Scrolling Past Public Health Campaigns: Information Context Collapse on Social Media and Its Effects on Tobacco Information Recall

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Although traditional media usually present content separated by topic, social media feeds are usually unsorted, shifting topics from post to post, a feature called "information context collapse." Public health groups have often failed to consider how the presentation context of their campaigns may influence message reception. This study uses a mock social media feed that presents content across six topics in a sorted or unsorted fashion to see how presentation order of content influences recall of information about a novel tobacco product. The moderating impact of topic relevance and source congruency are also tested. Results show that for some measures of recall unsorted presentation reduced recall. Impacts of source congruency and topic relevance are reduced when the content is unsorted. The application of these findings for both scholarship and digital health campaigns is discussed.

Keywords: digital media, health communication, tobacco, recall, social media

Social media have grown beyond a tool for connecting with friends and family and is increasingly used for news, health, and other types of information (Shearer & Mitchell, 2021). Forty-one percent of Americans have used social media to watch health-related videos (Chou, Gaysynsky, Trivedi, & Vanderpool, 2021), 11% have used social media for "reliable health information" (Hannon, 2021), and 11% of youth have seen adverts for tobacco products on social media (Cavazos-Rehg, Krauss, Spitznagel, Grucza, & Bierut, 2014, p. 438). However, although social media were originally perceived as a marketplace of ideas and information spread, critics have argued such platforms propagate mis-, dis- and malinformation (Wardle, 2017; World Health Organization [WHO], 2022). Despite such concerns, social media see increasing use by public health campaigns (Moorhead et al., 2013) including those on tobacco (Duke, Hansen, Kim, Curry, & Allen, 2014). While attention has been paid to the success of public health campaigns on social media (Moorhead et al., 2013) and how they may help reach certain demographics (e.g., Dunn,

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Pearlman, Beatty, & Florin, 2018; Smith & Denali, 2014), public health scholarship has been less concerned with how structures of social media may impact message processing and recall.

Social media generally arrange content by recency or popularity, not topic, meaning feeds often jump topics between each post. Social media have become a one-stop-shop for all information, collapsing boundaries between topics, and creating a phenomenon labeled information context collapse (ICC; Pearson, 2021). In the present study, participants saw a mock social media site manipulating ICC, showing content separated by topic (sorted), or where the topic varied randomly between each post (unsorted; i.e., elevated ICC). A posttest measured recall of information and sources seen on the site with a focus on recall of claims about novel tobacco products.

Social Media as an Information Source

As people increasingly find health information via social media (Cavazos-Rehg et al., 2014; Chou et al., 2021), it becomes important to examine the structures of these platforms. Two novel features of social media are of relevance here.

First, they are aggregators bringing together information from a range of primary sources and displaying them in a feed (Pearson, 2021). Thus, social media posts have two sources—the social media site where the information was posted, and the original, primary source (Kang, Bae, Zhang, & Sundar, 2011). Prior research finds users often pay less attention to primary sources on social media (Kalogeropoulos & Newman, 2017; Kang et al., 2011; Pearson, 2021). Second, most social media are not restricted to one topic (Wang, 2017). Sites (including the default views of Facebook, Reddit, Instagram, and Twitter) use algorithms that use recency, popularity, and users' past behaviors to order the content, but do not group by topic. Therefore, the modal social media experience is a feed that persistently changes topic, shifting from family updates, to jokes, to news, to health information. Although some sites segregate content by type or allow viewing of a single topic at a time, these approaches are the minority.

In most social media environments, ICC (Pearson, 2021) is the default. Although context collapse "describes how social media collapses boundaries between distinct social groups" (Pearson, 2021, p. 1185), users must also "contend with collapsed information environments containing indistinct boundaries between content types" (Pearson, 2021, p. 1186). The original ICC paper demonstrated that unsorted environments reduced recall of information (Pearson, 2021), explaining this effect via dual processing theories (Evans, 2003; Kahneman, 2011). Users likely desire to process some types of information with central (attentive) processing. However, users are also cognitive misers (Lodge, McGraw, & Stroh, 1989), and so, when faced with a feed that constantly shifts topic, they do not spend the resources required to assess the level of attention each post should be given, and instead default to peripheral (inattentive) processing of content.

However, alternative mechanisms for the effects of ICC are possible. Southwell (2005) argues context instability—the extent to which a piece of media shifts between distinct contexts—increases the frequency of new information, which can lead to an overloading of processing abilities. Whereas Southwell (2005) focused on context instability within commercials, such mechanisms may work on collected pieces

of small media too. Another possibility is that grouping content by topic facilitates greater processing fluency, allowing memories to be stored together and recalled more easily (Bower, Lesgold, & Tieman, 1969).

Although the mechanism is unclear, ICC environments were shown to reduce the attention paid to individual posts on the site and reduce recall (Pearson, 2021). However, ICC has been shown only in news contexts and not been tested in other domains, such as health. Additionally, the Pearson piece did not address moderators such as topic relevance and source-message relationships that may mitigate or intensify ICC effects. The same main effects finding is expected:

H1:   *In an unsorted environment, people will recall less information compared to a sorted environment.*

Source Congruency and Topic Relevance

Many factors have been identified that could affect attention to and consumption of information in modern media environments (Knobloch-Westerwick, 2015). Two discussed here are source congruency and topic relevance.

Source congruency is the perceived degree of match between a message and the source's associated actions and attributes (Kirmani & Shiv, 1998). Audiences derive expectations of a source's future positions based on previous statements by that source (Weiss, 1957). If a source later contradicts these schemata, it creates an expectancy violation (Burgoon, Floyd, & Guerro, 2009, p. 96). Research on schema violation on recall "has produced sharply contradictory results" (Rojahn & Pettigrew, 1992, p. 81). Schema discrepant information should be easier to process in the moment, which should aid recall (Neisser, 1976; Stangor & McMillan, 1992). Additionally, during recall, information matching source attributes is more easily retrieved (Snyder & Uranowitz, 1978). However, this can backfire. Individuals may rely too much on assumed congruency, misremembering schema-incongruent information as congruent (Kleider, Pezdek, Goldinger, & Kirk, 2008). Furthermore, expectancy violations may increase attention to information, enhancing processing and later recall (Hastie & Kumar, 1979). Two systematic reviews found expectancy-incongruent information was more likely to be recalled (Rojahn & Pettigrew, 1992; Stangor & McMillan, 1992), so that "ideas which violate our expectations [. . .] enjoy privileged status in terms of memorability" (Porubanova, Shaw, McKay, & Xygalatas, 2014, p. 1).

Source congruency is relevant to tobacco health information on social media. For example, the Federal Drug Administration (FDA, 2020) is authorizing modified risk tobacco products (MRTPs) and announcing their relative health benefits compared to cigarettes. If the FDA tweeted about a product that "the FDA's scientific review found that if an adult smoker completely switched from cigarettes to this smokeless product, it would reduce their risk of getting lung cancer" (FDA, 2023), it is predicted this will cause an expectancy violation, as people will be expecting a regulatory body to highlight the risks of a product. Conversely, they expect the tobacco industry to downplay associated risks. Indeed, tobacco companies have a long history of implying health benefits of tobacco products (Paek, Reid, Choi, & Jeong, 2010); a pattern exacerbated by novel products (Anderson, 2011; Wagoner et al., 2019) and social media (Laestadius et al., 2020; e.g., see Digiflavor, 2021; Innokintechnology, 2021; and Wismec, 2021).

Consequently, if a government body downplayed risks of a tobacco product or a tobacco company highlighted risks, the message would be source incongruent and create expectancy violations, aiding recall.

H2:   *Information about heated tobacco that is source incongruent will be recalled at higher rates than source-congruent information.*

ICC is expected to lead to increased use of peripheral processing and reduced attention. However, expectancy violation may disrupt peripheral processing, increasing attention, and recall. Alternatively, users may need attentive processing to notice expectancy violations, and only when content is sorted will source incongruency have an effect.

RQ1:   *Will the effect of source incongruency on recall (H2) be moderated by ICC?*

The issue of topic relevance is key to public health campaigns that often target small subsections of the population such as smokers. Topic relevance is the extent to which health information directly applies to the user's habits and behaviors, investigated via smoker status in the present study. Evidence has shown smokers pay greater attention to smoking-related cues (Ehrman et al., 2002; Mogg, Bradley, Field, & De Houwer, 2003), and desire to read smoking-related media (Feather, 1962). Former smokers may also show greater attention to smoking cues (Rehme et al., 2018). Those engaged in a behavior (e.g., smokers) have greater interest in that topic, which can increase recall (Chew & Palmer, 1994; Schiefele & Krapp, 1996). Furthermore, personally relevant information justifies the cognitive effort of central processing (Abele & Gendolla, 2007), which can aid recall. Alternatively, informing users of the effects of their risky behavior can increase counterarguing (Croyle, 1992; Reed & Aspinwall, 1998) or lead to users "freezing" (Block & Williams, 2002) and failing to process information. However, such evidence generally comes from forced exposure designs and do not account for the attention paid to information.

H3:   *Tobacco posts will be recalled at a greater rate than nontobacco information for current and former smokers, but not for never smokers.*

The interaction with ICC is less clear. In unsorted environments, topic relevance may draw users' attention, allowing them to employ more resources for processing (Kahneman, 2011). However, when content is sorted, smokers and former smokers may be able to identify tobacco information more readily.

RQ2:   *Will the effect of smoker status on recall (H3) be moderated by ICC?*

ICC in the Context of Tobacco

To explore a relevant public health topic, this study focuses on heated tobacco, which works by heating processed tobacco without burning and producing smoke (Tattan-Birch, Brown, & Hartmann-Boyce, 2022). Although some claim there are minimal gains or new risks in switching from cigarettes to heated tobacco (Moazed, Chun, Matthay, Calfee, & Gotts, 2018), others find heated tobacco can show benefits for smokers (Li et al., 2019, Polosa et al., 2021). One such product, IQOS, became one of the first products to be authorized by the FDA as an MRTP, permitting IQOS to be marketed as a product that when "switching

completely from conventional cigarettes to the IQOS system significantly reduces your body's exposure to harmful or potentially harmful chemicals" (FDA, 2020, para. 7).

Considering heated tobacco is largely unknown among the public (Berg, Room, Patterson, & Wysota, 2021), public health bodies face a unique information challenge. Though switching completely from cigarettes to heated tobacco may show health benefits for cigarette smokers, messaging must show heated tobacco is not risk-free or encourage use among nonsmokers. However, unsorted environments may provide a poor medium for the required nuanced messaging (Pearson, 2021). Hence, heated tobacco offers an ideal context for the present study.

Previous tobacco research (Blanc & Brigaud, 2014; Sutton, Yang, & Cappella, 2019) has examined two types of recall: the exact text or information seen and a paraphrased (gist) version of the information. On social media where the density of information is high, gist recall may be all that can be expected from an audience, but still be sufficient for message understanding. As recall of precise and gist information may occur at different rates (Sutton et al., 2019), recall of both information types are tested in the present study.

Methods

A 2 × 3 experiment was conducted with ICC (sorted and unsorted feeds) as two conditions and smoker status (current, former, and never) as a between-subject factor. Participants saw a mock social media site consisting of 36 posts, with down and up arrows allowing navigation between posts. After reviewing the site, recall was tested using four types of recall measures. The experiment was conducted using a web panel from November 2021 to February 2022.

Participants

A Qualtrics sample was used. Qualtrics uses an opt-in panel whose members receive benefits in the form of gifts, money, or other rewards. A total of 828 participants reached the posttest of the study. Participants spending too great or too short a time on the study were removed, including eight who took more than 90 minutes to complete the study; seven who finished in less than five minutes; and 15 who spent less than 45 seconds on the social media site. This left 798 participants with an average completion time of 20.56 minutes (SD = 12.32) and an average of 4.01 minutes on the social media site (SD = 3.12). Additional participants were removed (28) with duplicate IP addresses, multiple completions, or VPNs to hide location.

Of the remaining 770 participants, 29 participants did not complete any information recall sections of the survey (see Measures) and were removed. Thirty-nine dropped out while completing the source recall questions and were used only when analyzing information recall, not source recall. As these participants were missing demographic data, their ages and income were set to the rounded mean per smoker status (current, former, never).

Of the 741 participants used in the final analyses, there were 350 (47.23%) current smokers, 167 (22.54%) former smokers, and 224 (30.23%) never smokers. Table 1 shows demographic data for the sample.

Table 1. Demographic Data for the Whole Sample and Split by Smoker Status.

	Current Smokers	Former Smokers	Never Smokers	Total
Total (N, %)[1]	334 (47.58%)	154 (21.93%)	214 (30.48%)	702
Age (M, SD)	43.20 (13.84)	58.88 (16.32)	48.15 (17.39)	48.15 (16.67)
Income[2] (M, SD)	3.07 (1.66)	2.55 (1.4)	2.85 (1.6)	2.89 (1.6)
Female (N, %)	154 (46.11%)	94 (61.04%)	123 (57.48%)	371 (52.85%)
White[3] (N, %)	286 (85.63%)	129 (83.77%)	157 (73.36%)	572 (81.48%)
Black[3] (N, %)	35 (10.47%)	16 (10.39%)	32 (14.95%)	83 (11.82%)
Asian[3] (N, %)	5 (1.5%)	7 (4.55%)	17 (7.94%)	29 (4.13%)
N. American[3] (N, %)	7 (2.1%)	7 (4.55%)	6 (2.8%)	20 (2.85%)
Hispanic[3] (N, %)	22 (6.59%)	12 (7.79%)	38 (17.76%)	72 (10.26%)
< High School (N %)	18 (5.39%)	7 (4.55%)	6 (2.8%)	31 (4.4%)
High School (N %)	191 (57.19%)	107 (69.48%)	130 (60.75%)	428 (61%)
Degree (N %)	96 (28.74%)	28 (18.18%)	59 (27.57%)	183 (26.07%)
Postgraduate (N %)	22 (8.69%)	12 (7.79%)	19 (8.88%)	60 (8.55%)

[1] Not all participants completed demographic variables.
[2] Participants were asked at the end of the posttest, "Which of the following categories best describes your total household income in the last 12 months?" Responses were on a one-to-six scale, with "(1) Less than $25,000"; "(2) Between $25,000 and $49,999," "(3) Between $50,000 and $74,999"; "(4) Between $75,000 and $99,999"; "(5) Between $100,000 and $149,999"; and "(6) $150,000 or more."
[3] Race variables were binary for each option (so a user could identify as both White and Black, etc.)

Procedure

Participants were required to use a desktop computer (metadata were used to reject participants not using a desktop computer). After the consent form, participants were asked about media behaviors, interest in certain topics, smoker status, and other health behaviors (distractor topic). Participants were next informed that they would be redirected to the social media site.

On the site, participants were shown 36 posts across six different topics. These topics included three topics whose recall was tested in the posttest (tobacco, entertainment, and finance) and three distractor topics (lifestyle, sports, and tech). In the sorted condition, all posts for each topic were grouped together (e.g., six tech posts followed by six tobacco posts). In the unsorted condition, each set of six posts contained one post from each topic in random order.

After the participants viewed all posts, a button appeared allowing progress to the posttest. The posttest was divided into three sections. Initially, participants were shown the precise information recall measures for 10 tobacco posts (the six shown on the site and four false positives), six entertainment posts,

and six finance posts (three randomly selected posts from the site and three false positives for both topics), followed by the gist information recall using the same posts.

Second, participants were shown the six tobacco posts, three entertainment posts, and three finance posts used for information recall. For each, they were asked to identify the type of source that made the post. Different source types were used for each topic (for instance "a tobacco company" and "a government body" for tobacco posts; and "a media organization" and "a bank/financial institution" for financial posts. The online appendix at https://osf.io/rtse7/?view_only=32993ba437de48afbc80e4b7959e79be shows all source types shown for each source. Upon selection, the participants were prompted to select the exact source. For instance, for tobacco companies they could select "Philip Morris International"; "Marlboro"; "Camel"; "Natural American Spirit"; or "Pall Mall"; or, when selecting "bank/financial institution" on finance posts, the options were "Bloomberg"; "Financial Times"; "MSNBC"; "Yahoo Finance"; or "Forbes."

Finally, participants were asked to provide demographic data, debriefed—informed of the fictitious nature of the site and posts—and directed back to the Qualtrics panel site.

Stimuli

The study used a fictional social media site called "Reel Life" (see Figure 1). The site was modeled on Instagram, using the same color scheme and image dimensions. Only one complete post was shown at a time with up and down arrows used to navigate between them. Each post consisted of a background image with black text overlayed on a white background (see Figure 1 for an example). For the queried topics (tobacco, entertainment, and finance), the image was randomized from one of six. For the distractor topics, the same image was always used with the same post. Each post had a label at the top containing the source logo and name, as well as a colored box stating the topic. Thirty-six posts split evenly across six topics were shown on the site. For the queried topics (tobacco, entertainment, and finance) there were 10, nine, and nine posts, respectively, to be sampled from.

For entertainment and finance, the six posts displayed were randomly selected. For tobacco, the 10 posts were split emphasizing either the benefits or harms of heated tobacco; for instance, "Because heated tobacco operates at a considerably lower temperature, heated tobacco produces fewer harmful constituents compared to traditional smoking" (positive valence), versus "Heated tobacco has been shown to weaken your blood vessels, which can lead to early onset heart disease" (negative valence; see the online appendix at https://osf.io/rtse7/?view_only=32993ba437de48afbc80e4b7959e79be for all posts). The six sampled posts maintained this balance with three emphasizing the benefits and three emphasizing harms. For distractor topics (lifestyle, sports, and tech), the same six posts were always displayed.

For queried topics, sources were evenly split and fell into two broad groups per topic: for tobacco posts—tobacco companies and government bodies; for entertainment-media organizations and cable providers; for finance-media organizations and banks (a full list of all sources can be seen in the online appendix). For distractor topics, sources covering that topic (e.g., "TechCrunch" for Tech) were randomly assigned to posts.

Figure 1. Screenshot of the social media site used.

Note. Base image from "A man smokes a Philip Morris International Inc. iQOS electronic cigarette" [Photograph], by Kon and Bloomberg (2016).

Recall Measures

Recall was measured for six tobacco posts, three entertainment posts, and three finance posts shown on the site. During information recall, participants were also shown a cumulative 20 false positive responses (corresponding to four tobacco, three entertainment, and three finance posts not shown). False positives were included as a control (see Other Measures) but not counted as successful recall.

Precise Information Recall

Participants were told, "In this section, we will show you a series of statements. For each one, state whether you did or did not see the post on the social media site." They were shown 22 statements (12 actual, 10 false positives). The response options were "Post was on the site" or "Post was not on the site." Stating that the post was on the site (for nonfalse positives) was treated as successful recall. On average, participants recalled 8.6 posts (SD = 2.78).

Gist Information Recall

Participants were told, "Think back to the posts on the social media site. Review the statements below. For each one, state whether the information below was given on the site (even if the wording was different)." They were shown 22 statements (12 actual, 10 false positives), with response options of "Information was on the site" or "Information was not on the site." Participants recalling the information was on the site (for nonfalse positives) were classed as successful recall of the gist information. Additionally, participants who recalled the Precise Information Recall (see above) were classed as successful recall, as by virtue of recalling the exact text, participants were deemed to automatically be capable of recalling the vaguer gist. On average, participants recalled 9.94 posts (SD = 2.43).

Gist-Source Recall

Participants were shown 12 posts that appeared on the site (six tobacco, three entertainment, three finance). For each, they were asked, "One of the statements on the social media site was: [POST TEXT]. Can you name which source posted this information?" Response options for tobacco posts were: "a tobacco company"; "a government organization"; or "a media organization." For entertainment posts: "a media publication"; "a cable/internet provider"; or "a celebrity." For finance posts: "a media publication"; "a bank/financial institution"; or "a government organization." On average, participants recalled 4.66 sources (SD = 1.77).

Precise Source Recall

Upon clicking a response to the Gist-Source Recall, participants were asked, "What was the specific source?" Participants saw five sources based on their selections for Gist-Source Recall. For instance, selecting "a tobacco company" displayed a list of five tobacco companies. A list of precise sources for each gist source is in the online appendix at https://osf.io/rtse7/?view_only=32993ba437de48afbc80e4b7959e79be. On average, participants recalled 0.87 precise sources (SD = 0.87).

Other Measures

Smoker Status

Participants were asked, "Have you smoked at least 100 cigarettes in your entire life?" Those answering no were recorded as never smokers. Those answering yes, were then asked, "Do you now smoke

cigarettes every day, some days or not at all?" Those answering not at all were coded as former smokers; those answering every day, or some days, were coded as current smokers.

False Positives

The sum of false positive recalls across both precise and gist information recall questions (a possible maximum of 20) was included in analyses to control for people's tendency to identify all information as present (Kleider et al., 2008; $M = 8.84$, $SD = 5.76$).

Topic Interest

Participants in the pretest were asked, "How closely do you follow the following topics?" with responses on a seven-point scale from "1–Not at all" to "7–Very closely." A different topic was used depending on the topic of the post. For tobacco posts, "Tobacco-related products or advertising" ($M = 3.08$, $SD = 2.13$); for entertainment, "Entertainment content (e.g., TV or celebrity news)" ($M = 4.08$, $SD = 2.04$); and for finance, "Finance (e.g. personal finance, banking)" ($M = 4.28$, $SD = 1.95$). Responses to this question were added as a control to all models.

Income

Participants were asked in the posttest, "Which of the following categories best describes your total household income in the last 12 months?" Options included "(1) Less than $25,000"; "(2) Between $25,000 and $49,999"; "(3) Between $50,000 and $74,999"; "(4) Between $75,000 and $99,999"; "(5) Between $100,000 and $149,999"; and "(6) $150,000 or more" ($M = 2.89$, $SD = 1.6$).

Data Analysis

Analyses used multilevel modeling, whereby each individual recall answer was nested within the 28 possible posts, allowing control for the effect of both individual differences and post effects, similar to the approach used in Southwell (2005). This totaled 8,892 answers for information recall and 8,424 answers for source recall. Models were analyzed using the lme4 packages (Bates, Mächler, Bolker, & Walker, 2014) and the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2016) in R. All variables were standardized and mean-centered, and all models used the bobyqa optimizer.

Unless otherwise stated, models included as predictor variables: the condition (sorted, coded as 0, vs unsorted feeds, coded as 1), current smoker status and former smoker status (both dummy coded), topic interest, and the participant's age and income. The position of the post (where 1 was the first post seen and 36 the last post) was included as a control. For analyses that included all topics, the post topic (dummy coded as tobacco vs. nontobacco) and an interaction term between the condition and topic were included.

Results

Main Effects of Information Context Collapse and Tobacco Posts

To test H1 and H3, four multilevel models were created, each one predicting a different type of recall. The results for these models can be seen in Table 2. ICC only directly reduced recall in one model (gist source), where the unsorted feed (high-ICC) reduced recall of gist source information. This offers limited support for H1. In all four models, whether the post was a tobacco post was a significant predictor. For information recall measures, tobacco posts were recalled at significantly higher rates than nontobacco posts. However, for the two source-recall measures, tobacco posts were recalled at lower rates than nontobacco posts.

For current smokers, gist information (B = 0.48, SE = 0.139, p < .001) and precise information (B = 0.283, SE = 0.101, p =.005) recall was higher for tobacco posts (supporting H3), whereas gist-source recall for tobacco posts was reduced (B = −0.269, SE = 0.089, p =.003; a significant finding in the opposite direction to that hypothesized). Tobacco posts were insignificant in the precise source model (p = .111).

Table 2. Multilevel Models Predicting the Four Types of Recall.

Fixed Effects	Gist Information	Precise Information	Source Gist	Source Precise
	B (SE)	*B (SE)*	*B (SE)*	*B (SE)*
Intercept	1.511 (0.082)**	0.787 (0.067)**	−0.257 (0.06)**	−2.553 (0.111)**
Unsorted	0.035 (0.08)	0.099 (0.067)	−0.13 (0.063)*	0.008 (0.118)
Position	−0.118 (0.031)**	−0.087 (0.026)**	−0.031 (0.023)	−0.054 (0.045)
Former Smoker	0.077 (0.08)	0.107 (0.068)	−0.126 (0.065)	0.028 (0.132)
Current Smoker	0.184 (0.069)**	0.142 (0.057)*	−0.049 (0.054)	0.033 (0.109)
False Positives	0.67 (0.037)**	0.356 (0.028)**	0.001 (0.026)	−0.101 (0.053)
Tobacco Post[1]	0.26 (0.106)*	0.177 (0.085)*	−0.274 (0.074)**	−0.556 (0.137)**
Topic Interest	0.039 (0.036)	−0.013 (0.029)	−0.022 (0.028)	0.014 (0.056)
Age	0.206 (0.032)**	0.162 (0.027)**	0.052 (0.025)*	−0.041 (0.05)
Income	0.099 (0.032)**	0.111 (0.026)**	−0.063 (0.024)**	0.029 (0.048)
Interaction[1]	−0.11 (0.117)	−0.206 (0.096)*	0.218 (0.09)*	0.176 (0.187)
Random Effects	Var (*SE*)	Var (*SE*)	Var (*SE*)	Var (*SE*)
Intercept	0.0261 (0.162)	0.0155 (0.0125)	0.008 (0.089)	0.003 (0.007)

[1] Interaction is between Tobacco Posts and Unsorted
* Significant at *p* <.05.
** Significant at *p* < .01.

For former smokers, tobacco posts were insignificant in the gist information (p = .632) and precise information (p = .293) models, but significantly reduced recall in the gist source (B = −0.332, SE = 0.147, p = .024) and precise source (B = −1.004, SE = 0.349, p = .003) models. For never smokers, tobacco posts were insignificant predictors in the gist information (p = .702), precise information (p = .853), and gist source (p = .063) models, but reduced recall in the precise source model (B = −0.715, SE = 0.3, p =

.017). This means that although smoking status did increase the effect of tobacco posts on recall for current and former smokers (in line with H3), the direction was not always as hypothesized.

Topic Interaction With Unsorted Condition

There were also significant interactions between tobacco posts and the condition in the precise information and gist source models. To investigate these, the models for precise information and gist source were split by condition (sorted vs unsorted feeds) and tobacco versus nontobacco posts.

Precise Information Recall

For precise information, in the unsorted condition, tobacco posts were recalled at equal rates to other posts (p = .696). However, in the sorted condition (where ICC was not present), tobacco posts were recalled at higher rates than nontobacco posts (B = 0.196, SE = 0.78, p = .011).

Splitting data by smoker status further illuminates this interaction. For current smokers, in the unsorted condition, there were no significant differences in precise information recall between tobacco and nontobacco posts (p = .805), but tobacco posts were more likely to be recalled in the sorted condition (B = 0.287, SE = 0.098, p = .004). Similarly, for current smokers, the unsorted condition significantly reduced recall of precise information for tobacco posts (B = −0.204, SE = 0.103, p = .047) but not for entertainment and finance posts (p = .622).

Meanwhile, for former smokers, in the unsorted condition, precise information for tobacco posts were less likely to be recalled than nontobacco posts (B = −0.356, SE = 0.165, p = .031), while in the sorted condition, tobacco posts and nontobacco posts were recalled at the same rate (p = .098). Like current smokers, for former smokers, the unsorted condition significantly reduced recall of tobacco posts (B = −0.367, SE = 0.143, p = .01), but not for entertainment or finance (p = .63).

For never smokers, tobacco posts were recalled at similar rates to nontobacco posts in both the unsorted (p = .535) and the sorted conditions (p = .979). This supports the interaction being because of smoker status. See Figure 2 for illustrations of these interactions.

Gist-Source Recall

For gist-source recall, in the unsorted condition, tobacco posts were recalled at similar rates than nontobacco posts (p = .587), but in the sorted condition, tobacco posts were less likely to be recalled (B −2.95, SE = 0.071, p < .001). Splitting data supports this interaction being because of smoker status.

Gist sources for tobacco posts were recalled at lower rates in the sorted condition for both current smokers (B = −0.278, SE = 0.09, p = .002) and former smokers (B = −0.397, SE = 0.168, p = .018). However, in unsorted feeds, tobacco-post sources were recalled at the same rate as nontobacco posts (p = .345 for current smokers and p = .919 for former smokers). Never smokers showed no difference between

tobacco and nontobacco posts for gist-source recall ($p = .06$ for the sorted and $p = .76$ for unsorted condition). The results indicate conflicting results for RQ2. See Figure 2 for illustrations of these interactions.

Source Congruence

Source congruence existed only for tobacco posts. To briefly examine whether participants expected tobacco companies to produce statements downplaying risks and government agencies to produce posts highlighting risks, a chi-square test was run on answers to the gist-source question for tobacco posts.
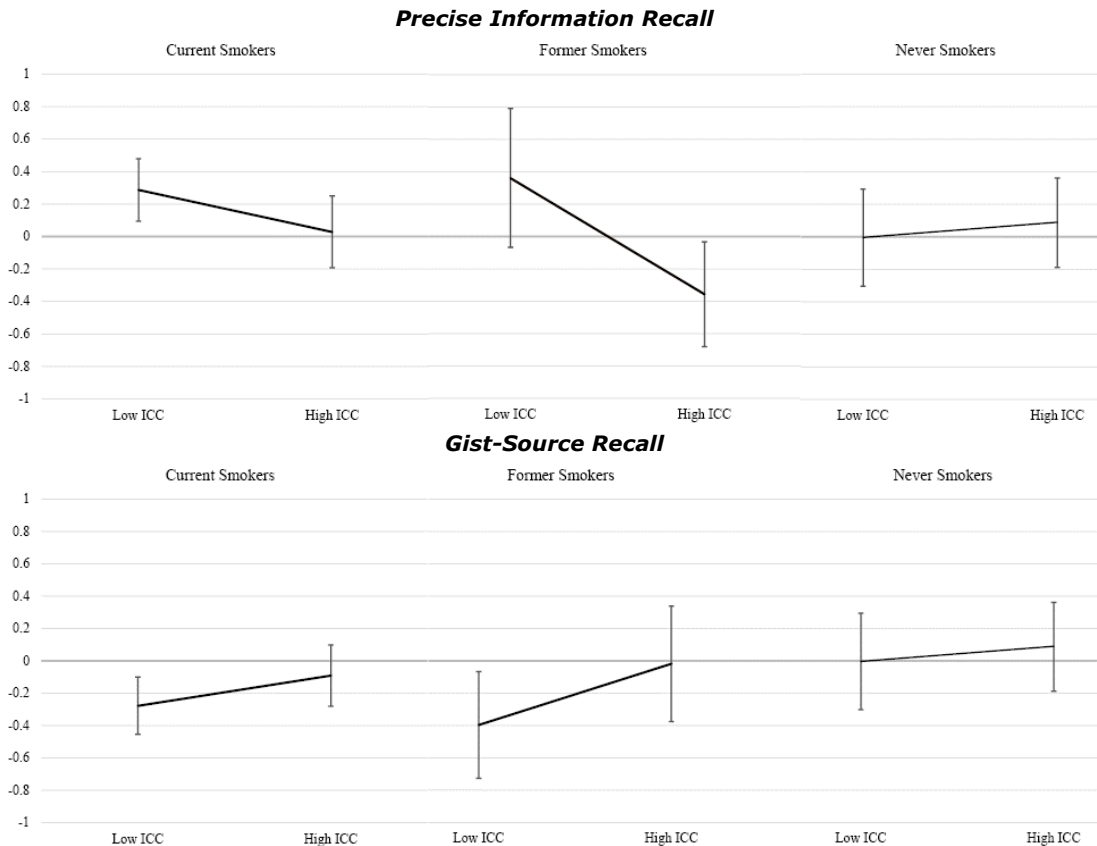
Precise Information Recall

Gist-Source Recall

Figure 2. Figures showing interaction terms for tobacco posts split by condition.

The crosstabs in Table 3 show how often participants reported posts with positive valance (highlighting comparative health benefits) and negative valance (highlighting risks) as being by each source type, alongside the expected number if there was no association between valence and source type. For media organizations (who would not be hypothesized to be either positive or negative), the expected number and actual number are similar. However, participants underreported positively valanced posts as being by government organizations and overreported positively valanced posts as being by tobacco companies. The chi-square test was significant ($df = 2$, $N = 4195$, $X^2 = 80.64$, $p < .001$). The same chi-square test analyzing

only incorrect answers (where the participant did not know the correct source type) shows similar biases ($df = 2$, $n = 2636$, $X^2 = 23.66$, $p < .001$).

Table 3. Number of Answers for Source Gist Question for Tobacco Posts Split by Post Valance and Source Type.

	Government Organization	Media Organization	Tobacco Company
All Answers			
Negative valance	844 (718)	586 (591)	676 (796)
Positive valance	587 (713)	592 (587)	910 (790)
Incorrect Answers Only			
Negative valence	395 (346)	586 (591)	384 (342)
Positive valence	296 (344)	592 (586)	425 (382)

[1] Expected number shown in parentheses.

Source congruency was significant only for gist-source posts, where source congruent information was less likely to be remembered ($B = -0.21$, $SE = 0.091$, $p = .021$)—offering limited support for H2. The gist-source model was also the only one that showed a significant interaction between source congruency and the condition ($B = 0.3$, $SE = 0.129$, $p = .02$).

In the sorted condition, source-congruent sources were remembered at lower rates than source-incongruent information ($B = -0.218$ $SE = 0.092$, $p = .017$). However, in the unsorted condition there is no such effect ($p = .306$). Therefore, for RQ1, for gist-source information, source incongruency increased recall but only in the sorted condition. Splitting data by smoker status revealed this effect only exists for current smokers. For current smokers, in the unsorted condition, source-congruent sources were less likely to be recalled ($B = -0.384$, $SE = 0.131$, $p = .002$); however, no such effect appeared in the sorted condition ($p = .803$).

Discussion

Social media has become an important platform for use by public health campaigns (Duke et al., 2014). However, many social media show content in an unsorted fashion. This study investigated how this unsorted presentation (information context collapse) influenced recall of novel tobacco claims.

Main Effects of ICC

H1 predicted ICC would reduce recall. Results indicated insignificant effects for information recall and precise source, but significant effects for gist source, offering partial support. When the topic changed between posts, users were less likely to recall the type of source that posted the information. This mirrors the results found by Pearson (2021), which focused exclusively on sources.

This should be of interest to public health bodies. Information encouraging follow-up with a source may be negatively impacted when posted in unsorted environments. "Visit our website for information on quitting smoking" loses usefulness if the source is not recalled. Additionally, campaigns

relying on receivers recognizing consistent messaging by a source may be impacted if messages are inferred as distinct posts rather than thematic messaging from a consistent source. Failure to recall sources could impact misinformation. If messages from a low-credibility source (e.g., individual with no qualifications) say a tobacco product is safe, and messages from a high-credibility source (e.g., the FDA) say the product is unsafe, a user may process both to long-term memory but later fail to recall sources treating both messages as equally credible. Scholars could consider ICC impacts-source recall in other settings. The findings here replicate the effect in a health context. Other contexts, such as environmental communication, call for attention.

Source Congruency and Topic Relevancy

The decreased recall in ICC for gist-source information is made more relevant by source-congruency findings. H2 predicted source-incongruent tobacco information would be recalled at higher rates. This was significant for source-gist recall, but not for other types. Furthermore, this increased recall for source-incongruent posts was found only when content was sorted. This suggests users in unsorted environments not only fail to process source information to memory but broadly pay less attention to sources in general. It seems likely that source incongruency did not impact recall in the unsorted condition as users simply spent less time attending to sources and never noticed the incongruency.

H3 proposed the relevance of tobacco information for current and former smokers would increase recall of tobacco posts. Results were conflicting. The hypothesis was supported for information recall but in the reverse direction for source recall. RQ2 asked how this effect would be moderated by ICC. Results showed smoker-status effects for tobacco-post recall were reduced when content was unsorted. As the effect of smoker status on tobacco-post recall was in conflicting directions between information and source recall; the direction of the interaction also differed between recall types. It is unclear why information and source recall showed effects in conflicting directions. One possibility is that attentional resources are finite so that as attention to information increased in tobacco posts, attention to sources decreased. This is an area for future research.

For practitioners, such effects could be both useful and worrying. On one hand, if users receive information of importance to them, attention increases, and they are more likely to later recall it. As such, campaigns encouraging people to share useful information have merit. On the other hand, if people are unconcerned with the source, misinformation that targets relevant topics to users is likely to spread virally on social media and lead to misinformed citizens. Indeed, the recent pandemic has seen misinformation spread rapidly (Ramjug & Esomonu, 2020).

That smoker status did not impact recall of tobacco posts in unsorted environments also raises challenges. Health campaigns often target specific groups. For bodies like the FDA, the hope would be to share information on social media and information relevant to an individual would stand out. However, the results suggest, because of ICC, such posts may not grab users' attention. Consequently, public health bodies may need more focused campaigns to be better able to target subpopulations rather than adding posts to a broad information ecosystem.

Reviewing Effects of ICC

Overall, impacts of ICC were mixed. Of the four recall types tested, only two showed significant results. However, it is worth noting that overall recall of precise source information was very low likely because of measure complexity. Hence, the lack of findings for precise sources may be a floor effect. That only one variable (of ten) in the main model was significant adds weight to this possibility.

It is unclear why the main effect of ICC—reduced recall in the unsorted condition—was found only for sources and not information. Prominence-interpretation theory (Fogg, 2003) argues some features of a media item would likely be immediately more noticeable. Perhaps, users process a post's most prominent features before deciding whether to process other cues. Consequently, ICC may affect how many cues are processed rather than the level of attention paid in general. Further research is needed to explore this.

One consistent finding is that the effects found—main effects, source congruency, and topic relevance—are all stronger in the sorted condition. Overall, ICC seems to minimize the impact of message features on recall, making each post more like those that surround it. This is the core concern of ICC and for the social media milieu, which is predominantly unsorted. As boundaries between information topics collapse, users are unmotivated or unable to spend the additional mental resources required to process each post. The result is all posts become processed similarly. The outcome of ICC is to hide—cognitively, at least—distinguishing features that otherwise make posts distinct. Such findings support the notion that ICC requires further study. Studies should focus on how people find information on social media and on how ICC impacts attention, storage, and recall using ecologically valid designs rather than single-message scenarios.

Public health communicators should consider that all information media are not equal. A message seen in isolation will be processed differently when placed in an unsorted feed. As such, they could spend efforts targeting uncollapsed information environments, even within the same sites. For instance, on Reddit users can browse by subreddit (usually focused on one topic) or a wider feed from many subreddits. Findings here suggest public health messaging seen when browsing by subreddit will have greater impact.

Limitations and Conclusion

The study is not without limitations. To ensure participants viewed all posts, participants viewed one post at a time with only the start of the next, and end of the preceding post also viewable. Therefore, each post lacked visible context of those around it. Hence, participants may have been limited in their certainty that posts were grouped by topic, as participants would be aware only that the topic had not changed upon viewing the next post. Additionally, this setup may have increased attention to posts as participants had to click to continue for each post rather than passively scrolling. However, the site was modeled on Instagram. Instagram and many sites similarly show only one post at a time when browsing on mobile browsers and apps, an increasingly common medium of consumption. So, this display is not uncommon in the real world.

Although the study used six topics, one—heated tobacco—was of particular interest, and the sole used for analyses of source congruency. It is not certain results translate to other health or nonhealth

contexts. However, as the study replicates previous findings (Pearson, 2021), the likelihood results would be found in other settings increases.

Although effects showed current and former smokers displayed increased recall of tobacco posts—supporting existing evidence (Ehrman et al., 2002; Feather, 1962; Rehme et al., 2018)—we did not conduct a manipulation check to see if tobacco information was perceived as more relevant to current and former smokers. This was an assumption, but with prima facie validity and one made in other studies (liberman & Chaiken, 1992; Nan & Zhao, 2012). Other factors, for instance, the smoker status of family members, may also alter the relevance of tobacco posts.

The sample was broadly representative of wider U.S. demographics but nonrandom. Additionally, demographic matching was not possible within each smoker status category. Consequently, there are differences in the median age and racial makeup of the smoker subgroups.

The results are mixed—hypotheses received only conditional support—and effect sizes were small. However, study design may have influenced this. The nature of the precise source-recall measure led to low recall and curtailed variance, so insignificant findings there may be a matter of measurement, rather than manipulation failure. Additionally, the manipulation was very subtle. The only difference between conditions was the order in which posts appeared (sorted or unsorted). This increases ecological validity but comes at the cost of stronger manipulations that may have revealed greater effects. The results were found with a subtle manipulation speaks to the relevance of ICC as a topic of study. The effects of ICC, like many in media, are likely subtle and cumulative (Valkenburg & Peter, 2013).

Social media are an increasingly important outlet for communicators. However, little attention has been paid to how social media structures impact health-messaging success. Analogue media were inherently sorted. Television had distinct themes to programs. Newspapers divided content into sections. Communication theories and campaigns that do not account for the shift to unsorted presentations on social media and its impact on information presentation may struggle.

This study replicates and extends previous findings in a novel context, suggesting that further study is warranted. Both scholars and practitioners can benefit from increased attention to how information is structured on social media.

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