t(4) = .08$, $p = .939$; or group, β = −.15, $t(4) = -.81$, $p = .420$, can predict statement valence. Thus, there was no support for H7.

Discussion

In contrast to previous studies on selective exposure that mainly used Festinger's (1957) concept of cognitive dissonance as an implicit framework, our study examined selective exposure as a way of coping with cognitive dissonance. It combined physiological measures and self-reports of affect as novel operationalization of cognitive dissonance. The results demonstrate that cognitive discrepancy was neither correlated with users' eye blinks nor discomfort. These findings might be explained by the fact that the stimulus article used in the present study did not trigger (enough) cognitive discrepancy in participants to arouse negative affect. Another reason for this null finding might be that the chosen self-report and physiological measurement of affect are not valid indicators of cognitive dissonance. Future studies should therefore refine the measurement of cognitive dissonance via self-reports of affect and eye-blinks.

Furthermore, this study did not confirm selective exposure for searching, selecting, and viewing online information about self-driving cars. Allowing participants to freely search the Internet for scientific information, we found no evidence for an attitude-consistent online search. Nevertheless, our study contributes to the growing literature on selective exposure to online information by encompassing three levels of selective exposure that have been awarded less attention by previous research: the selection of search terms, search results, and the actual exposure time to the statements of a given article. In contrast to numerous studies that follow the mock-website paradigm (e.g., Knobloch-Westerwick & Meng, 2009, 2011), participants' selection was not restricted to an equal number of mock articles, consistent with or opposed to their initially stated attitude. Instead, we allowed the participants to freely choose search terms, reformulate them, run several searches, and to switch back and forth between them while reading an article. When participants are given these possibilities, they use mainly neutral instead of one-sided search terms; they select mainly neutral search results; and they view mainly neutral articles and article statements. These results might be seen to support an argument by Clay and associates (2013) that restricting users' searches to preselected articles amplifies selective exposure effects, because participants can select only attitude-consistent information or counterattitudinal information, but not neutral information. Thus, the results of our study underscore the importance of relaxing the captive audience problem when examining selective exposure and illustrate the advantages of measuring the actual viewed online content via eye tracking.

However, we do not suggest that our results query the theoretical concept of selective exposure. Instead, they help to demonstrate the boundaries of the selective exposure concept. One form of boundary search is to apply a theoretical concept that has been rigorously tested in controlled laboratory experiments to less controlled settings (Shapiro, 2002). Allowing participants to perform a real Internet search and recording users' actual viewed online content via eye-tracking is one relevant step toward a less controlled setting. Our descriptive findings suggest that the topic of self-driving cars is not as controversial for university students as it is for other segments of the German population. Hence, participants' attitudes toward self-driving cars were not as pronounced as the pretest had given reason to expect, possibly weakening selective exposure effects. In addition, although participants could freely search the Internet, the instruction given by the researchers was to inform themselves about self-driving cars, representing an interpretive task. Thus, we do not know whether our participants would have searched the Internet differently if they had, for example, been given an exploratory task that addresses their desire to broaden their knowledge of a topic (J. Kim, 2009). The chosen task might also have primed an accuracy motivation instead of a defense motivation, promoting tendencies to process information in an objective way (Hart et al., 2009). Taken together, these limitations may account for the lack of felt cognitive dissonance, as well as the null findings for selective exposure. Without a clearer indication of users' reasons for exposing themselves mainly to neutral information, it is hard to clarify the underlying mechanisms of selective exposure (Dvir-Gvirsman et al., 2016).

While this observational laboratory study tried advancing selective exposure research by relaxing the captive-audience problem and addressing the interplay of cognitive discrepancy, cognitive dissonance, and selective exposure, it has several limitations. First, we analyzed selective exposure about only one topic and did not incorporate several scientific topics. Because only one eye tracker was at our disposal, individual appointments had to be made for each participant, reducing the sample size. Furthermore, the sample comprised only university students, who may have similar cognitive abilities regarding the selection of online science information. Thus, the results should be replicated with a larger, more heterogeneous sample for different scientific controversies to enhance the statistical power of the results. Second, while recording search terms, search results, articles, and statements via eye tracking allows for a detailed analysis of participants' online searches, the coders of the content analysis categorized the content regarding its evaluation. Thus, we do not know if our study's participants interpreted the content in the same way (Clay et al., 2013). Third, our study did not control users' searches (see also Dvir-Gvirsman et al., 2016). Hence, it might be that information from more credible sources or information that is expected to have a higher quality is more likely to be clicked on and viewed (Fischer, Jonas, Frey, & Schulz-Hardt, 2005; Metzger et al., 2015), regardless of whether or not it is attitude consistent.

Nevertheless, the present study adds to the vast body of selective-exposure literature by proposing novel measures of cognitive dissonance and by investigating different levels of users' exposure to online information, with the help of eye tracking. It is hoped that these findings will inspire other researchers to further examine whether and how searching, selecting, and viewing online information is affected by users' attitudes and how this selectivity relates to eye blinks and eye movements.

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