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Strategic advertising of online news articles as an intervention to influence wildlife product consumers

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Abstract

Changing human behavior is essential for biodiversity conservation, but robust approaches for large scale change are needed. Concepts like repeat message exposure and social reinforcement, as well as mechanisms like online news coverage and targeted advertisements, are currently used by private and public sectors, and could prove powerful for conservation. Thus, to explore their potential in influencing wildlife consumption, we used online advertisements through Facebook, Google, and Outbrain, to promote news articles discussing the use of a Critically Endangered antelope (the *Saiga tatarica*) as a traditional Chinese medicine in Singapore. Our message, tailored to middle-aged Chinese Singaporean women, framed saiga horn products as being no longer socially endorsed. Through advert performance and in-depth analyses of Facebook user engagement, we assessed audience response. Our message pervaded Singapore's online media (e.g., our adverts were shown almost five million times; and the story ran on seven news outlets), and resulted in widespread desirable audience responses (e.g., 63% of Facebook users' engagements included identifiably positive features like calls for public action to reduce saiga horn consumption, anger at having unknowingly used a Critically Endangered species, and self-pledges to no longer use it; only 13% of engagements included identifiably negative features). This work shows that targeted dissemination of online news articles can have promising results, and may have wide applicability to conservation.

KEYWORDS
behavior change, complex contagions, demand reduction, evidence-based, information seeking, online marketing, social sharing, wildlife trade

1 | INTRODUCTION

The global expansion of the internet has rapidly made it an integral part of communication at personal and societal levels. It offers unmatched channels to disseminate ideas and information. Some online mechanisms have been used for social good via public health and social marketing interventions targeting individuals'

behavior (Clarke, Kuosmanen, & Barry, 2015; Kubacki, Rundle-Thiele, Schuster, Wessels, & Gruneklee, 2015), however, few have been strategically employed to promote behavior change for biodiversity conservation.

Online profiling and targeted advertising underpin the business model of most large online platforms (Wu, 2016). Paid advertising is offered on most platforms like social media, search engines, and websites; and the platforms' ability to identify and present relevant advertising to consumers on the basis of demographic and behavioral factors (Berghel, 2018) could be used to identify groups likely to perform undesirable conservation behaviors, and directly target messages accordingly. Non-paid content (i.e., "organic content") includes user-created social media posts, blog posts, and newspaper articles, which can be similarly used to strategically influence audiences. For instance, the effect of news coverage on political opinion and voting behavior is well studied (Reeves, McKee, & Stuckler, 2016), and has been shown to affect awareness and behavior in health and climate change (Weeks, Friedenberg, Southwell, & Slater, 2012; Maxwell Boykoff, McNatt, & Goodman, 2015).

1.1 | Idea adoption

Which ideas people pay attention to, remember, and adopt depends on a number of factors. For example, ideas that are framed to better align with strongly held beliefs and attitudes are more likely to be adopted (Heberlein, 2012); and idea framing that employs social norm structures can also increase idea adoption (Farrow, Grolleau, & Ibanez, 2017). Additionally, adoption can be affected by dissemination characteristics, like the perceived source of the idea (Fishman, Greenberg, Bagga, Casarett, & Propert, 2017), or the frequency of exposure to an idea (Zhou, Zhao, & Lu, 2015).

Literature on information-spreading (i.e., the way information flows through social networks) shows that repeated passive exposure to an idea can affect the adoption of both attitudes and behaviors, including increasing an individual's likelihood of further spreading the idea (Bao, Shen, Chen, & Cheng, 2013; Zhou et al., 2015). Some idea adoption, such as the transfer of neutral information, flows through a network like many diseases would—requiring only one source of exposure in order for the next individual to adopt it (i.e., *simple contagions*; Centola, 2010). In contrast, ideas that go against social norms or ingrained behaviors, for instance, are likely to require multiple different sources of exposure in order for them to be adopted (i.e., *complex contagions*; Centola, 2010). In addition, the adoption of some ideas is augmented by social reinforcement (i.e., hearing it from

other people); for example, shifting an individual's perception of whether consumer products are socially acceptable or not (Heal & Kunreuther, 2010; Zheng, Lü, & Zhao, 2013).

Aside from passive idea exposure, individuals actively seeking information can also adopt ideas they find, if the ideas are discoverable and attractive to them. For example, health information-seeking literature details the notable effect that available health information can have on the individuals actively looking for it, often online (Morahan-Martin, 2004).

1.2 | Study context

Illegal or unsustainable wildlife trade affects both floral and faunal species across the world, and the full extent of its impacts are unknown ('t Sas-Rolfes, Challender, Hinsley, Veríssimo, & Milner-Gulland, 2019). Despite numerous concerted conservation efforts to tackle this challenge (World Bank, 2019), it remains a key contributor to global species decline (Ceballos, Ehrlich, & Dirzo, 2017). There has thus been critique on the design and impact of the many recently implemented consumer-focused demand reduction efforts, some of which have been online (Greenfield & Veríssimo, 2018; United Nations Environment Programme, 2016). As such, there is a clear need for robust, scalable, and effective intervention methods to help tackle demand for illegal or unsustainable wildlife products.

The saiga (*Saiga tatarica*) is a Critically Endangered antelope whose horn is used in traditional Chinese medicine (TCM) (Convention on the Conservation of Migratory Species of Wild Animals [CMS], 2017), and often marketed as líng yáng, 羚羊. Poaching for saiga horn threatens species survival (CMS, 2017). Singapore is a top saiga horn consumer country (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2018), where saiga horn is legal and commonplace (Doughty et al., 2019). A study by Doughty et al. (2019) found that 19% of Chinese Singaporeans stated saiga horn was the product they use *most often* to treat fever and *heatiness* (a TCM state of illness with symptoms like sore throat). This study also found that the largest consumer group was aged 35–59 years, and women of this age were the most likely to purchase saiga horn for both themselves and others. Saiga horn use was based heavily on recommendations from others and perceptions of its efficacy. Most consumers, however, were wholly unaware of the saiga's conservation status (Doughty et al., 2019). There are general misunderstandings around saiga horn in Singapore (such as beliefs that it is an herb, or that saiga horns fall off), and this knowledge gap can be

utilized to influence consumer choices via a carefully designed intervention accounting for the social influences on saiga horn usage.

Singaporeans use the internet heavily for news, entertainment, information seeking, and social networking. Singaporean daily internet usage was estimated at 92% for those aged 35–44 years, 85% for those aged 45–54 years, and 78% for those aged 55+ years (Statista Research Department, 2016). This high level of internet usage together with the pivotal role of middle-aged women in saiga horn consumption, suggest that an online intervention targeting this group could be an effective way to reduce consumption.

We thus assessed the applicability of information-spreading and -seeking approaches to changing individuals' perception of wildlife products via a case study of saiga horn consumption in Singapore. Using online news outlets and targeted adverting, we: (a) spread information among Chinese Singaporean women aged 35–59 years which discussed saiga horn as coming from a Critically Endangered species, in a way that implied saiga horn usage was now no longer socially endorsed; and (b) made this information discoverable to information seekers within this audience. Our three main approaches were to:

- treat our core message as if it were a complex contagion, by spreading it via online platforms to our target audience in diverse ways repeatedly,
- promote social sharing of the core message within our target audience, and thus socially reinforce the message,
- make accurate information readily available to target audience members actively seeking such information.

We assessed the effectiveness of advertising platforms and news sources at inducing message engagement and analyzed how individuals engaged with, responded to, and further spread the message.

2 | METHODS

Our implementation process (detailed in Figure 1) began with us working with a trusted Singaporean news outlet to publish an article containing information about saiga horn medicine. Subsequently, other news outlets generated their own articles based on this original article. All such articles were then considered "seed sources" of the core message. We promoted these seed sources through online adverts on multiple advertising platforms. These adverts passively exposed the target audience to our core message in diversely repeated ways and encouraged

social sharing of the message. We also used adverts to promote older online resources (considered "support sources") discussing saiga horn use and its conservation impact, to individuals actively seeking related information or verifying our core message.

This experimental design was exploratory in nature because we did not have access to news articles before they were published, nor control over their publication timeline. Thus, adverts were not entirely predefined, and instead implemented and removed adaptively depending on article publications and real-time advert performance. Where possible, though, we advertised specifically to our target audience so that a future evaluation comparing effects on the target and nontarget audience would be feasible (see below for advertising platform details). Our design was based on a theory of change shown in Figure S1.

2.1 | Ethics

This research was approved by the Oxford Internet Institute's Departmental Research Ethics Committee of the University of Oxford (SSH OII C1A 19 005 and SSH OII C1A 18 094). Publicly visible Facebook content was obtained via review board-approved web scraping. All names were pseudonymized by H. D. before analysis.

2.2 | Message

Several factors determined our core message. Firstly, saiga horn is a socially endorsed product tied to recommendations from others (Doughty et al., 2019) and perceptions of its commonness (File S1). Secondly, in pilot focus groups with middle-aged Chinese Singaporean women, (both saiga horn users and nonusers), many participants aligned strongly with the notion that Singaporeans strive to be health conscious and *responsible* consumers (File S1). Participants were upset to learn saiga horn comes from a Critically Endangered species because that new information did not align with their self-identity. Most participants felt this new information was persuasive enough to dissuade them from using saiga horn. Thirdly, participants appreciated suggestions of cheap, common, and cultivated alternative TCM products. It was important for us to suggest alternatives that did not force individuals to choose between personal/cultural values and being a "responsible" consumer (Manfredo et al., 2017). Lastly, participants trusted Singaporean universities more than foreign universities for health research.

Based on these factors, we used (a) results from past research by our team (including the Singapore-based
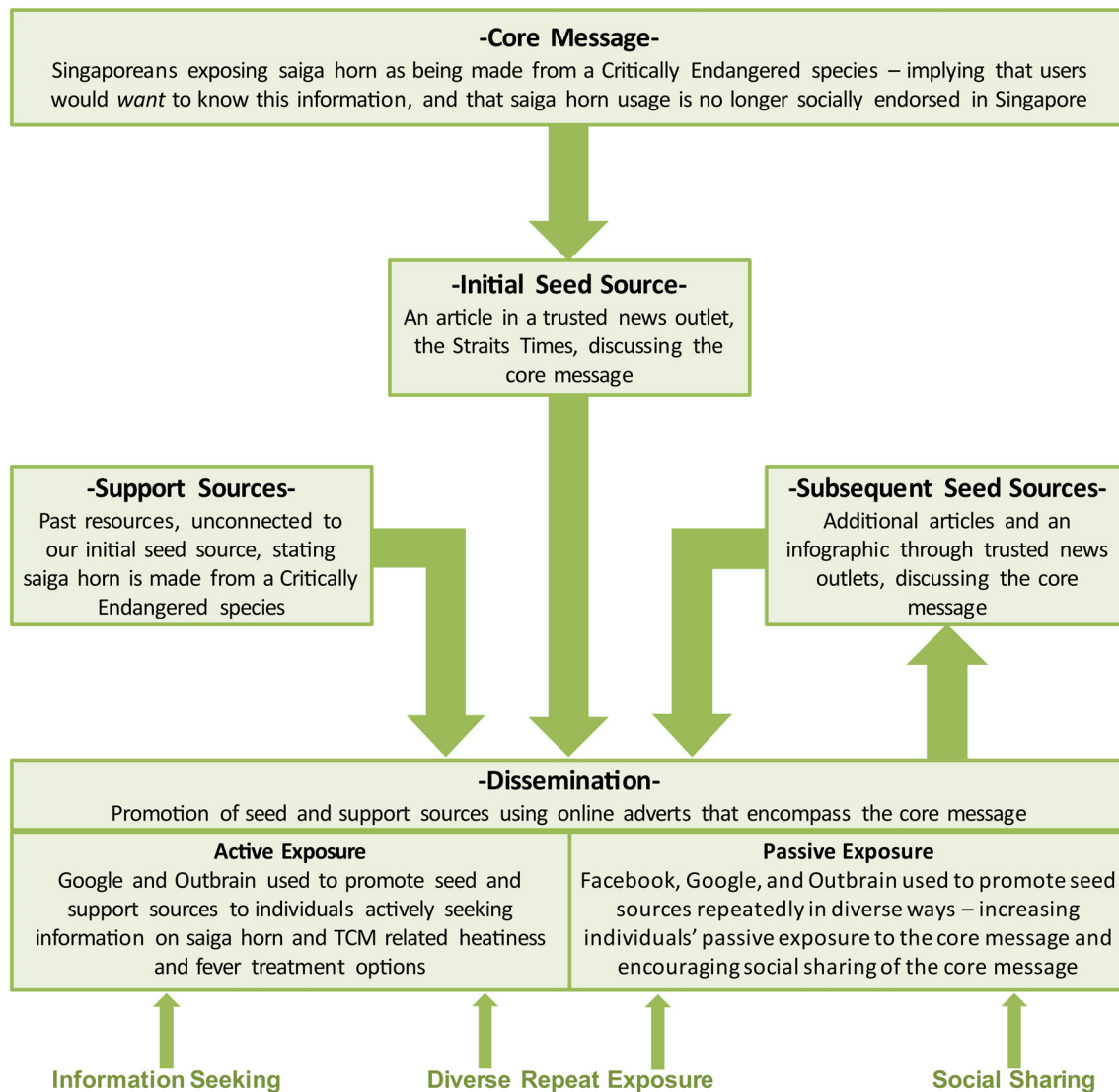
-Core Message-
Singaporeans exposing saiga horn as being made from a Critically Endangered species – implying that users would *want* to know this information, and that saiga horn usage is no longer socially endorsed in Singapore

-Initial Seed Source-
An article in a trusted news outlet, the Straits Times, discussing the core message

-Support Sources-
Past resources, unconnected to our initial seed source, stating saiga horn is made from a Critically Endangered species

-Subsequent Seed Sources-
Additional articles and an infographic through trusted news outlets, discussing the core message

-Dissemination-
Promotion of seed and support sources using online adverts that encompass the core message

Active Exposure
Google and Outbrain used to promote seed and support sources to individuals actively seeking information on saiga horn and TCM related heatiness and fever treatment options

Passive Exposure
Facebook, Google, and Outbrain used to promote seed sources repeatedly in diverse ways – increasing individuals' passive exposure to the core message and encouraging social sharing of the core message

Information Seeking   **Diverse Repeat Exposure**   **Social Sharing**

FIGURE 1 The intervention implementation process used to target saiga horn consumers in Singapore. The key components are described in boxes with black text. Three concepts founding the dissemination approach are in green text at the bottom

Nanyang Technological University; Doughty et al., 2019), and (b) Singapore-based seed sources (see below), to form a core message: Singaporean researcher and news outlets expose that numerous consumers in Singapore are unknowingly using a Critically Endangered species. This message implied that, based on this "new" information on the source of saiga horn, its usage was no longer socially endorsed. TCM alternatives made from cultivated plant species (chrysanthemum tea, barley water, and honeysuckle) were also included in the source articles.

We could not specify the exact text that journalists chose to write within news articles, but we did have control over text in our adverts (which were probably a primary exposure point for many individuals). We aimed for these adverts to express the core message (see File S2 for all advert text); and we based advert text around: (a)

phrasing found in the source articles (so that adverts were not misleading relative to article content); and (b) the hypothetical adverts we tested in our pilot focus groups (File S1). We also chose to slightly vary the advert text across different promotions in an attempt to further augment audience perceptions that this new information was coming from multiple sources, and thus was a socially popular message.

2.3 | Sources

We chose content published through news outlets to be our seed sources because news outlets are perceived by many Singaporeans to be credible for health-related news (links to all source articles can be found in File S2)

(Tang & Lee, 2013). For the initial seed source we chose the Straits Times newspaper because our focus group participants trusted international sources less than national sources, and they particularly trusted the Straits Times—the most read English language newspaper in Singapore (Kok, 2017; File S1). We provided relevant material to the Straits Times, which published an article in print and online behind a paywall (Figure 1). This article's story was picked up by other open-access online news outlets, which we identified via daily online searches and then included in our advertising as additional seed sources.

English and Chinese are the most common languages among Chinese Singaporeans (Department of Statistics Singapore, 2019), so we promoted articles in both languages. The Singapore-based English outlets included: the Mothership (a popular source for younger audiences); The New Paper (the third most-read English newspaper; Kok, 2017); and The Asian School of the Environment at Nanyang Technological University's News Blog (ASE News). The Chinese language outlets included: Lion City News (a.k.a. Shicheng News, 狮城新闻; a Singaporean outlet); and China Press (中國報; a Malaysian outlet). Additionally, we promoted an infographic on Nature Society Singapore's Facebook page as a seed source. Nature Society Singapore is a well-known Singaporean nonprofit, which fit our general aim of employing trusted local sources.

The support sources (corroborating our message but not linked to our initial seed source), included: a 2012 The Asian Scientist article in English discussing Singaporean saiga horn consumption, and a 2017 Mongabay article, a 2015 Taiwan Animal News article, and a 2016 Taiwan Environmental Information Center article—all in Chinese and discussing saiga antelopes and their consumption in Asia more broadly (Figure 1).

2.4 | Dissemination

The dissemination goals included: repeatedly and diversely expose the target audience to the core message, encourage social sharing of this message, and provide readily discoverable resources for information seekers (Figure 1). Dissemination lasted for five weeks (February–April, 2019).

For the first goal, we employed Facebook, Google, and Outbrain (a company that places adverts on third-party websites) to passively expose the core message to our target audience. Facebook also encouraged, and easily allowed for, social sharing of the message. For the second goal: since our target audience actively seeks information on health topics (Tang & Lee, 2013) and often does so through impersonal channels like Google (File S1), we promoted seed and support sources on

Google. Google thus made these sources among the top links advertised to individuals performing a relevant Google search (since this is how Google Ads displays 'promoted' links). Similarly, to capture individuals actively reading related articles on third-party websites, we used Outbrain. Adverts on all three platforms were implemented using guidelines and information provided by the platforms themselves. Platform-specific implementation notes for our process can be found in File S2, and broader considerations for others wishing to use these platforms can be found in File S3.

Facebook is a social media platform with 4.7 million users in Singapore, including 890,000 women aged 35–59 (Facebook, 2019). Our focus group participants frequently used Facebook to learn about and share health-related information (File S1). Facebook therefore met our objectives of diversely repeated message exposure and social sharing. We promoted all of our seed sources on Facebook. See File S2 for details on how Facebook advert audiences were selected. For most of our Facebook adverts, the "promoter" (which is automatically displayed on the advert) was the nonprofit organization Saiga Conservation Alliance—as this was the relevant Facebook Page we had access to. The infographic promoter was Nature Society Singapore. We recognize the potential for bias from using conservation groups as promoters. For example, individuals who are disinclined toward conservation may be put off from engaging with our adverts. However, this bias was unavoidable given our constraints and Facebook's requirements. Further, the extent of this bias was likely moderated by the fact that the majority of the advert—the text, images, and enlarged link—focused on our core message which included the Singapore-based seed sources. See File S2 for Facebook advert snapshots.

Google is a top search engine in Singapore (We Are Social, 2018), and the most commonly used search engine by our focus group participants for health information (File S1). Google met our objectives of diverse repeat exposure and providing accurate sources to information seekers, so we promoted some seed sources and all support sources on Google. See File S2 for details on how we selected Google search terms.

Outbrain sells native adverts on third-party websites. Native adverts appear more seamless on a webpage than traditional adverts and are argued by some to be more effective (Sharethrough & IPG Media, 2019). They often look like "suggested articles" on the bottom of an article that an individual is viewing. Outbrain met our objectives of diverse repeat exposure and capturing information seekers by reaching individuals while they read articles related to heatiness and fever. We promoted some of our seed sources through Outbrain. See File S2 for the topics selected for Outbrain adverts.

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2.5 | Audience response

For all newspaper sources, clicking on an advert sent an individual to the source article. For Nature Society Singapore, clicking opened the infographic as a full Facebook image. To compare the performance of adverts between advert platforms, we used the following metrics provided by all three platforms: the number of times adverts were shown (impressions), the number of times adverts were clicked on (clicks), the rate at which an advert was clicked on (click-through rate [CTR]; i.e., number of clicks per impressions), and the cost we incurred for each click (cost per click [CPC]). We also measured the highest and lowest CTR, and the cheapest and priciest CPC.

We used the same performance metrics to compare between sources. But on Facebook we were also able to measure the number of *different* Facebook users reached, and the average number of times each user saw an advert. Since we treated the core message like a complex contagion, we would have liked to assess whether diversely repeated exposure was correlated with audience engagement. We were unable to do so, however, because the information required to analyses this was not available.

To test whether advert text affected engagement, we compared adverts *within* each source on Facebook, so that all other things being equal (i.e., source, image, release date, run-time, platform), we could assess which text phrasing performed better.

2.6 | Facebook-specific analysis

On Facebook there are multiple ways for a user to engage with a message and to explicitly express their response to that message, thus our Facebook-specific analysis was particularly helpful in assessing audience response (Figure 2). We grouped audience engagements on both our paid adverts and the organic Facebook posts created by the Straits Times and the Mothership, into four types (reactions, comments/responses, shares, and clicks). To gauge whether engagement varied across adverts, we visualized the engagement type frequencies for the five adverts with the most clicks.

To capture how an individual was (a) reacting to the message, (b) relating this message to their own or others' behavior, and (c) endorsing/not endorsing this message to their networks or wider society, we conducted a qualitative features analysis of all content engagements (Figure 2). Facebook engagements (e.g., comments or shares) that included user-created content such as text and emojis were defined as "content engagements." Data included only publicly visible content engagements. This
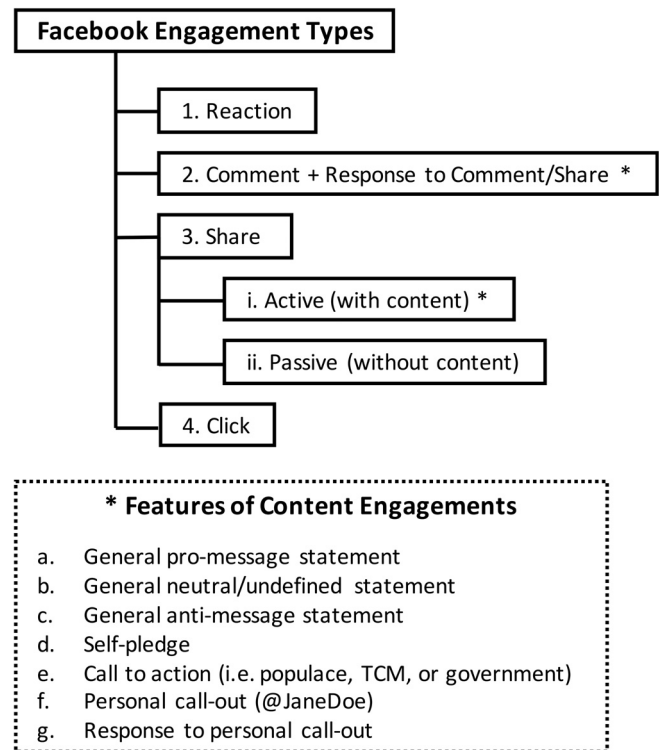

FIGURE 2 The types of engagement that an individual performed when interacting with an intervention advert on Facebook. Audience-created content was coded for listed features

content was coded for features (Figure 2) determined via a pilot coding of two adverts. Before coding, Chinese language content was translated to English by a native Chinese Singaporean fluent in English and Chinese. To evaluate content differences between adverts, we visualized the proportion of features for the four most engaged-with Facebook adverts.

3 | RESULTS

3.1 | Reach

The core message was published on at least five English and two Chinese language news outlets, with the Straits Times, The New Paper, and the Mothership being widely popular. Through just our Facebook adverts, we reached 479,258 women in Singapore aged 35–59. The proportion of the total Singaporean population is unknown because Facebook reach includes citizens and noncitizens; but within Facebook users, Facebook estimates 890,000 individuals were eligible to see our adverts (Facebook, 2019). Across all three platforms our adverts were shown almost 5 million times. Though large, these numbers underrepresent the intervention spread. Through others' promotions and the news outlets themselves, the number

of individuals reached was potentially vast. For example, 2,700 people shared the Mothership's Facebook post, but an *additional* 26,500 people shared the article directly from the Mothership website onto Facebook (Tan, 2019). The full saliency of the message, and how many times a target individual was exposed, is thus not known, but the message was evidently prevalent among Singaporean internet users.

3.2 | Platforms and sources

CTR is an important metric because it indicates some level of audience interest and is useful for comparing between adverts. Google had the highest average CTR (2.1%), followed by Facebook (1.89%) and then Outbrain (0.31%) (Table 1). For general context, Google search adverts average at 1.9%, and Facebook page adverts average at 1.4% (CXL Institute, 2020). CTR range indicates how consistently adverts perform on a platform. Outbrain had the smallest CTR range (0.82%, 0.13%), followed by Google (4.37%, 0%), and then Facebook (4.96%, 0.42%). CTRs for our seed sources were generally correlated across platforms, with The Mothership, the Straits Times, and The New Paper having the highest recorded CTRs (Table 1).

Cost-effectiveness depends on both CTR and CPC. In total, we spent about 20,900 USD on Facebook, 3,300 USD on Outbrain, and 2,700 USD on Google (values converted from SGD or GBP to USD; OANDA, 2019). Facebook was the cheapest (CPC of 0.34 USD), and Google the most expensive (CPC of 7.44 USD). Google also had the largest CPC range, with some individual clicks costing as much as 20.93 USD. Because Facebook had a relatively high CTR compared to Outbrain, but was much cheaper than Google, we consider Facebook our most cost-effective platform for passively exposing the target audience to the message. Since Facebook is a social media platform where adverts can be re-disseminated by individuals easily, Facebook was also a cost-effective way to engender visible social reinforcement of the message.

Only Facebook provided information on frequency of advert exposure. According to Facebook, on average, each person within our targeted Facebook audience was served some combination of our adverts 6.97 times while they were looking at their Facebook newsfeed. The overall average number of times each person was served *each* advert was 1.99. When comparing between seed sources, ASE News and Lion City News had the highest average frequency of exposure.

We were also interested in reaching individuals actively seeking saiga horn-related information. Google's low total impression frequency indicates how many people probably used Google to search for saiga-related information. Google Trends data similarly shows that such keywords are not often searched for, compared to say, "paracetamol." Thus, Google's high CTR suggests that even though there were relatively few people searching for saiga-related information, those individuals were distinctly interested in the message topic.

Among the support sources (i.e., older online resources providing corroborating information) that we advertised on Google: the Asian Scientist article had the highest CTR and cheapest CPC (Table 1). This was our only English language support source and the only one focused on saiga horn consumption in Singapore.

3.3 | Advert text

When comparing between Facebook adverts *within* a seed source, we found that adverts specifically referencing "Chinese Singaporeans" or "Singaporean consumers" were more effective than adverts not referencing Singaporeans — i.e., the Singapore-specific adverts had a higher average CTR, cheaper CPC, and larger reach in their first 4 days of running (see File S2 for all advert performance data). This trend is exemplified in the comparison of Mothership adverts shown in Figure 3, and confirms past research around the importance of message tailoring (Hine et al., 2014).

3.4 | Facebook engagement and spread

We measured Facebook users' engagements with our adverts and the Mothership and Straits Times organic posts. The most common engagement on our adverts was clicks (63,189); click data for the organic posts were inaccessible. The other publicly viewable engagement types across the adverts and organic posts totaled:

- 540 comments and responses on an advert/post or direct share
- 5,581 direct shares of an advert/post, of which 12–22% were *active* shares, meaning the user added their own content like text or emojis
- 6,233 reactions on an advert/post or direct share; not including reactions to others' comments or responses.

Additional comments, responses, and reactions using privately viewable shares that we could not access, are likely. Therefore, these statistics are estimates of minimum engagement. Individuals could also engage multiple times, so values do not equate to numbers of people.

TABLE 1 Comparisons of analytics for advert platforms and news sources

Platforms	Total impressions	Total clicks	Total CTR (highest, lowest)	Total average CPC[a] (cheapest, priciest)	Total reach[b] (advert average reach)	Total average frequency[b] (advert average frequency)
Facebook	**3,340,628**	**63,189**	**1.89% (4.96%, 0.42%)**	**0.34 USD (0.17, 1.03 USD)**	**479,258 (98,921)**	**6.97 (1.99)**
Google	**17,306**	**366**	**2.11% (4.37%, 0%)**	**7.44 USD (1.32, 21.16 USD)**	-	-
Outbrain	**1,628,512**	**5,037**	**0.31% (0.82%, 0.13%)**	**0.65 USD (0.63, 0.72 USD)**	-	-

Sources	Platform	Total impressions	Total clicks	Total CTR	Total average CPC[a]	Source average Reach[b]	Source average Frequency[b]
Seed sources							
ASE News	Facebook	517,606	2,647	0.51%	0.95 USD	85,882	2.63
	Google	544	6	1.10%	20.21 USD	-	-
	Outbrain	848,613	1,598	0.19%	0.65 USD	-	-
Mothership	Facebook	792,785	17,258	2.18%	0.34 USD	182,813	1.66
	Google	2,930	113	3.86%	6.50 USD	-	-
	Outbrain	219,675	1,552	0.71%	0.63 USD	-	-
Nature Society Singapore	Facebook	193,366	6,028	3.12%	0.18 USD	97,284	1.99
Straits Times	Facebook	134,555	4,933	3.67%	0.22 USD	37,690	1.19
The New Paper	Facebook	445,266	14,685	3.30%	0.18 USD	150,809	1.47
	Google	1,339	36	2.69%	4.68 USD	-	-
	Outbrain	188,723	644	0.34%	0.67 USD	-	-
China Press	Facebook	396,759	4,716	1.19%	0.58 USD	64,111	1.97
	Google	550	7	1.27%	10.44 USD	-	-
	Outbrain	371,501	1,243	0.33%	0.65 USD	-	-
Lion City News	Facebook	860,291	12,922	1.50%	0.39 USD	121,063	3.44
	Google	559	9	1.61%	10.84 USD	-	-
Support sources							
Asian Scientist	Google	6,582	136	2.07%	5.04 USD	-	-
Mongabay	Google	922	12	1.30%	15.22 USD	-	-
Taiwan Animal News	Google	1,738	24	1.38%	14.01 USD	-	-
Taiwan Environmental Information Center	Google	2,142	23	1.07%	13.96 USD	-	-

Notes: English language sources include: ASE News, Mothership, Nature Society Singapore, Straits Times, The New Paper, and Asian Scientist. Chinese language sources include: China Press, Lion City News, Mongabay, Taiwan Animal News, and Taiwan Environmental Nature Center.

Abbreviations: CPC, cost per click; CTR, click-through rate.

[a]Values were converted from SGD or GBP to USD (OANDA, 2019) and do not include taxes.

[b]Reach and Frequency were given by Facebook at the advert and account level, and did not include which individuals saw which adverts.
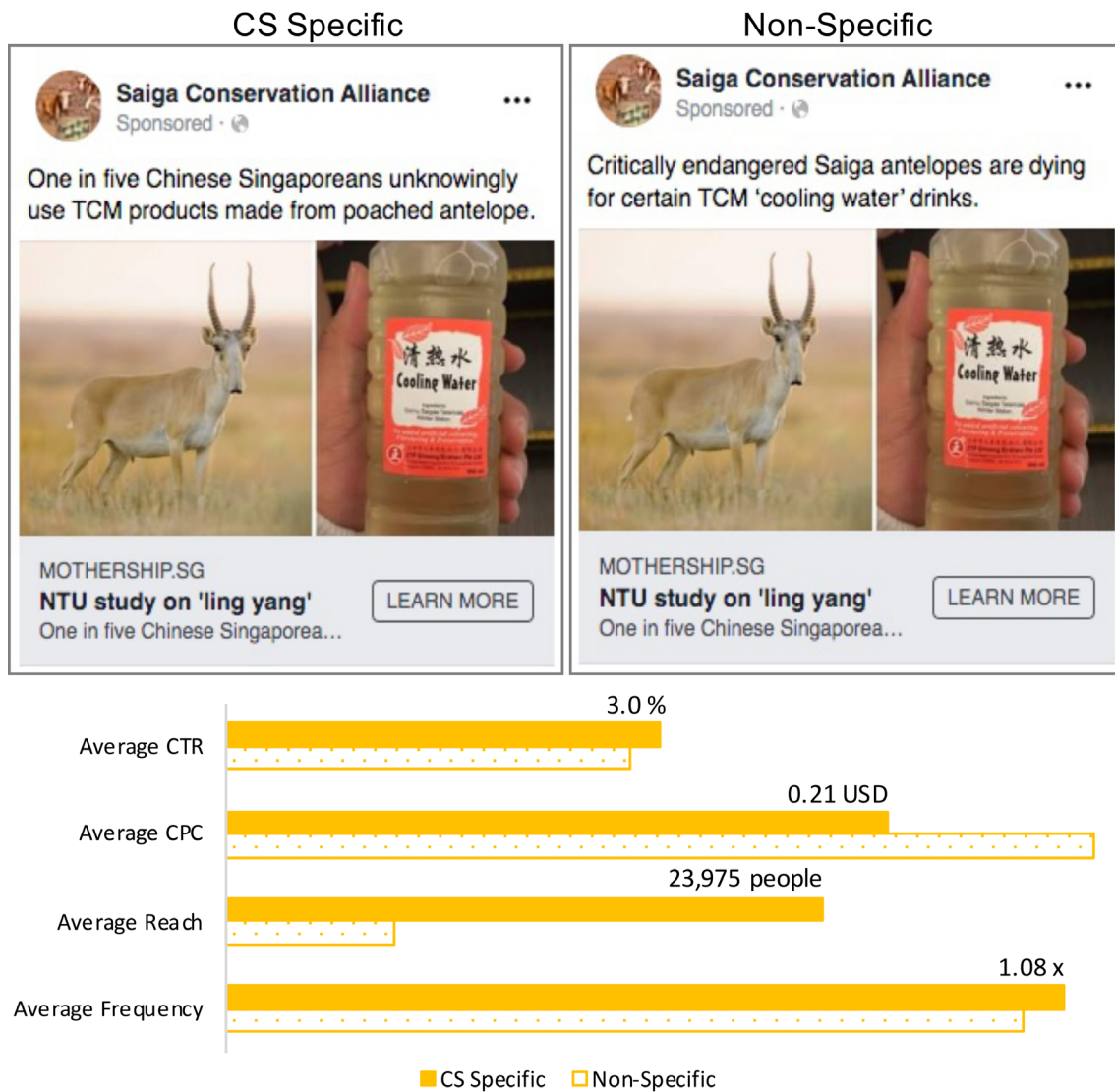
FIGURE 3 Facebook advert comparisons for the Mothership article. The advert referencing Chinese Singaporeans is "CS Specific" and the advert not referencing Chinese Singaporeans is "Non-Specific." Advert analytics include the averages for the first 4 days of advert runtime

Proportions of engagement types varied across adverts (Figure 4). For instance, the Mothership advert in Figure 4 had the most clicks, shares, and comments, but the Nature Society Singapore advert had substantially more reactions and a similar number of comments.

3.5 | Facebook features analysis

We coded 926 publicly visible content engagements (e.g., text or emojis) on our Facebook adverts and the Straits Times and Mothership organic posts, or direct shares of these adverts/posts (Figure 5). Descriptions of the features (Figure 2) we coded for, along example quotes, are available in File S4. Many of these engagements were related to an individual's own offline behavior — e.g., past positive or negative experiences with saiga horn, or their future saiga horn use. This analysis also suggested that our core message angle of "exposing the unwitting nature of saiga horn consumption" appeared to garner the desired response in those who chose to write content: with numerous content engagements expressing individuals' shock, guilt, or anger at having consumed a Critically Endangered species "without their knowledge" or at having these products in stores without potential consumers being aware of their provenance. Additionally, content engagements where individuals discussed TCM alternatives confirmed the value of seed sources mentioning these products.

Overall, we found 63% of content engagements contained features that were identifiably in line with the core message or showed a pro-conservation response to the
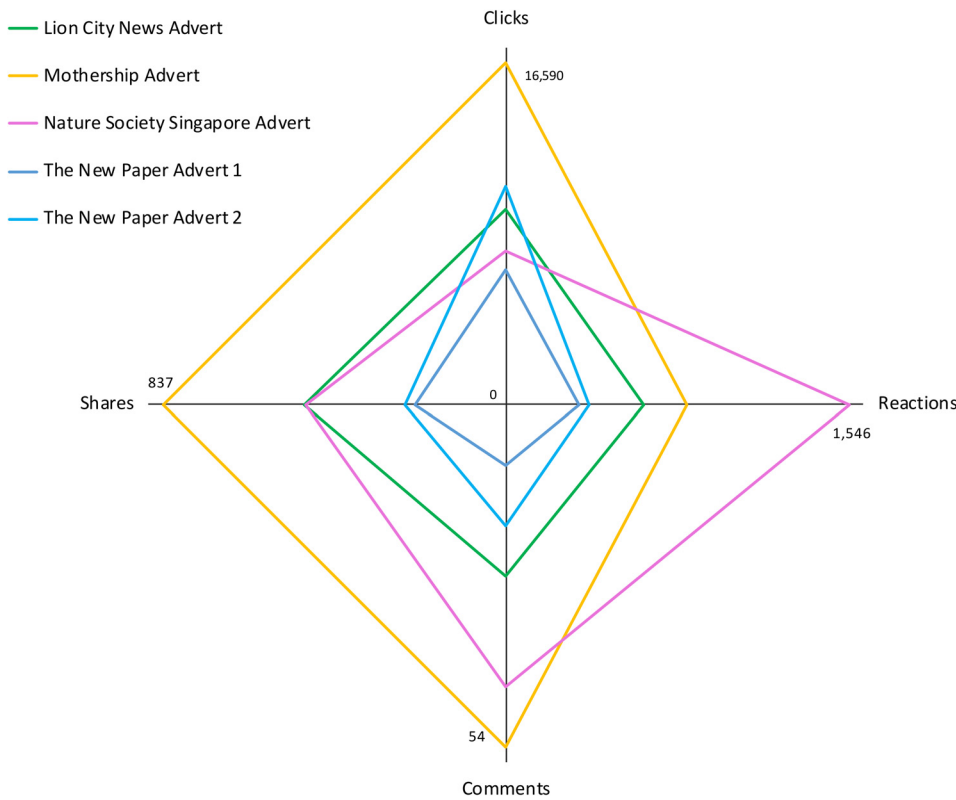
FIGURE 4 Engagement types for the five most clicked-on Facebook adverts. Axes are relative to the highest value obtained by any advert for a given engagement type. Values include only interactions directly on an advert and not shares of that advert
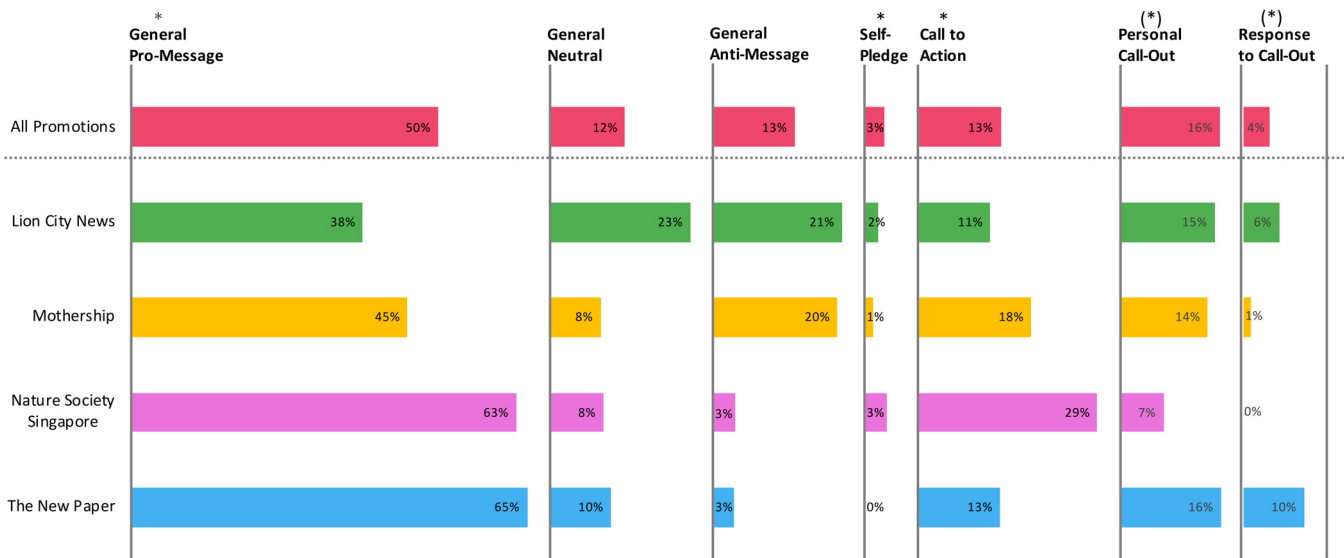

FIGURE 5 The proportion of features in publicly viewable content engagements for all our Facebook paid adverts and the Straits Times and Mothership organic posts, and then specifically for the four advert sources with the most content engagements. Bars indicate the percentage of content engagements containing a given feature. * indicates an identifiably positive feature, (*) indicates a _sometimes_ identifiably positive feature

message. The most common were general pro-message statements (in 50% of content engagements) and these ranged from single crying emojis to detailed text describing outrage at the sale of an endangered species, pro-environmental opinions, or comments around the keratin composition of saiga horn and therefore its lack of medical efficacy. Based on past research (Doughty et al., 2019) we hypothesized that there were widespread prior misunderstandings about saiga horn, and this hypothesis was evidenced by the high number of engagements indicating

that individuals were previously unaware of, or misinformed about, the source of saiga horn.

Personal call-outs, (when individuals engaged someone else using the @ symbol), were found in 16% of content engagements, and 17% of these were identifiably pro-message (e.g., advising the target individual not to use saiga horn). The rest were not identifiable as pro- or anti-message. Further, 25% of personal call-outs were responded to by the target individual, accompanied by both positive and negative features. Calls to action (in 13% of content engagements), involved the individual calling for the populace at large, or for specific entities outside of their social network, to take action (e.g., telling the government to ban saiga horn or telling a well-known TCM store to stop selling it). Self-pledges were the rarest feature (in 3% of content engagements), and consisted mainly of individuals stating they would no longer use saiga horn or that they would find alternatives.

Only 13% of content engagements contained identifiably negative features regarding the core message. Some anti-message statements indicated the individual misunderstood the intended message or wished to discredit the stated source of saiga horn products. Some common inaccuracies which we recorded were: saiga horns come from farmed saigas, the horns fall off naturally, or all products marketed as *líng yáng* are now fake. An equally common form of anti-message statement included perceptions of saiga horn's efficacy and feelings that saiga horn is safer and/or more potent than alternatives.

Different sources yielded different features compositions (Figure 5). For example, Nature Society Singapore had the highest proportion of calls to actions and self-pledges, but the lowest personal call-outs. Lion City News had the highest proportion of general anti-message and neutral features, and the lowest general pro-message features.

4 | DISCUSSION

We found a high level of positive intervention engagement, based on CTR and CPC data across Facebook, Google, and Outbrain, as well as data on Facebook engagement types and audience-created content engagements. Our Facebook analysis yielded pro-message responses from Facebook users, like furthering message spread, calling for social change, expressing angst over the previously unknown sale and use of a Critically Endangered species, and self-reporting intentions to reduce saiga horn usage. All these engagements suggest that our selected message of "exposing" the source of saiga horn medicine resonated with the target audience and may have affected perceptions of saiga horn in Singapore.

We were unable to directly test whether diversely repeated passive exposure to our adverts resulted in reduced saiga product consumption. We can say that the coverage across multiple top Singaporean news outlets, high volume of advert runs, and the news outlets' own promotions, likely resulted in a vast number of individuals in our target audience viewing the intervention message multiple times, from multiple sources. In a 2015 Chinese microblogging study, probability of forwarding an online message peaked at three exposures (Zhou et al., 2015), a frequency we far exceeded. Given the importance of social influence around saiga horn use (Doughty et al., 2019), our intervention design also assumed some individuals in our target audience would require social reinforcement in order to adopt the core message (Figure S1). The many Facebook shares and personal call-outs (particularly with identifiably positive responses from targeted individuals), indicates that we achieved our objective of social sharing, thereby socially reinforcing the message. Further, since our target audience looks to their social network for health treatment advice (Chang, Basnyat, & Teo, 2014), even if individuals did not adopt the message *directly* from our adverts, social reinforcement online or offline by their networks increased the likelihood they would subsequently adopt it.

Google's high CTR suggests some individuals were seeking saiga horn related information. As such, having the core message readily discoverable to them at the moment of searching meant the message was delivered to individuals for whom it was likely highly applicable.

CTR is not a perfect engagement measure. It indicates audience interest, but clicking on an advert in no way determines whether an individual endorses and retains the message, or shifts behavior. In fact, an individual may never click on an advert, but may write a self-pledge on Facebook or actively share that advert with friends, and these actions potentially tell more about their response to the underlying message. However, none of these guarantee actual behavior change, nor stand alone as reliable indicators of intervention impact. A full assessment of potential effects on the target audience's saiga horn purchases requires a follow-up evaluation.

The content engagements on Facebook, though, helped elucidate the target audience's immediate sentiments toward the core message. There is likely a self-selection bias, in that individuals *choose* to write content, nonetheless, the majority of content engagements (63%) contained features in line with the core message or desired intervention effect. Additionally, differences in feature proportions between seed sources (e.g., Lion City News vs. The New Paper), which possibly relate to differences in these sources' population-wide audiences, help to confirm that the Facebook "promoter" being a conservation

group did not strongly dictate audience response – since adverts with the same promoter but different seed sources yielded different audience engagement.

Our core message assumed that our focus group participants, and the prior research findings we employed to shape the message, portrayed a fairly reliable image of the target audience (Figure S1). In particular, that the target audience wished to identify as a "responsible consumer", and that consumption impacting a Critically Endangered species contradicted this identity. Had our focus group participants not indicated this sentiment, then we would not have chosen a seemingly conservation-based message. Similarly, our expectation of desirable target audience response assumed: (a) that the target audience perceived that the Singaporean seed sources viewed the common use of a Critically Endangered species without consumers' knowledge, to be a negative thing; and (b) that the target audience perceived this negative viewpoint to be socially popular among Singaporeans. Since saiga horn is legal, commonly available, and already culturally engrained, it was unlikely that by stating the proportion of saiga users in Singapore (i.e., "One in Five Chinese Singaporeans") we would make saiga horn appear more common than consumers initially perceived (Farrow et al., 2017). Instead, confirming its popularity helped to form our desired view that this behavior with previously unknown "negative impacts" was highly pervasive and needed to be addressed. This audience response was confirmed through the comments made on Facebook, and discussions during subsequent consumer surveys (not reported here).

4.1 | Wider considerations

The potential for large-scale dissemination and uptake makes online intervention approaches enticing (e.g., major corporations and organizations have reached millions of people via online promotions; Laskin et al., 2018), and specific mechanisms linked to news coverage, repeat exposure, and social reinforcement could prove powerful for many conservation efforts. For example, there are numerous wildlife trade products where socio-cultural influence determines product desirability (e.g., luxury seafood consumption in China; Fabinyi, 2012), and careful online interventions could leverage this influence. More broadly, attempts to shift behavior for pro-environmental aims are globally ubiquitous (e.g., the many climate change campaigns; Barratt, 2017), and these efforts could be dramatically augmented by strategic repeat-exposure.

However, like any intervention medium, the internet should only be used when it is target audience and behavior appropriate. Singapore is an internet-heavy country, and the target audience uses it daily—prerequisites to intervention success. Furthermore, our prior research gave us the understanding that:

- saiga horn use was influenced by social endorsement, so social perceptions could be leveraged
- our target audience gained health information from impersonal content, like news articles
- our target audience used the internet for social exchange and accessing impersonal content.

In other words, we first identified specific influences to be leveraged in the intervention and then determined whether leveraging these influences online would be applicable to our target audience.

To use many online mechanisms, it is also necessary to be able to identify online sources perceived as trustworthy by the target audience, direct channels that reach the audience, and tested message framing that induces the desired effect. These insights hold for any behavioral change intervention, and speak to the need for robust baseline research before embarking on any intervention (Greenfield & Veríssimo, 2018). Further, through our intervention process we learned that there are a number of things to consider when carrying out this type of online work (File S3). For example, when using online channels, spill-over of the intervention message to non-targeted individuals is likely, and may need to be mitigated to meet research needs. For our study, spill-over was not an issue because we wanted general social reinforcement of the intervention message. But for an evaluation of our intervention's impact, comparing effects on targeted and nontargeted individuals would be useful.

To improve our intervention process in future research, we would more systematically test message framing and the exact text and images used in the adverts (even if news article text was beyond our control). Depending on the scale of the intended audience, we would also assess whether building in a control group, or possibly a model-based counterfactual, was feasible. We elected not to conduct statistical analyses given the opaque differences between how each platform promotes adverts, and our organic approach to advert roll-out, but such analyses would be feasible in a follow-up evaluation, and may also be possible during implementation of future interventions given changes to the experimental design.

5 | CONCLUSION

By spreading a carefully shaped message via online news stories shown to an audience in diversely repeated ways, with added social reinforcement, and meeting the

interest of information seekers, we achieved high saliency and desirable target audience engagement. Given the ever-increasing number of internet users globally, and the undeniable power of news coverage and targeted advertising, harnessing an audience's information-spreading and -seeking tendencies has great potential for disseminating conservation ideas in change-inducing ways. These influential tools are already being exploited by many sectors to promote consumer goods and political ideas (Berghel, 2018), but conservationists have yet to fully employ them to achieve conservation goals.

CONFLICT OF INTEREST
The authors declare no potential conflict of interest.

AUTHOR CONTRIBUTIONS
H. D. conceptualized the intervention design, and led the intervention implementation, advert performance data collection, and overall data analyses, with input from J. W., D. V., J. S. H. L., and E. J. M. G.. J. W. coded and carried out the Facebook web-scraping. H. D. wrote the initial manuscript. All authors contributed critically to subsequent manuscript drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT
All data is available in the supplementary materials.

ETHICS STATEMENT
This research was approved by the Oxford Internet Institute's Departmental Research Ethics Committee of the University of Oxford (SSH OII C1A 19,005 and SSH OII C1A 18,094). Publicly visible Facebook content was obtained via review board-approved web scraping. All names were pseudonymized by HD before analysis.

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REFERENCES
Bao, P., Shen, H.-W., Chen, W., & Cheng, X.-Q. (2013). Cumulative effect in information diffusion: Empirical study on a micro-blogging network. *PLoS One*, *8*, e76027.

Barratt, B. (2017). Greening the debate: Timing, locality and participation in predicting success of environmental justice campaigns. *Interdisciplinary Environmental Review*, *18*, 263–280.

Berghel, H. (2018). Malice domestic: The Cambridge analytica dystopia. *Computer*, *51*, 84–89.

Boykoff, M., McNatt, M., & Goodman, M. (2015). Communicating in the Anthropocene: The cultural politics of climate change news coverage around the world. In A. Hansen & R. Cox (Eds.), *The Routledge handbook of environment and communication*, Abingdon, UK: Routledge.

Ceballos, G., Ehrlich, P. R., & Dirzo, R. (2017). Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines. *Proceedings of the National Academy of Sciences*, *114*, E6089–E6096.

Centola, D. (2010). The spread of behavior in an online social network experiment. *Science*, *329*, 1194–1197.

Chang, L., Basnyat, I., & Teo, D. (2014). Seeking and processing information for health decisions among elderly Chinese Singaporean women. *Journal of Women & Aging*, *26*, 257–279.

Clarke, A. M., Kuosmanen, T., & Barry, M. M. (2015). A systematic review of online youth mental health promotion and prevention interventions. *Journal of Youth and Adolescence*, *44*, 90–113.

Convention on International Trade in Endangered Species of Wild Fauna and Flora. (2018). Saiga antelope (*Saiga* spp.): Report of the Secretariat. Seventieth meeting of the Standing Committee, Rosa Khutor, Sochi (Russian Federation).

Convention on the Conservation of Migratory Species of Wild Animals. (2017). *Memorandum of understanding concerning conservation, restoration and sustainable use of the Saiga antelope*, Retrieved from http://www.cms.int/en/legalinstrument/saiga-antelope

CXL Institute. (2020). *What is a "good" click-through rate? Click-through rate benchmarks*. Retrieved from https://cxl.com/guides/click-through-rate/benchmarks/

Department of Statistics Singapore. (2019). Education, Language Spoken and Literacy. Retrieved from https://www.singstat.gov.sg/find-data/search-by-theme/population/education-language-spoken-and-literacy/publications-and-methodology

Doughty, H., Veríssimo, D., Tan, R. C. Q., Lee, J. S. H., Carrasco, L. R., Oliver, K., & Milner-Gulland, E. J. (2019). Saiga horn user characteristics, motivations, and purchasing behaviour in Singapore. *PLoS One*, *14*, e0222038.

Fabinyi, M. (2012). Historical, cultural and social perspectives on luxury seafood consumption in China. *Environmental Conservation*, *39*, 83–92.

Facebook. (2019). *Facebook ads manager*. Retrieved from https://www.facebook.com/adsmanager

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social norms and pro-environmental behavior: A review of the evidence. *Ecological Economics*, *140*, 1–13.

Fishman, J., Greenberg, P., Bagga, M. B., Casarett, D., & Propert, K. (2017). Comparing strategies for health information dissemination: Messengers that can help or hinder. *American Journal of Health Promotion*, *32*, 932–938.

Greenfield, S. & Veríssimo, D. (2019). To What Extent Is Social Marketing Used in Demand Reduction Campaigns for Illegal Wildlife Products? Insights From Elephant Ivory and Rhino Horn. *Social Marketing Quarterly*, 25(1), 40–54. http://dx.doi.org/10.1177/1524500418813543.

Heal, G., & Kunreuther, H. (2010). Social reinforcement: Cascades, entrapment, and tipping. *American Economic Journal: Microeconomics*, 2, 86–99.

Heberlein, T. A. (2012). *Navigating environmental attitudes*. New York, NY: Oxford University Press.

Hine, D. W., Reser, J. P., Morrison, M., Phillips, W. J., Nunn, P., & Cooksey, R. (2014). Audience segmentation and climate change communication: Conceptual and methodological considerations. *Wiley Interdisciplinary Reviews: Climate Change*, 5, 441–459.

Kok LM (2017, November 2). Digital news consumption in Singapore on the rise; The Straits Times remains most-read English paper: Nielsen survey. *The Straits Times*. https://www.straitstimes.com/singapore/digital-news-consumption-in-singapore-on-the-rise-the-straits-times-remains-most-read

Kubacki, K., Rundle-Thiele, S., Schuster, L., Wessels, C., & Gruneklee, N. (2015). Digital innovation in social marketing: A systematic literature of interventions using digital channels for engagement. In W. Wymer (Ed.), *Innovations in social marketing and public health communication, Applying quality of life research*. Switzerland: Springer International Publishing.

Laskin, A. V., Anthony, K. E., Cabezuelo-Lorenzo, F., Cruz, J., Freberg, K., Gilles, E. E., ... Lievonen, M. (2018). *Social, mobile, and emerging media around the world: Communication case studies*, London, England: Lexington Books.

Manfredo, M. J., Bruskotter, J. T., Teel, T. L., Fulton, D., Schwartz, S. H., Arlinghaus, R., ... Sullivan, L. (2017). Why social values cannot be changed for the sake of conservation. *Conservation Biology*, 31, 772–780.

Morahan-Martin, J. M. (2004). How internet users find, evaluate, and use online health information: A cross-cultural review. *Cyberpsychology & Behavior*, 7, 497–510.

OANDA. (2019). *Currency converter*. Retrieved from https://www.oanda.com/uk-en/

Sharethrough., & IPG Meda. (2019). *Native ads vs banner ads: Native ad research from IPG & sharethrough reveals that in-feed beats banners*. Retrieved from https://www.sharethrough.com/resources/in-feed-ads-vs-banner-ads/

Reeves, A., McKee, M., & Stuckler, D. (2016). "It's the sun Wot won it": Evidence of media influence on political attitudes and voting from a UK quasi-natural experiment. *Social Science Research*, 56, 44–57.

Statista Research Department. (2016). *Daily internet usage rate in Singapore in 2016, by age group*. https://www.statista.com/statistics/348101/daily-internet-usage-age-group-singapore/ Accessed October 28, 2019

't Sas-Rolfes, M., Challender, D. W. S., Hinsley, A., Veríssimo, D. & Milner-Gulland, E. J. (2019). Illegal Wildlife Trade: Scale, Processes, and Governance. *Annual Review of Environment and Resources*, 44, (1), 201–228. http://dx.doi.org/10.1146/annurev-environ-101718-033253.

Tan, A. (2019, March 6). Critically Endangered saiga antelopes are dying for certain TCM "cooling water" drinks. *The Mothership*.

Tang, E., & Lee, W. (2013). Singapore internet users' health information search: Motivation, perception of information sources, and self-efficacy. In M. Murero & R. E. Rice (Eds.), *The internet and health care: Theory, research, and practice*, New Jersey, NJ: Taylor & Francis.

United Nations Environment Programme. (2016). *Wild For Life Campaign*. Retrieved from https://wildfor.life/the-campaign

We Are Social. (2018). *Digital in 2018 in Singapore*. Retrieved from https://www.slideshare.net/wearesocial/digital-in-2018-in-singapore-86861961

Weeks, B. E., Friedenberg, L. M., Southwell, B. G., & Slater, J. S. (2012). Behavioral consequences of conflict-oriented health news coverage: The 2009 mammography guideline controversy and online information seeking. *Health Communication*, 27, 158–166.

World Bank. (2019). *Illegal logging, fishing, and wildlife trade: The costs and how to combat it*. Washington, DC: World Bank.

Wu, T. (2016). *The attention merchants: The epic scramble to get inside our heads/Tim Wu*. New York, NY: Alfred A. Knopf.

Zheng, M., Lü, L., & Zhao, M. (2013). Spreading in online social networks: The role of social reinforcement. *Physical Review E*, 88, 012818.

Zhou, C., Zhao, Q., & Lu, W. (2015). Impact of repeated exposures on information spreading in social networks. *PLoS One*, 10, e0140556.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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