RESEARCH ARTICLE

Using theory and evidence to design behaviour change interventions for reducing unsustainable wildlife consumption

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Funding information
Oxford Martin Programme

Handling Editor: Ambika Aiyadurai

Abstract

1. Efforts to shift unsustainable human behaviour are at the crux of many conservation interventions, particularly when addressing illegal or unsustainable wildlife trade. These efforts, often in the form of behaviour change interventions, have proven largely unable to counteract this pervasive issue, however, leading to calls for more robust intervention designs.

2. In behavioural science fields like public health, design processes that integrate human behaviour theory and evidence from data collection are often developed to ground behaviour change interventions within a strong understanding of the context, thus supporting interventions that are efficient and have a higher likelihood of success.

3. Here we detail the foundational process of designing an intervention around the use of a wildlife product by a particular group: Singaporean consumers of saiga horn (from the Critically Endangered *Saiga tatarica*).

4. We employ both qualitative and quantitative data, along with human behaviour theories and past literature on the study system, to develop a comprehensive understanding of the many influences driving this target audience to purchase saiga horn products.

5. We use this insight to identify the key influences to leverage in a behaviour change intervention: those that are both the most powerful and the most amenable to change.

6. This work provides a reproducible process which can be used by other intervention implementers, highlights the often complex intricacies of socially influenced behaviour, and demonstrates why a methodical understanding of these intricacies is invaluable when attempting to shift human behaviour for conservation goals.

KEYWORDS
demand reduction, evidence-based, medical pluralism, mixed-methods, Social Cognitive Theory, sustainable consumption, theory of change, traditional Chinese medicine

1 | INTRODUCTION

1.1 | Background

Illegal and unsustainable wildlife trade is a major threat to species across the globe ('t Sas-Rolfes et al., 2019). In addition, such trade has undermined local livelihoods and effective governance (Haenlein & Smith, 2016), as well as being implicated in the spread of infectious diseases (Rosen & Smith, 2010), possibly including COVID-19 (Liu et al., 2020). Extensive global efforts to combat illegal wildlife trade have been carried out, the majority of which have been supply side-focused (e.g. anti-poaching patrols in protected areas; World Bank, 2019). There has, however, been growing criticism that supply-side efforts alone cannot address the root causes of trade, and in some cases negatively affect local communities (Challender & MacMillan, 2014; Duffy et al., 2019). As such, conservation has seen a recently growing focus around shifting consumer demand (Veríssimo & Wan, 2019). Consumer behaviour can be shifted via interventions targeting individual consumers, industry actors, or policy-makers (whether national or international). In some instances using behavioural science to inform policy directly is more effective than using it to induce individual change (Ewert, 2019). This is because many drivers of behaviour are often outside of an individual's control, for example, product availability (Heberlein, 2012). However, attempting to implement regulatory change, or influence an industry or supply chain, is not realistic in many wildlife trade contexts, especially given the time-sensitive nature of threats to some species. Further, individual consumers can be an important group to address because successful behaviour change often requires public norms supporting the desired behaviour (Heberlein, 2012). This could be particularly true for reducing purchases of products with ingrained usage among a population (e.g. medicines associated with longstanding traditions (Cheung et al., 2020)). It is therefore important to be able to shift consumer behaviour through a number of means (Michie et al., 2011). Though any attempt to shift others' behaviour risks accusations of exerting paternalism over others' lives (Leggett, 2014) and unintended consequences—especially when consumer research and behavioural theory are lacking (Veríssimo et al., 2019). Thus, behaviour change efforts of any kind should be implemented cautiously, with careful thought about their potential negative impacts on target groups (Häußermann, 2020).

Wildlife trade demand reduction interventions have historically had shortcomings in their design and assessment, and have seldom been meaningfully evaluated (Veríssimo & Wan, 2019). Further, they often make limited use of the extensive literature and theory around human behaviour and behaviour change (Greenfield & Veríssimo, 2018), which means they are also unable to fully address the often complex social environment and societal-level influences that affect target behaviours (de Lange et al., 2019; Schwartz et al., 2018; Travers et al., 2019). By contrast, in public health, where behaviour change interventions have been extensively implemented, it is argued that for interventions to be effective they must be based on: an understanding of the intervention's context, a theory of change delineating assumptions and their supporting evidence, and pilot testing for feasibility and acceptability (Melnyk & Morrison-Beedy, 2018). These elements of effective interventions can be achieved through reviewing relevant published literature, collecting meticulous data, and applying health behaviour-related theory (MRC & NIHR, 2019).

Theory-based behaviour change interventions involve implementers using one or more theories, along with additional evidence, to understand the behaviour in question and find appropriate ways to influence it (Bartholomew & Mullen, 2011). Different theories can be used at each stage, as theories differ in their aims (Davidoff, 2019) and explanatory power (Bearman et al., 2017). Evidence-based behaviour change interventions use empirical evidence to support the assumptions the intervention makes, to justify the theoretical basis of the intervention, and to test hypotheses (Melnyk & Morrison-Beedy, 2018). This evidence encompasses newly collected data and existing research. It is generally accepted that interventions which are both theory- and evidence-based have a higher likelihood of success (Fernandez et al., 2019).

The process of designing an intervention serves to pull together varying theoretical and evidence-based components in a coherent way. It aids implementers in crucial decision-making steps such as who should be the target audience and at what level the intervention should be targeted (i.e. from individual through to policy). Moreover, it gives a more complete insight into the target behaviour and audience, allowing implementers to discern which factors are the most effective and feasible to trial in an intervention (Melnyk & Morrison-Beedy, 2018). Important as this process is, the specific steps can be somewhat opaque or researcher-specific, and thus there is a need for a reproducible process that can be easily applied by others. With such a process, intervention implementers targeting wildlife trade could make better use of theory and evidence so as to mitigate current biases (see Greenfield & Veríssimo, 2018) and increase the likelihood of having desirable and measurable behavioural impacts.

1.2 | Study system

The saiga (*Saiga tatarica*) is a Critically Endangered antelope from Central Asia (Mallon, 2008). Its horn is used in traditional Chinese medicine (TCM) where it is often marketed as líng yáng, 羚羊, and the species has suffered major declines due to poaching (Kühl et al., 2009; Milner-Gulland et al., 2001). Despite extensive international and saiga range state regulations and conservation efforts, continuing high demand for saiga horn exists throughout Asia (CITES, 2018; CMS, 2017; Doughty et al., 2019). Singapore is a top saiga horn consumer country (CITES, 2018) and thus is a desirable target for an intervention. Within Singapore, saiga horn is legal, easily identifiable and its purchase is non-sensitive. It is an over-the-counter product (i.e. it does not require a TCM practitioner to prescribe it) and can be found as shavings, ground up in saiga horn cooling water or medicinal pills, or intact as whole horns (Theng et al., 2017). Our extensive consumer surveys found 19% of Chinese Singaporeans consider saiga horn a product they use *most often* to treat fever or heatiness (Doughty et al., 2019). Heatiness is a TCM state of illness with symptoms like nasal congestion

and cough. It is possible that other Singaporean ethnicities use saiga horn, but because Chinese Singaporeans are the largest TCM users in Singapore (Lim et al., 2005), our work focused on them.

Health products in general are a ubiquitous component of the Singaporean consumer marketplace. Singapore's over-the-counter drug market was worth 610 million USD in 2019, and the dominating companies included both biomedical corporations and a TCM corporation (Eu Yan Sang International Ltd.; MDF, 2020). As such, Singapore is home to biomedicine as well as complementary and alternative medicine (which includes TCM), and Singaporeans frequently make use of both medical systems (Lim et al., 2005). TCM has been used in Singapore since Chinese migrants first came from mainland China in the early 1800s (Singapore CPA, 2011); and TCM stores today include both family-owned shops as well as large chain-stores that look like contemporary biomedical pharmacies (Tan & Freathy, 2011).

1.3 | Manuscript aims and structure

In this manuscript, we lay out the foundational process underpinning the design of a country-level intervention to influence the behaviour of saiga horn consumers in Singapore (Doughty et al., 2020). The aim of this manuscript is twofold. First, we aim to show how connecting and grounding empirical evidence in theoretical and conceptual literature throughout the design process allowed us to better see the intricate and important social influences around our target behaviour, and to create a strategic intervention. Second, we aim to

provide a reproducible structure for this often overlooked process, which could prove beneficial to others working to shift human behaviour in conservation.

The following section of this manuscript provides a brief overview of this foundational process, and discusses the evidence and theory inputs that were used. The next three sections walk through the process, with 'Target Audience Influences' detailing the most in-depth portion of this process. In that section we identify influences on the target audience's choice to use saiga horn and contextualise these influences to determine which ones should be leveraged in an intervention. We conclude by reflecting on the process of designing a wildlife trade behaviour change intervention, and the broader applicability of our approach to conservation.

2 | DESIGN PROCESS OVERVIEW AND INPUTS

2.1 | Process overview

The foundational design process we used to underpin a behaviour change intervention is shown in Figure 1. The seven steps of this process illustrate the key actions taken from the point a study system is selected to the proposal of an intervention approach, along with when various evidence and theory inputs are utilised. Upon selecting the study system of saiga horn in Singapore in Step 1, we then conducted detailed empirical research (described in Section 2.2) to gather
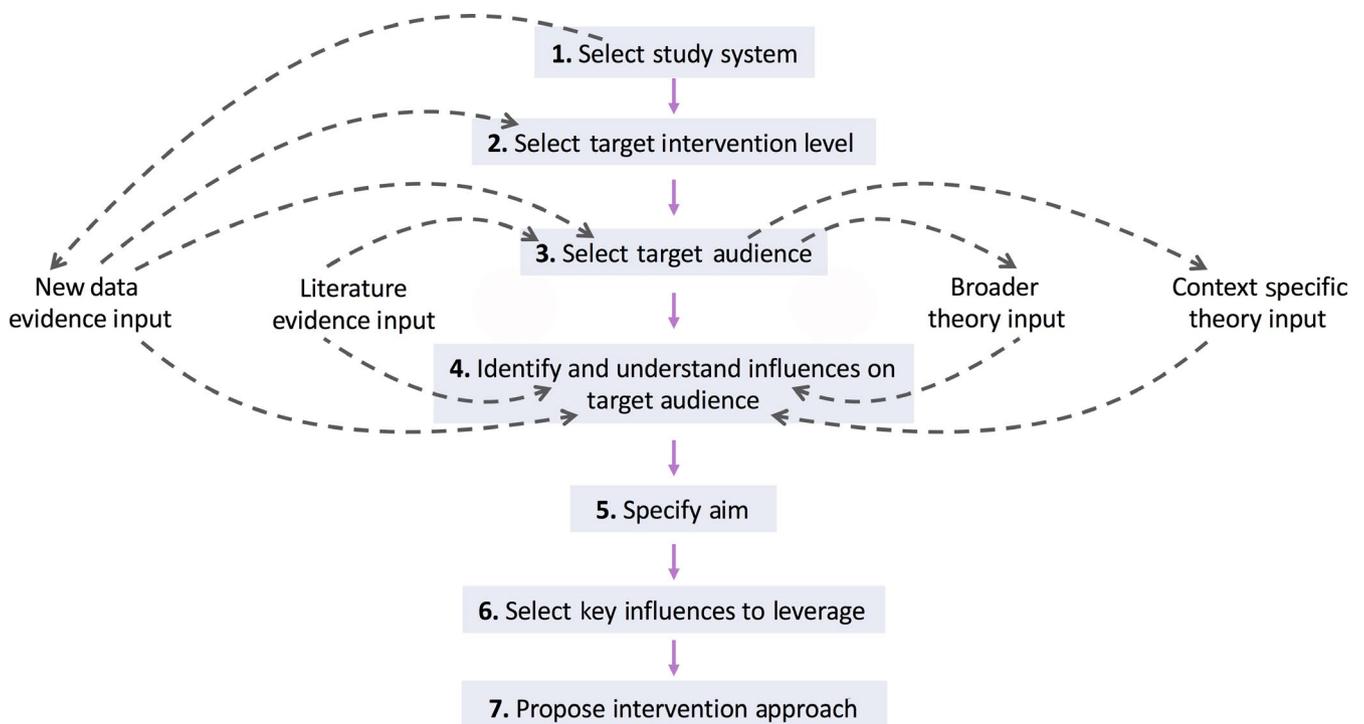

FIGURE 1 Foundational design process used to underpin a behaviour change intervention approach. The diagram includes the numbered steps taken (grey boxes with solid purple arrows) from selecting the study system to proposing the intervention approach, and shows when evidence and theory inputs (unshaded text with grey dashed arrows) were deployed based on previous steps (outward arrows) or utilised during a given step (inward arrows)

new data on this system. These data were used in Step 2 to determine whether targeting individuals' saiga horn consumption through a behaviour change intervention was feasible and well-placed. We then used this same empirical evidence, along with existing evidence from the literature, to select a target audience in Step 3. The target audience we chose was Chinese Singaporean women, aged 35–59 years old. With this target audience in mind, we compared broader human behaviour theories for their ability to explain the influences affecting our target audience (see Section 2.3). Next, we looked for health behaviour concepts that would be directly relevant to our target audience's health behavioural context (Section 2.4). Using our newly collected data, literature evidence and selected theories, we carried out Step 4 which included identifying, collating and understanding the influences on our target audience's saiga horn usage. To garner this understanding, we explored in detail how the influences related to the chosen broader theoretical model and its related concepts. With this newfound insight we completed Step 5–7, where we identified a specific intervention aim, in correspondence to the influences most feasible to employ in a tailored behaviour change intervention. We then proposed how we might leverage them.

2.2 | New data and existing literature (evidence inputs)

Four types of inputs were integral to the design process (Figure 1). The first two refer to empirical evidence. The new data used to determine the intervention level and target audience (in Steps 2 and 3) were in-person consumer surveys with Chinese Singaporean members of the public conducted by Chinese Singaporean researchers (see Doughty et al., 2019). The new data used for identifying and understanding the influences on the target audience's behaviour (in Step 4) included both these quantitative surveys and 10 in-depth qualitative consumer focus groups also conducted by a Chinese Singaporean (File S1). Forty-three individuals participated in our focus groups, though in order to analyse women's preferences and behaviours (which ended up being our intervention focus), we excluded the results of the four male participants. The remaining 39 participants were all Chinese Singaporean women aged 18–70+ years old; 26 of whom had either used saiga horn before or currently used it. The original gender imbalance of the groups was not intentional. This research was approved by the Institutional Review Board of Nanyang Technological University (IRB-2017-04-018) and the Central University Research Ethics Committee of the University of Oxford (R50787/RE001). Informed consent was obtained in writing, as approved by the preceding review boards. See File S1 for more details on focus group methods and findings.

The existing literature evidence input also used in Steps 3 and 4 was garnered through searches of relevant literature bodies, and cover topics predominately related to health information seeking behaviour and the influence of family and home-life experiences on behaviour (example texts include: Basnyat & Lim, 2017; Loh, 2009; Ryan et al., 2010).

2.3 | Social Cognitive Theory (broader behavioural theory input)

The broader human behaviour theory utilised in Step 4 was identified via a methodical search of the literature relevant to health and pro-environmental behaviours. Some implementers may also find that as a result of this literature search, they now wish to revise their selections in Steps 1–3 (e.g. target audience).

There are many factors contributing to an individual's health treatment decisions. Some are more apparent, such as their ability to afford a treatment. Others are less obvious, like their parents' health decisions. Some speak to larger social, religious and tradition-based norms surrounding an individual (Bruns et al., 2020; Evans et al., 2001). All these influences play a part in determining how an individual treats a condition such as heatiness. The field of medical anthropology, for instance, offers extensive literature on how health behaviour is intrinsically integrated into daily and societal life as well as how factors as diverse as industry change and familial values can affect health behaviour (Stoner, 1986; Whyte et al., 2002). Fields like public health and psychology further propose many theories (Glanz et al., 2015), as well as a number of frameworks (Michie et al., 2011), for how to best understand (and change) an individual's behaviour based on these influences.

Having analysed the consumer survey and focus group results, we reviewed the literature to identify human behaviour theories that would be most useful in: explaining our observed findings, filling gaps in our understanding, and ultimately helping us form a cohesive and structured narrative as to which influences led our target audience to use saiga horn. We selected a subset of well-evidenced theories that seemed most useful in understanding a health behaviour with conservation impacts (Table 1). These included the Health Belief Model, Transtheoretical Model, Integrated Behavioural Model, Model of Pro-Environmental Behaviour, Value Belief Norm Theory and Social Cognitive Theory (SCT; Davis et al., 2015). Each of these theories approach human behaviour in a different way, and provide different insights into our study system (Table 1). Comparing the merits and limitations of these theories for our purposes, we decided SCT provided insights that would be especially helpful in developing our intervention.

The SCT is widely used as a foundation for behaviour change interventions, counselling, and education (Glanz et al., 2008). For example, it has been used to assess climate change perceptions (Devine-Wright et al., 2004), and influence energy saving choices (Cornelius et al., 2014) and sustainable product purchases (Schutte & Bhullar, 2017). A core SCT principle is the 'triadic reciprocality' (i.e. triple interaction) between person (e.g. cognition), behaviour, and environment (both physical and social; Figure 2; Bandura, 1978). SCT argues these vertices are inherently linked. The triadic reciprocality of SCT, along with a number of other SCT concepts discussed in proceeding sections (Figure 2), provided a unique and detailed perspective on how outside factors, like social environment, interplay with an individual's past behaviour and desires for agency, resulting in a given health behaviour.

TABLE 1 Comparing a subset of human behaviour theories from public health and social psychology for their applicability to understanding our target audience's saiga horn usage. CS = consumer surveys (Doughty et al., 2019). FG = focus groups (File S1)

| | Overview | Study system specific | | Example of use |
		Merits	Limitations	
Social Cognitive Theory (SCT; Glanz et al., 2015; see text for more details)	An individual's behaviour is an interactive processed response to (1) personal factors (e.g. cognition), and (2) their perception of environmental factors (both physical and social); behaviour in turn affects these factors. Highlights social learning as a critical influence.	Emphasizes social influences while still highlighting an individual's interaction with these factors based on internal reasoning and desires for personal agency—all of which are highly relevant to our study system.	Some components of the SCT that may be of interest to us are less directly operational or have not been tested in a wide range of contexts (such as for wildlife trade products).	Improving cancer patients' quality of life: intervention review (Graves, 2003)
Integrated Behavioural Model (including Theory of Reasoned Action/ Planned Behaviour; Darnton, 2008; Glanz et al., 2015)	Behaviour is most determined by an individual's intention, and intention is formed from attitudes, perceived social norms, and personal efficacy. Inhibition of behaviour is due to barrier factors.	Easy to operationalise and previously used to address a wide range of behaviours. It also highlights perceived social norms, along with personal attitudes, which appear to be large influences on our target audience.	Compared to the interactive perspective of SCT, this model is less detailed in how social-level or cultural factors, interactions with others, and gained information, all interplay to result in a given behaviour. And these factors are likely important in our study system.	Increasing cervical cancer screening in the Netherlands (Knops-Dullens et al., 2007)
Health Belief Model (Glanz et al., 2015)	Predicting pro-health behaviour based on an individual's perceived (1) risk of not performing the behaviour, (2) mitigation of risk by performing the behaviour, and (3) ability and confidence in performing the behaviour.	A straightforward and operational theory with many examples of its use.	Most used for encouraging preventative health behaviours where the personal consequence of not performing the behaviour is easily comprehensible and high. There is, however, no easily argued strong personal consequence related to saiga horn use.	Understanding condom use in Kenya (Volk & Koopman, 2001)
Transtheoretical Model (Glanz et al., 2015)	An individual's 'readiness' to change a certain health behaviour is dependent on which of five stages they are on along a behaviour change process. Thus, the model calls for 'stage-specific' interventions.	Can identify which individuals are 'ready' to change, and target the intervention accordingly. Such as saiga horn users who always use saiga horn and who know but do not care about the impact on wild populations, versus those who may use saiga horn or other treatments and who do not know (but may care) about the conservation impact. Further, the model is useful for habitual behaviours, and though saiga horn use is inherently not particularly frequent it is arguably 'habitual' in that it is based on long-standing patters of use.	Helpful for countering behaviours where there are clear gradients in frequency of use, and willingness to change. However, gradients in use (given the data we had) were less definitive (e.g. all CS saiga horn users were significantly less likely to also use biomedicine, and FGs did not suggest who in the group might be willing to change based on conservation impact).	Review of smoking cessation interventions (Aveyard et al., 2009)

TABLE 1 (Continued)

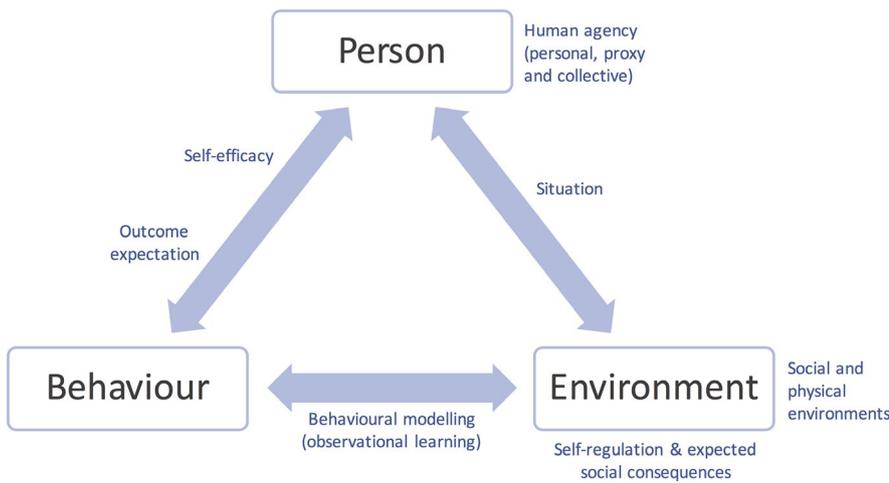|	Overview	Study system specific		Example of use
		Merits	Limitations	
Value Belief Norm Theory (Stern et al., 1999)	An individual will engage in pro-environmental behaviour when their personal norms are activated, that is, when they feel (1) that not performing the behaviour will result in adverse consequences for things they value, and (2) they hold significant responsibility in preventing these consequences.	Aimed at eliciting pro-environmental behaviour, and not using saiga horn could be framed as a pro-environmental choice.	Best used when the consequences of not performing the pro-environmental behaviour can be shown to negatively impact something the individual strongly values like their air quality. Saiga populations, though, are far removed from our target audience, and thus difficult to link to personal consequence.	Predicting pro-environmental behaviour in Taiwan (Chen et al., 2015)
Model of Pro-Environmental Behaviour (Kollmuss & Agyeman, 2002)	An individual is most likely to perform a pro-environmental behaviour when internal factors (like knowledge and values) align with external factors (like political structure), and there are not strong opposing habitual patterns in place.	Aimed at eliciting pro-environmental behaviour, and not using saiga horn could be framed as a pro-environmental choice. Attempts to incorporate factors of many models, including the Value Belief Norm Theory.	Saiga horn usage appears most based on reasoning around personal health, and so it would be limiting to posit it solely as a pro-environmental/non-environmental (altruistic) behaviour. Saiga horn use also appears habitual in nature, in that it is based on long-standing patterns of use, which is the largest 'barrier' in this model. This is also a younger theory with less direct application to interventions.	Understanding pro-environmental behaviour of park visitors in Canada (Halpenny, 2010)

FIGURE 2 Social Cognitive Theory (SCT) triadic reciprocality. Adapted from Bandura (1978) to include additional SCT concepts relevant to our study system and discussed in proceeding sections

2.4 | Medical pluralism (context specific theory input)

To carry out Step 4, we also searched literature on the specific context and behaviours of our target audience in order to find directly useful theoretical concepts and applicable existing evidence. When attempting to understand behaviour, it is critical to use a lens relevant to the individual's culture, age, or gender (Airhihenbuwa, 2007; Quah, 1985).

There is little information on broader human behaviour theories employed to understand the health choices of Chinese Singaporean women. The few studies that do target (or heavily involve) this audience, are focused on women-centred health and sex practices (Straughan & Seow, 2000; Wong et al., 1995). However, there is highly applicable medical anthropology literature discussing medical pluralism, that is, instances where individuals have access to and use multiple coexisting medical systems (Stoner, 1986). The selection of a given

medical system is often a fairly subconscious and fluid process, and the 'systems' themselves (e.g. biomedicine vs. traditional medicine) can be overlapping or imperfectly defined (Stoner, 1986). However, this process can also include more conscious decision-making; for example, it may involve individuals considering their perceived understanding of the different medical systems, and personal, social, or traditional factors, alongside their desire to be healthy (Cant & Sharma, 1999; Chang & Basnyat, 2014). Studies of Southeast or East Asian ethnicity individuals living in Asia who face medically pluralistic options primarily between biomedical and more traditional medicine help shed light on our Chinese Singaporean community (Hong, 2001; Shih et al., 2008). Singapore is simultaneously home to an extensive biomedical infrastructure and a thriving TCM community (MoH Singapore, 2012). Traditional Malay (Jamu) Medicine and Traditional Indian (Ayurverdic) Medicine are also available in Singapore but are used substantially less often than TCM (8%, 3%, vs. 88% of the population respectively, according to 2005 research; Lim et al., 2005).

A study on medical pluralism among elderly Chinese Singaporean women found participants exerted strong personal agency over their choice to use biomedical or traditional medicine, and this choice was highly situational, depending on the ailment and severity (Chang & Basnyat, 2014). Past research has found 95% of Singaporean participants who used non-biomedical treatments (mainly TCM) also used biomedicine (Lim et al., 2005). Singaporean patients generally prefer traditional treatments when looking for overall improvement of health and wellbeing, or for minor ailments (Loh, 2009; Tan & Freathy, 2011). Chang and Basnyat (2014) also found that to retain personal agency and avoid criticism, their female Chinese Singaporean participants withheld their full medical decisions from professionals in either medical system. This caused participants to depend heavily on self-diagnosis and personal opinion when treating themselves and their family. This observation is supported by other research (Lim et al., 2005), and links to anthropological literature around female kin networks and how access to, and reliance on, these networks has impacts on women's health (Davis et al., 2020).

3 | PRELIMINARY DESIGN STAGES (STEPS 1–3)

3.1 | Location and intervention level (Steps 1 and 2)

Singapore was chosen as a study site because the country is a top consumer of saiga horn (CITES, 2018), and because within the country the product is legal and widely sold, thus non-sensitive. Further, Singapore is accessible for research studies and is low risk for individual researchers' safety, regardless of whether they are Singaporean or non-Singaporean. When assessing an appropriate level (consumer through policy) to intervene at, we concluded it was not feasible for our intervention to involve policy change. This was because most of the project leads (the co-authors on this manuscript) are non-Singaporean who had little influence with Singaporean policy-makers, and shifting policy can be lengthy and unpredictable. In addition, since saiga horn is

legal and common in Singapore, we did not see a readily evident angle for an industry-level intervention. We felt, though, that a behaviour change intervention at the consumer level was well placed because: Singapore is a spatially discrete and relatively small area, despite its large population; and unlike other wildlife trade study systems (e.g. rhino horn in Vietnam, Olmedo et al., 2017), at the time of intervention development there were no other saiga horn interventions being implemented in Singapore or elsewhere in Southeast or East Asia, which might confound our evaluation. There were also no relevant national or international policy changes ongoing or anticipated. Lastly, our consumer surveys showed that saiga horn users were already purchasing alternative products to treat fever and heatiness (Doughty et al., 2019), and thus might be open to shifting more to these options. With these factors in mind, we felt targeting individual consumers' health product purchasing behaviour (as a way to reduce saiga horn purchases) was an appropriate intervention for this study system.

3.2 | Target audience (Step 3)

Attempting to target all saiga horn users in a single intervention with limited resources was not desirable because audience segmentation and message tailoring are known to increase the likelihood of intervention success (Greenfield & Veríssimo, 2018). We therefore sought to identify a target audience that was among the largest saiga horn consumers, potentially had strong influencing power over *others'* saiga horn consumption, and was feasible to target. Clear trends from the consumer surveys and existing literature suggested the target audience: female, middle-aged (36–59 years old) Chinese Singaporeans.

Middle-aged Chinese Singaporeans were the largest saiga horn user group (40%), and females of this age were the most likely to buy saiga horn for other people (Doughty et al., 2019). Past research found that Singaporean wives made more decisions than their husbands about over-the-counter medication for their families (Xia et al., 2006). However, adults are often viewed as 'set in their ways'; as such, conservationists often champion efforts targeting youth (Ngusaru, 2016). The rationale for this approach is that younger age-groups have not yet begun, or made habitual, a given undesirable behaviour, and thus may be more persuadable. But with the ageing of developed nation populations, and the power of leveraging 'opinion leaders' whose decisions influence others (de Lange et al., 2019), it is crucial that conservationists do find effective measures to engage with and elicit change in non-youth, highly influential, generations. This is particularly true when impacts on species are time-sensitive.

4 | TARGET AUDIENCE INFLUENCES (STEP 4)

4.1 | Identifying and understanding influences

Step 4 of the design process is the most in-depth, and utilised inputs from our consumer research data, existing literature and insights

from SCT and medical pluralism, along with general knowledge about the target audience. It began by first identifying the influences most likely to be affecting our target audience's saiga horn usage (Figure 3). We then detailed the evidence for these influences, whether they were supported by SCT and medical pluralism, and whether we felt they were feasible and wise to employ in a behaviour change intervention given the evidence and theoretical backing (Table S2). For example, past influences like experiences they had of being given saiga horn as a child are likely to be quite strong for many individuals (see following section). However, it was not realistic or appropriate in our intervention to contradict such personal longstanding influences; therefore, we chose not to pursue this influence. It should be noted that an audience is selected based on a finite set of variables (e.g. age and gender) and thus is always going to be heterogeneous to some extent since humans are infinitely variable in their backgrounds, daily life factors, etc. As such, these influences have varying applicability to each individual within the target audience.

To form our deep understanding of the influences surrounding the target audience's saiga horn usage, we viewed them in the combined context of evidence and theory. The triadic reciprocality in SCT (Figure 2) aims to encapsulate every factor affecting an individual from

birth onwards, and from physiological through to societal levels (Glanz et al., 2008). As such, in the following Sections 4.2–4.4 we discuss the axes of this SCT triangle, along with additional SCT principles, and how they relate to the evidence that we collected, medical pluralism literature, and additional existing evidence. This discussion highlights identified influences (Figure 3) most related to these SCT concepts.

4.2 | Social Cognitive Theory—Person (human agency)

Human agency according to Bandura is the active sentient thought enabling humans the intentionality and choice to act (Figure 2, top apex; Bandura, 2001). SCT defines three modes of agency (personal, proxy, and collective) that humans employ to feel they are in control of their actions and the subsequent outcomes.

4.2.1 | Personal agency

Personal agency is the personal thought processes of an individual that result in their actions (Bandura, 2001). Modern preventative
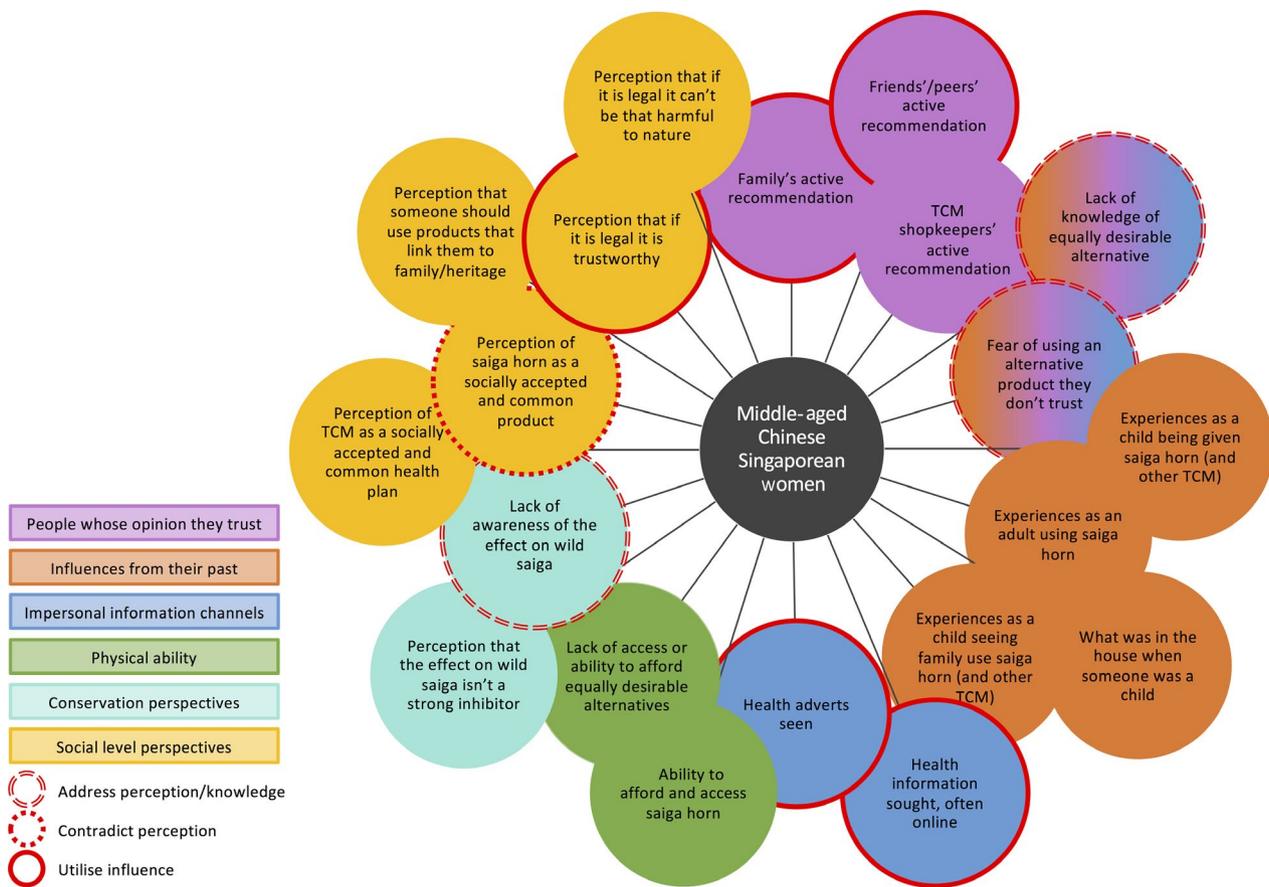

FIGURE 3 Potential influences around the target audience's saiga horn usage. We designate the decision about whether and how to address an influence in an intervention by the red outline of the circle. Selections were based on the evidence and theoretical backing (discussed in the following section), and thus whether we felt an influence was feasible and wise to employ (Table S2)

healthcare fosters personal agency and encourages individuals to exert it over their health (Bandura, 1997a; Morahan-Martin, 2004). Women, including our target audience, are particularly likely to exhibit personal agency by seeking out health information for themselves and their family (Chang & Basnyat, 2014; Yan, 2010). Our identified influences on the target audience relating to personal agency are: *Impersonal information channels*, and *People whose opinion they trust* (Figure 3).

Singaporean women actively and passively get health information through impersonal channels (Lim et al., 2011; Tang & Lee, 2013). In a past study, Singaporeans preferred the internet and mass media, second only to doctors, as their health information source; 93% of individuals seeking health information online acted on that information (Siow et al., 2003). A study of Singaporean women found that for health information, women aged 20–39 years old used the internet more than they used their friends and family; and women aged 40–59 years old used the internet about the same as they used friends and family (Chang et al., 2017). In our focus groups, participants commented on health adverts they had seen, and often stated that they used the internet for health information (File S1).

Interpersonal networks, though, are also a highly important information source for our target audience. Elderly Chinese women in past research cited their spouses, parents, and peers as key health influences (Chang et al., 2014). Friends and family are a top information channel for Singaporean women (Chang et al., 2017). Another study found young-adult Chinese Singaporean women commonly gained health information from social networks (Basnyat & Lim, 2017). Our consumer surveys found similar results: 'someone recommended it to me' was the second most cited reason for saiga horn usage, with family and TCM shopkeepers being the most common recommenders (Doughty et al., 2019). This was echoed in our focus groups with participants noting family, peers, and fellow church-goers as individuals they asked for health advice (File S1).

4.2.2 | Proxy agency

A proxy agent is someone whom an individual enlists in order to work on their behalf, or to help the individual perform or manage a necessary task (Bandura, 2001). These people are trusted to act for, or with, the individual who may not have the time or ability to directly manage every aspect of life themselves. Proxy agents relate to the influences on our target audience through *People whose opinion they trust* (Figure 3). Our target audience may not only actively listen to certain others, but allow that input to determine their ultimate health choice. For example, Chang et al. (2014) found some elderly Chinese Singaporean women 'based' their health decisions on their husbands, or 'automatically trusted' friends. Another study with younger Singaporean women found they 'based' their vaccination decisions on validation from, and a sense of belonging to, their peer group (Basnyat & Lim, 2017). In addition to our survey respondents who cited recommendations from others as their *reason* for using saiga horn (Doughty et al., 2019), many of our focus group

participants mentioned *automatically following* the advice of family or friends (File S1).

4.2.3 | Collective agency

Collective agents are community- or government-level bodies that an individual entrusts to act responsibly, or make appropriate decisions, on their behalf (e.g. government-mandated toxic ingredient labels). Collective agency relates to some target audience influences under *Social level perspectives* (Figure 3). Reliance on a collective agent would seem common in a country like Singapore, where government is perceived as heavily involved in citizens' lives. However, this agency is not often cited in Singapore health information literature. One study, though, highlights the strong trust that Singaporeans have in government-approved health information and products, including information garnered from Singaporean newspapers, which are government-regulated (Tang & Lee, 2013). Such insights might imply that for some target audience individuals, the legality of a health product, such as saiga horn, implicitly validates its effectiveness (or maybe even implies that it is ecologically sustainable). The former was anecdotally mentioned to us during our consumer research but not directly discussed during focus groups or consumer surveys.

4.3 | Social Cognitive Theory—Environment

4.3.1 | Social and physical environment and behavioural modelling

In SCT, an individual's social and physical environment is composed of current and past surroundings (Figure 2, lower right-hand apex). And it is likely that behavioural modelling (observational/social learning) occurred during those past environments, such as an individual's home life as a child (Glanz et al., 2002). Bandura argues this learning involves individuals distilling observed 'rules' and then acting upon these rules in future instances (Bandura, 1999).

Such concepts tie in with family influence literature repeatedly showing the home environment (particularly through caregivers), impacts multiple facets of children's health, including their medication use for minor ailments (Lokker et al., 2009). This effect can be caused directly via items adults give to children or have in the home (e.g. cough treatments, Paul et al., 2007). But it can also result from adults' subconscious modelling of their own behaviour to children, which the children then resemble when they are adults (e.g. alcohol use Ryan et al., 2010). These effects can last long into adulthood. For example, due to psychological (and palate) conditioning, individuals often prefer foods they were served as a child (Singh et al., 2008). Marketing research also highlights that individuals prefer brands they know and trust (Park et al., 2016). Our identification of *Influences from their past* relates to these environmental impacts on our target audience (Figure 3).

A study with elderly Chinese Singaporean women found childhood memories of using TCM with family members, along with how they were taught to understand health, not only caused them to feel a current attachment to TCM, but shaped the lens through which they viewed biomedical health theories and treatments (Chang & Basnyat, 2014). This melding of highly differing views from an individual's childhood and current experiences, is the foundation of medically pluralistic decision-making. Our focus group participants similarly recounted experiences of seeing their family use TCM when responding to questions about their *own* health preferences or a treatment's efficacy (File S1). They also commonly cited experiences of being given saiga horn by their family.

4.3.2 | Social situation

In SCT, an individual's social 'situation' is their *perception* of the social environment in which they live (Figure 2, right-side arrow; Glanz et al., 2002). Social norms are perceived socially appropriate behaviours and ways of thinking within this social situation (Heberlein, 2012). These perceptions are based on direct interpersonal networks and past experiences, and views of society through indirect channels like social media, news outlets, and television (Bandura, 1999). According to Bandura, personal behaviour is influenced by social norms via expected social consequences from acting out-of-sync with these norms, and self-regulation due to an internalisation of socially acceptable behaviour (Figure 2, lower left-hand apex; Bandura, 1997b). Using this logic, efforts to alter behaviour could alter an individual's social situation (since it is only perceived), and this in turn will shift their behaviour as they respond to their 'new' situation. Our target audience's social situation is represented in Figure 3 as *Social level perspectives*.

Such perspectives were evidenced in focus group comments regarding the general use of TCM and saiga horn (File S1). Not surprisingly, participants often felt a 'normal' behavioural choice (e.g. whether other mothers use biomedicine) aligned with their or their network's behaviour. Nonetheless, regardless of their own personal preferences, participants often commented that TCM is popular in Singapore and is a whole-body, safer, nourishing, natural, often slower approach. Most participants used non-biomedical approaches, including TCM, in some capacity in their lives, and their preference appeared heavily context-specific (e.g. depending on the ailment or severity, whether they wanted a rapid recovery or could take the time for a slower recovery, etc.); which is in line with medical pluralism literature on Singaporean women (Chang & Basnyat, 2014). Further, participants spoke positively about the fact that Singapore *does* straddle these two medical systems, for it gives residents the opportunity to choose between them and change that choice easily. Social level perspectives regarding saiga horn were that it is a common product (File S1). Even participants who didn't state they currently preferred saiga horn would often state they had used it before, knew of someone who currently uses it, or had heard of it as a product used by Singaporeans.

4.4 | Social Cognitive Theory—Behaviour

4.4.1 | Triadic reciprocality and outcome expectation

Social Cognitive Theory's triadic reciprocality suggests behaviour is a processed response to inputs from one's perceived environment and past behaviours (Figure 2, lower left-hand apex). Due to this internal processing (which is likely predominately subconscious), an individual *expects* a certain outcome regarding a behaviour, and if they feel they can adequately carry out that behaviour (i.e. they have self-efficacy), then they will perform the behaviour (Figure 2, left-hand arrow; Bandura, 1997b). In our study system the amalgamation of multiple influences (*People whose opinion they trust*, *Influences from their past*, *Impersonal information channels*, and *Social level perspectives*; Figure 3), results in an internal *expectation* regarding the efficacy of saiga horn, which individuals then act upon. This internal expectation is often the reason given by an individual when asked why they use saiga horn; which explains why 'It works' was the most commonly reported reason for using saiga horn (Doughty et al., 2019), and why this answer is deceptively multifaceted. As shown in other literature around TCM, its users do not necessarily need to integrate 'biomedical evidence' into their internal processing in order to expect TCM to be effective, but rather their internal expectations are likely to be shaped by other, often social or historical, factors (Cheung et al., 2020). In addition, the effectiveness of a medicinal treatment can also be conceptually extended to include not only its physical effects but also the impacts it has on an individual's social placement (c.f. Davis et al., 2020), which may factor into their internal processing.

5 | POPULATING THE DESIGN PROCESS (STEPS 5–7)

Saiga horn use by our target audience exists in a complex context in which all influences are interlinked to some degree, and together result in the action of using saiga horn. Given the power and practicability of leveraging various influences (Figure 3; Table S2), along with the insight gained into how each influence affects the target audience, we hypothesised we could shift the behaviour of saiga horn users in our target audience by attempting to subvert perceived saiga horn usage at the societal level (i.e. their perception of saiga horn as a *socially accepted* and common product; Figure 4). We hypothesised we could accomplish this by strategically employing facets of:

- their family and friends' active recommendations;
- health adverts they see, or health information they seek, often online;
- their perception that if it is legal it is trustworthy (e.g. through news outlets);
- their lack of awareness of the effect on wild saiga;
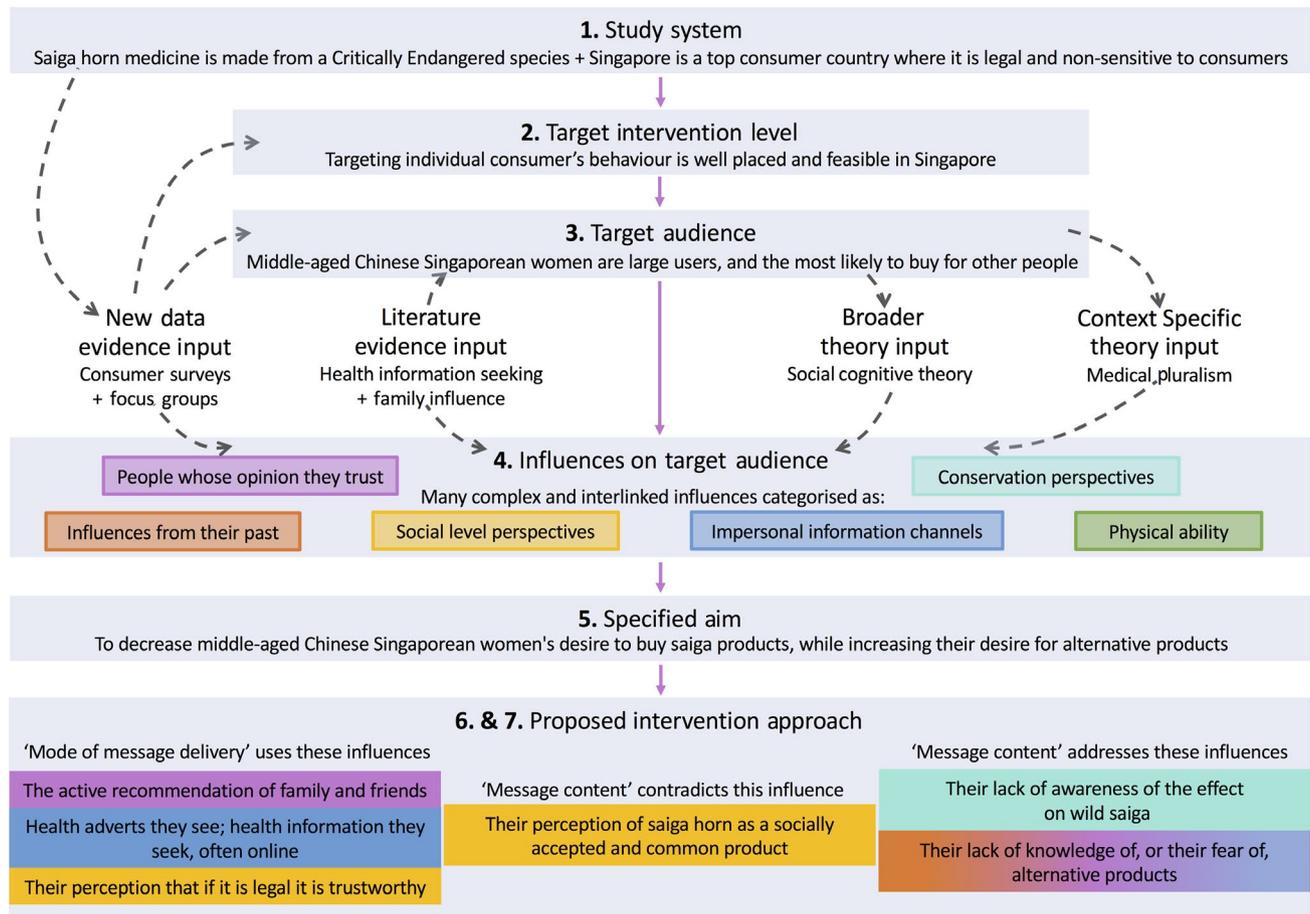- and their lack of knowledge of, or their fear of, alternative products.

1. Study system
Saiga horn medicine is made from a Critically Endangered species + Singapore is a top consumer country where it is legal and non-sensitive to consumers

2. Target intervention level
Targeting individual consumer's behaviour is well placed and feasible in Singapore

3. Target audience
Middle-aged Chinese Singaporean women are large users, and the most likely to buy for other people

New data evidence input
Consumer surveys + focus groups

Literature evidence input
Health information seeking + family influence

Broader theory input
Social cognitive theory

Context Specific theory input
Medical pluralism

4. Influences on target audience
Many complex and interlinked influences categorised as:

People whose opinion they trust

Conservation perspectives

Influences from their past

Social level perspectives

Impersonal information channels

Physical ability

5. Specified aim
To decrease middle-aged Chinese Singaporean women's desire to buy saiga products, while increasing their desire for alternative products

6. & 7. Proposed intervention approach

'Mode of message delivery' uses these influences

The active recommendation of family and friends

Health adverts they see; health information they seek, often online

Their perception that if it is legal it is trustworthy

'Message content' contradicts this influence

Their perception of saiga horn as a socially accepted and common product

'Message content' addresses these influences

Their lack of awareness of the effect on wild saiga

Their lack of knowledge of, or their fear of, alternative products

FIGURE 4 Populated intervention design process for understanding and influencing saiga horn usage among Chinese Singaporean women aged 35–59 years old. Steps of the process (grey boxes with purple solid arrows) and the inputs used for each step (unshaded text with grey dashed arrows) are shown; referencing the underlying process shown in Figure 1

The overall aim of this approach was to decrease the target audience's desire to buy saiga horn products, while increasing their awareness of and desire for alternative products, such that current saiga horn users would select alternative products.

In practice, this approach was then refined into an intervention plan: the use of targeted online advertising to promote news articles about saiga horn in Singapore (Doughty et al., 2020). This plan drew on literature around the influence of repeated message exposure, social reinforcement, and news coverage, as well as a second set of focus groups, where we could test components such as which news outlets our target audience preferred. The underlying intervention message was 'Singaporean researcher and news outlets expose that numerous consumers in Singapore are unknowingly using a Critically Endangered species' which implied that, based on this 'new' information about the source of saiga horn, its usage was no longer socially endorsed (Doughty et al., 2020). An online analysis showed the intervention message pervaded Singaporean media, and garnered largely desirable audience responses (e.g. 63% of Facebook users' content was identifiably positive while 13% was identifiably negative). A follow-up offline evaluation found that, though a significant decrease in high-level saiga horn users was not visible at the target audience population-level, the target audience did decrease saiga horn usage significantly more than the non-target audience, and among those who changed their behaviour, our intervention was the significantly most cited reason for decreasing saiga horn usage (Doughty et al., in press).

6 | CONCLUSION

Conservation interventions and management decisions are developed and evaluated via a range of approaches, including decision support frameworks like Structured Decision Making and Systematic Conservation Planning (Adams et al., 2019; Schwartz et al., 2018; Young & Van Aarde, 2011). Conservation organisations also use tools such as Miradi (Miradi, 2007) to design and evaluate interventions. However, these frameworks and tools usually do not directly incorporate human behaviour theory or structured ways to deeply address and harness the often complex social environments within which conservation projects operate (Schwartz et al., 2018). Calls have regularly been made for wider use of theories or models which address social-level behaviour within intervention design (de Lange et al., 2019; Travers et al., 2019).

In addition, the foundation for conservation actions, including wildlife trade behaviour change interventions, is often built upon the experiences and expertise of practitioners on the ground, or on previous research conducted by them or others (Cook et al., 2010; Greenfield & Veríssimo, 2018; Young & Van Aarde, 2011). This first-hand knowledge is especially useful in designing interventions, however, on its own it can amplify biased interpretations, as well as lack the deep and broad conceptual understanding of a system that is gained from using human behaviour theory coupled with robust primary research. Thus, employing such theory and data inputs alongside practice-based knowledge would broaden intervention options, give a better predictive understanding of outcomes, and increase an intervention's likelihood of achieving its conservation aims.

Through this work we learned that to fully benefit from both theory and evidence, we had to embrace the iterative nature of gaining an understanding of a study system. For instance, we used SCT to help explain our many empirical findings, and in doing so we found ourselves going back to various bodies of literature in order to gain further insight into specific concepts that we realised were most applicable to our target audience and behaviour. Thus, the 'identifying and understanding influences' stage (Figure 1), took a concerted effort and significant time, which could be a limitation for implementers under tight funding or implementation deadlines. However, this investment was worth it, as the foundational design process led us to an intervention approach we would not have otherwise selected. For example, without new data, we would be limited to prior exploratory findings that suggested young people were primary consumers (Theng et al., 2017). Similarly, by combining our data and the available literature we realised that middle-aged women, instead of older audiences, are the primary individuals influencing others' saiga horn use. Finally, without SCT, medical pluralism, and existing literature insights, we would not have understood the intricate influences surrounding our target audience, nor have known that leveraging our audience's social-level perception of saiga horn acceptance via other influences (e.g. their trust of news articles) was a feasible and highly appropriate tactic for addressing our target audience and behaviour. A barrier to implementers using these kinds of literature-based inputs, though, is that they can be inaccessible due to pay-walls (Veríssimo et al., 2020); fortunately third-party platforms offering access to literature and the increasing prevalence of open-access publishing are helping to lower this barrier.

Using the intervention approach developed through the design process in this text, we carried out the next steps in the intervention: (a) identifying applicable behaviour change techniques; (b) conducting thorough testing of selected technique components; and (c) implementing and evaluating the intervention (Doughty et al., 2020; Doughty et al., in press). These steps enabled us to assess whether the assumptions we had made about these influences on our target audience held, and whether the intervention based on these assumptions did in fact induce a desired change.

In summary, the process laid out here gave us an actionable understanding of our study system that we would have otherwise been missing. Stepping through this foundational design process could support implementers wishing to carry out behaviour change interventions within a wildlife trade context (or more broadly across biodiversity conservation) to work through critical decision-making steps in a more methodical way, as well as providing a model for how to integrate theory and evidence so as to gain a more complete insight into their target behaviour and audience. Both of which serve to increase the likelihood that interventions have desirable, measurable behavioural impacts, and make best use of an implementer's time and resources.

CONFLICTS OF INTEREST
The authors have no conflicts of interest to disclose.

AUTHORS' CONTRIBUTIONS
H.D. led the methods design, data collection, and data analyses for the empirical evidence, with input from K.O., D.V., J.S.H.L. and E.J.M.-G.. Both H.D. and K.O. conceptualised the specific design process detailed in this manuscript. H.D. conducted the relevant exploratory literature searches and wrote the initial manuscript. All authors contributed critically to subsequent manuscript drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT
We are unable to archive transcripts of the focus groups in order to protect the identity of participants, as per the conditions of our ethics approval.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.