

Review

Messaging matters: A systematic review of the conservation messaging literature



Lindall R. Kidd^{a,b,*}, Georgia E. Garrard^{a,b}, Sarah A. Bekessy^{a,b,c}, Morena Mills^d, Adrian R. Camilleri^e, Fiona Fidler^f, Kelly S. Fielding^g, Ascelin Gordon^a, Emily A. Gregg^{a,b}, Alexander M. Kusmanoff^{a,b,c}, Winnifred Louis^h, Katie Moonⁱ, Jenny A. Robinson^j, Matthew J. Selinske^{a,c}, Danielle Shanahan^k, Vanessa M. Adams^l

^a Interdisciplinary Conservation Science Research Group, School of Global, Urban and Social Studies, RMIT University, Melbourne, VIC 3000, Australia

^b Australian Government's National Environment Science Program, Threatened Species Recovery Hub, St Lucia, Australia

^c ARC Centre of Excellence for Environmental Decisions, The University of Queensland, St Lucia, QLD 4072, Australia

^d Department of Life Sciences, Imperial College London, Berkshire SL5 7PY, United Kingdom

^e UTS Business School, University of Technology Sydney, NSW 2007, Australia

^f University of Melbourne School of BioSciences, Melbourne, VIC 3052, Australia

^g School of Communication and Arts, The University of Queensland, St Lucia, QLD 4072, Australia

^h School of Psychology, The University of Queensland, St Lucia, QLD 4072, Australia

ⁱ School of Business, University of New South Wales Canberra, ACT 2601, Australia

^j School of Media and Communication, RMIT University, Melbourne, VIC 3000, Australia

^k Centre for People and Nature, ZEALANDIA ecosanctuary, Wellington, New Zealand

^l School of Technology, Environments & Design, University of Tasmania, Hobart, TAS 7001, Australia

ARTICLE INFO

Keywords:

Biodiversity
Communication
Conservation
Framing
Marketing
Messaging

ABSTRACT

Changing human behavior and attitudes are key to conserving global biodiversity. Despite evidence from other disciplines that strategic messaging can influence behavior and attitudes, it remains unclear how to best design messages to benefit biodiversity. We conducted a systematic literature review to investigate the status of conservation messaging research, and to evaluate whether studies address essential elements of message design and theory from other disciplines. We show that academic interest in conservation messaging is growing rapidly. However, our results suggest that conservation scientists are not effectively drawing from the long-standing expertise of disciplines with well-established messaging techniques. Many studies do not draw on established behavior change theories or audience segmentation techniques. Given the urgent need to address the loss of biodiversity, we discuss how conservation messaging can draw on existing empirical and theoretical knowledge, with a focus on the application of established techniques used in messaging for pro-environmental behavior.

1. Introduction

As the actions of humans are driving the extinction crisis (Maxwell et al., 2016), human behavior change will be key to preventing further biodiversity loss (Schultz, 2011). Consequently, communications that influence attitudes and behaviors are a vital component of effective conservation programs and policy development (Jacobson et al., 2015; Mascia et al., 2003).

To shift attitudes and behavior, conservation practitioners have traditionally used the knowledge-deficit model, assuming that people will adopt a given behavior if they are simply informed about the

benefits it will bring (Sturgis and Allum, 2004). However, this strategy is often ineffective because behavior is determined by multiple factors including a person's values, attitudes, relevant social and personal norms (Ajzen, 1991), and identity (Whitmarsh and O'Neill, 2010). In addition, contextual factors such as socioeconomic circumstances and infrastructure are known to affect behavior (Stern, 2005). Therefore, to be effective, communications must do more than simply provide information to an audience; they must be strategically designed to maximize responses through effective messaging (Heimlich and Ardoin, 2008). Here we adopt the definition of 'messaging' as the process of designing a message with the intent to shape, reinforce, or change the

* Corresponding author at: Interdisciplinary Conservation Science Research Group, School of Global, Urban and Social Studies, RMIT University, Melbourne, VIC 3000, Australia.

E-mail address: Lindall.kidd@gmail.com (L.R. Kidd).

<https://doi.org/10.1016/j.biocon.2019.05.020>

Received 15 November 2018; Received in revised form 6 April 2019; Accepted 15 May 2019

0006-3207/ © 2019 Elsevier Ltd. All rights reserved.

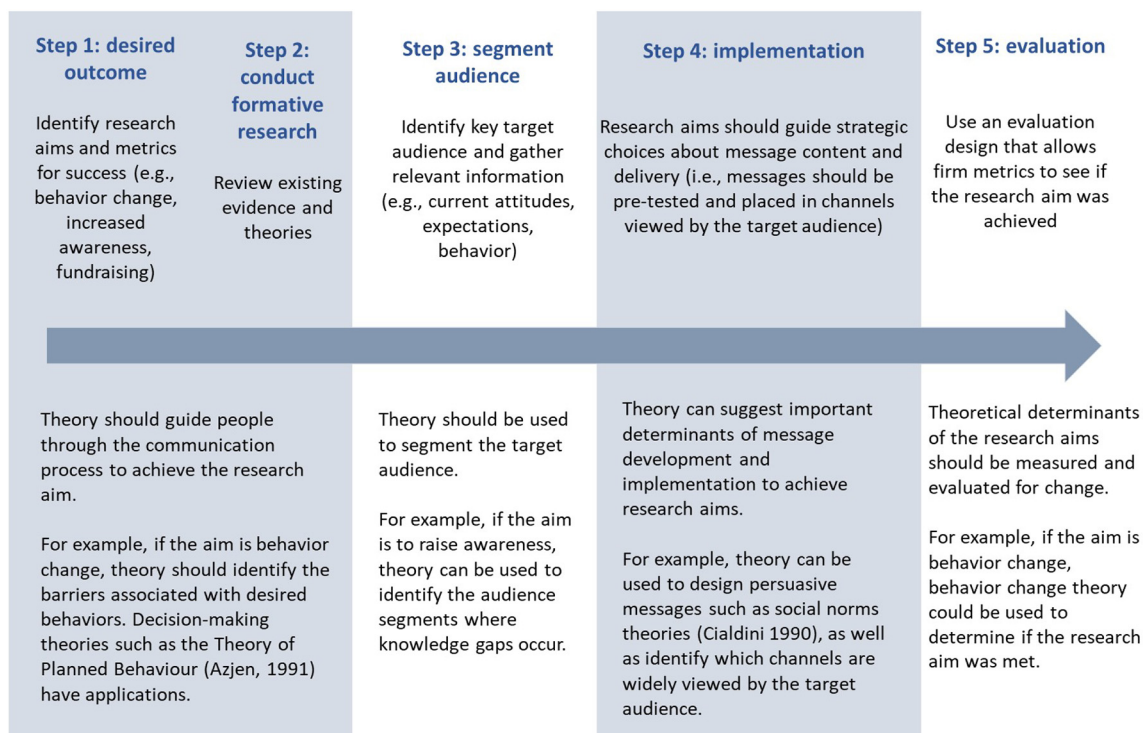


Fig. 1. A schematic representation of strategic communication design steps using theory as a conceptual framework. Campaign design steps are shown above the arrow, and the relevant application of theory with examples at each stage is described below. Adapted from Noar, 2006.

response of message recipients (Roloff, Miller & Roloff, 1980).

Strategically-designed messages with a clear aim and intent have been shown to influence attitudes and behaviors in public health and medicine. For example, decades of research within the health sector has highlighted how different approaches to message design affect behavior. Strategic messages now form the basis of health intervention media campaigns, targeting attitude and behavior change for numerous health problems, from increasing vaccination rates (Zimicki et al., 2002), to encouraging people to quit smoking (Tamir et al., 2001). Research in the health sector has advanced from investigating the design of messages targeted to groups of people, to tailored messages for individuals (Noar et al., 2007). These types of studies have informed key standards for effective message design, including the use of theory as a conceptual framework to underpin messaging campaigns (Fig. 1).

Similar advances in messaging have been made in environmental sustainability, where messaging has been used to influence behaviors in the context of energy consumption (Steinhorst et al., 2015), water use (Berk et al., 1980; Goldstein et al., 2008) and recycling (Davis, 1995; White et al., 2011). Experimental studies have found that participants who were shown messages designed to encourage energy efficiency used significantly less energy than participants who received control messages (Abrahamse et al., 2007; Steinhorst et al., 2015). Comparable results have been shown in water consumption experiments (Fielding et al., 2013). In addition, a large body of literature now exists on the use of messaging for climate change mitigation (Bostrom et al., 2013; Myers et al., 2012; Nisbet et al., 2009).

Despite the important links between conservation outcomes and public attitudes, opinions, and behaviors (Newton, 2001; Schultz, 2011), little is known about the influence of message design on biodiversity conservation behaviors (Kidd et al., 2019; Kusmanoff, 2017). Changes in human behavior and attitudes can have direct benefits to biodiversity. For example, behaviors such as keeping pet cats indoors has immediate benefits for wildlife (Loss et al., 2013). Further, attitudinal change can affect biodiversity, for example, by changing people's voting preferences to increase support for environmental policies (Pietsch and McAllister, 2010).

While it is possible that lessons learned about strategic messaging in the context of other behaviors could be applicable to biodiversity conservation, the unique attributes and challenges of conservation make it likely that influencing biodiversity relevant behaviors will require something more than a direct transplanting of these messaging strategies. Biodiversity issues are often context-specific or diffuse, making the link between behavior and biodiversity impact difficult to examine (Selinske et al., 2018). Unlike pro-environmental behaviors such as energy use reduction which are directly observable and can have immediate economic benefits to the individual, there may be no individual benefits to engaging in biodiversity conservation behaviors. Further, any benefits may be difficult to identify or take a long time to emerge. So, while the lessons already learnt from other disciplines provide a convenient starting point, conservation researchers must also examine how this learning applies to the unique and challenging context of biodiversity conservation.

Given the potential for strategic messages, which outline a clear aim and intent, to affect attitudinal and behavioral change to benefit biodiversity, it is important to understand the current status of conservation messaging research. This paper presents the first review of conservation messaging studies published in the scientific literature. The aims of this review are to: 1) synthesize and describe the current state of research regarding conservation messaging; 2) assess whether the conservation messaging literature includes key elements of message design and theory from other disciplines; and 3) identify research gaps to provide critical guidance for the development and design of conservation messages. We draw on key aspects of strategic communication, as identified by Thorson (2013), which describes a process grounded in research and involving planning, implementation, and evaluation phases (Fig. 1). Using a strategic communication approach, we review key theories and approaches used in environmental messaging, with a focus on their application to biodiversity conservation.

2. Methods

We systematically reviewed the literature relating to conservation

messaging, identified by Web of Science (webofknowledge.com). We developed a review protocol in accordance with published systematic literature review methods (Partelow et al., 2018). We used the following search terms: (“framing” OR “marketing” OR “messaging”) AND (“conservation” OR “environment”) AND (“biodiversity” OR “species”). The motivation behind each of the communication related search terms was as follows:

- 1) The term “framing” was used because it is the most common approach for manipulating strategic messages. Message framing suggests that the structure or organization of a message can alter perception of its content (Entman, 1993), and its importance is increasingly recognized in conservation studies (Kusmanoff, 2017).
- 2) The term “marketing” was used to capture references that use a popular approach to strategic communication (McKenzie-Mohr, 2011). In particular, research into social marketing is increasingly used to resolve biodiversity conservation issues (Smith et al., 2010; Veríssimo et al., 2017; Wright et al., 2015).
- 3) We chose to use the term “messaging” as messages form the basis of all purposeful communications. A message is the focal element of any communication campaign and is intended to shape, reinforce, or change the responses of another, or others (Stiff and Mongeau, 2016).

Our initial search returned 943 references with publication dates ranging from 1990 to July 19, 2018. We excluded papers that did not have at least one of the following defined research purposes: 1) to document a case study that describes an existing message; 2) develop theory relating to conservation messaging; or 3) conduct an experiment to test a theory or contribute to a design aspect of a message. After applying these criteria, we were left with a final set of 89 papers for analysis. For each paper, we collected data using predetermined categories that followed our research focus (Table S2). These categories included the type of research (theoretical, case study or experimental), and the overall aim of the study (i.e., what outcome the message was intended to have on recipients). We then recorded which self-identified theory researchers used to guide their study. We also recorded aspects of the experimental design, and/or the methods used to investigate messaging, including information on audience identification and segmentation, and evaluation techniques. Finally, we noted the outcomes of the research. Our review categories were based on common elements of strategic communication campaigns (Fig. 1). Our step-by-step review protocol can be found in Table S1 and a full list of review categories is presented in Table S2. In order to investigate which disciplines researchers were drawing from, after completing the review process, we extracted a list of all references cited within each reviewed paper. We used R software (R Core Team 2018) to loop through each reference, and count the number of references that fell into each disciplinary category defined by Web of Science.

3. Results

We identified a total of 89 relevant conservation messaging papers: Twenty-four papers discussed theory relating to conservation messaging, 27 were experimental, and 38 documented case studies. The oldest study was published in 1995; most ($n = 61$, 69%) studies were published within the last five years, indicating that conservation messaging is an emerging research area (Fig. 2).

Reviewed articles covered five broad and not mutually exclusive topics. Most of the articles covered general biodiversity and nature conservation issues ($n = 45$), species-specific conservation ($n = 21$), and natural resource management ($n = 7$), while fewer dealt with climate change ($n = 6$). Five studies covered multiple issues, and five covered other topics including messaging to influence policy and prevent the spread of invasive species. Of the papers that covered species-specific conservation issues, over half focused on threatened species (as

assessed by the IUCN Red List 2018).

The primary aim of reviewed articles varied, with the most common aim to increase awareness and educate people ($n = 31$), or to encourage behavioral change ($n = 20$) (Fig. 3). Eight studies investigated messages with an aim to increase fundraising revenue for conservation purposes. Four studies that investigated conservation messaging did not include an overall aim or purpose of the research. Thirteen studies had multiple aims, and the remainder of studies were concerned with other aims; for example, assessment of the terms used in policy discourse ($n = 13$).

The reviewed papers comprised a total of 4811 references. The majority of cited references related to environmental sciences and biodiversity conservation. References from multidisciplinary science, biochemistry, sociobiology and public health were also commonly cited (Fig. 4; Table S3).

The theories used for the design or evaluation of messages spanned a range of disciplines including psychology, marketing and communication (Table 1). Many studies listed more than one theory or approach. Framing ($n = 36$) and marketing ($n = 26$) were the most commonly used approaches, potentially reflecting the search criteria. Thirty-six studies used framing to guide their research and the most frequently used frame within these studies was ‘ecosystem services’. This frame is an increasingly popular way of discussing biodiversity, emphasizing the useful and essential services biodiversity provides to humans (Kusmanoff, 2017). The theory of flagship or charismatic species (Jepson and Barua, 2015) was used as a conceptual framework for fourteen studies. Decision-making theories such as the Theory of Planned Behavior and the Theory of Reasoned Action were used by five studies. Fourteen of the reviewed research papers did not indicate that their research was guided by theory.

One third of reviewed studies did not state a target audience ($n = 29$). Of the fifty-eight studies that did state a target audience, 27 targeted a mass audience and 33 targeted a defined audience segment. Most studies segmented participants based on demographics such as age and gender. Only a few studies used detailed audience segmentation methods, such as separating people into groups by profession ($n = 10$). Participants in experimental studies ($n = 27$) were found using a broad range of methods. For example, studies surveyed visitors to national parks ($n = 3$), university students ($n = 7$), and members of local communities and villages ($n = 5$).

Thirty-seven percent of case studies ($n = 14$) did not evaluate the effectiveness of their messages. These articles documented an existing messaging campaign but did not follow up to determine whether the research aims were achieved, making it difficult to determine effectiveness. All experimental studies evaluating the effectiveness of message design used pre- and post-measures of a dependent variable and a control group ($n = 27$). Dependent variables differed, but most relied on self-reported measures; some studies measured the degree to which people agreed with certain statements ($n = 5$), others questioned participants about whether they would donate to a certain charity after exposure to different messages (i.e. behavioral intention; $n = 4$), and others evaluated participants' attitudes before and after message exposure ($n = 12$). Only five studies evaluated specific behavioral change. A further four studies measured participants' willingness to pay as the response variable. Most studies used quantitative methods to analyze their results, although the specific methodology varied. For instance, some studies used ANOVAs or Chi square tests to quantify differences between treatments.

4. Discussion

While academic interest in conservation messaging is increasing, some critical research gaps remain in the existing conservation messaging literature. In other disciplines where strategic messaging is widely used, such as public health, message design is based on sound theory and experimental design. In addition, messages are typically targeted to

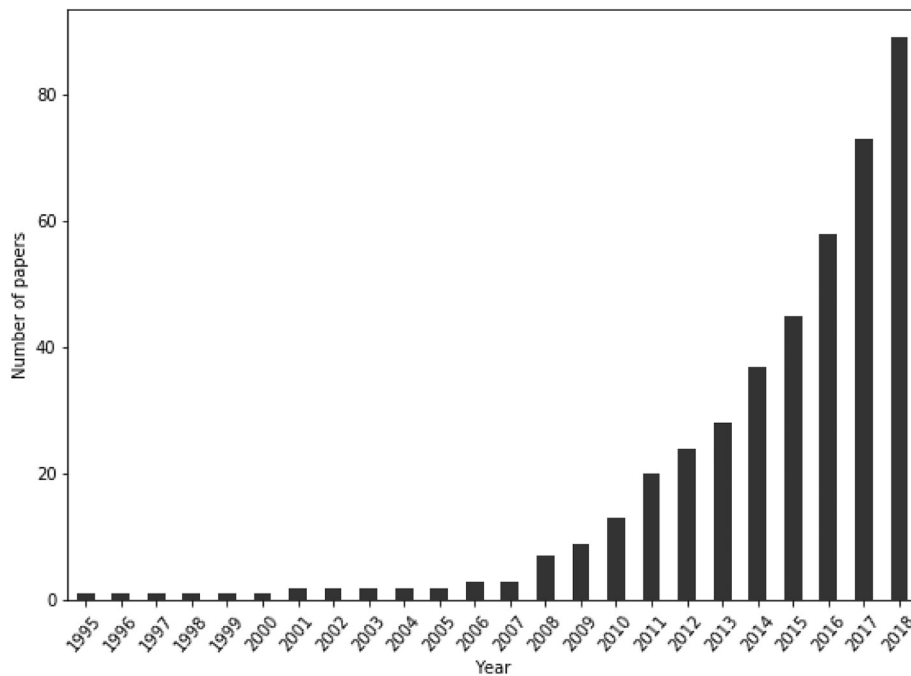


Fig. 2. The cumulative number of conservation messaging studies in the peer reviewed academic literature, based on a systematic search of Web of Science.

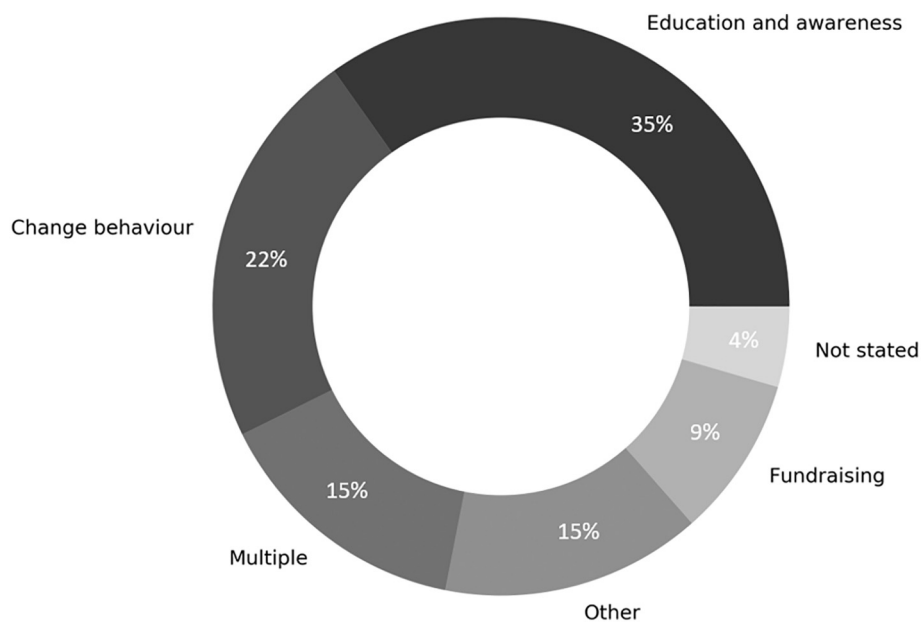


Fig. 3. The aim of messaging studies in the peer reviewed academic literature, based on a systematic search of Web of Science. Other aims of reviewed papers included assessment of the terms used in policy discourse.

specific audiences, and message effectiveness is assessed using established evaluation techniques (Gordon et al., 2006; Hine et al., 2014; Noar, 2006). Our review suggests that conservation messaging research does not fully achieve these standards of strategic communication in several key areas. Firstly, many studies are not grounded in established theories relevant to the research aim (i.e., behavioral decision-making theories). Secondly, current studies often do not select a target audience appropriate to the research aim. Finally, much of the literature focusing on nature conservation and biodiversity issues aims to educate and increase awareness, despite acknowledgment of the need to move away from the knowledge-deficit model of communication (Jacobson et al., 2015). Overcoming these shortcomings is critical to establish an evidence base for effective conservation messaging. Fortunately, guidance

can be taken from other fields. Here, we discuss how the emerging field of conservation messaging can draw on existing knowledge, with a focus on the application of established techniques used in environmental messaging.

4.1. Theory and approach

Our results suggest some conservation messaging studies are not grounded in established theories relevant to their research aim. For example, almost one third of reviewed studies stated that their research aim was to encourage behavioral change, yet few studies used important decision-making theories such as the Theory of Planned Behavior (Ajzen, 1991) to guide their research. The behavioral sciences

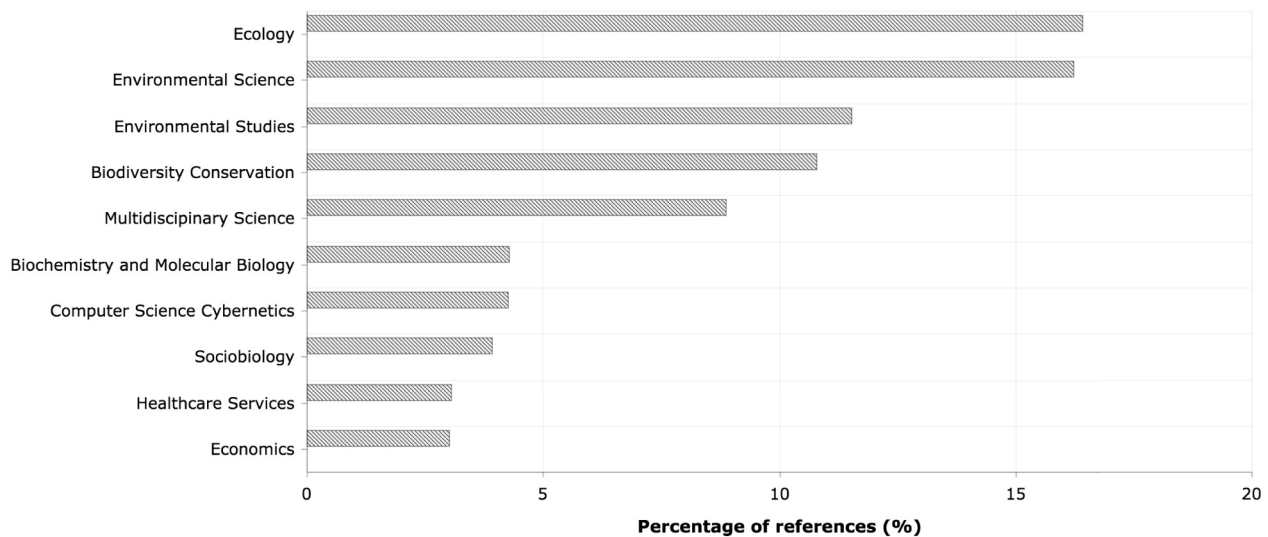


Fig. 4. The top ten Web of Science research disciplines of 4811 papers cited within a set of reviewed conservation messaging papers ($n = 89$). Note: some papers fall into multiple disciplinary categories.

Table 1

The self-identified theory or approach used by 89 studies on conservation messaging, based on a systematic review of the academic literature in Web of Science. Some studies used more than one theory.

Self-identified theory or approach	Definition and key references	Number of papers
Framing	Message framing suggests that the structure or organization of a message can alter perception of its content (Entman, 1993).	36
Marketing*	Marketing involves a range of processes concerned with finding out what consumers want, and then providing it for them (Kotler et al., 1999). Social marketing is defined as 'the systematic application of marketing along with other concepts and techniques to achieve specific behavioral goals for a social good' (French et al., 2006).	26
Charismatic and flagship species	High profile species can act as symbols or ambassadors for conservation campaigns. They often possess appealing or charismatic traits (Jepson and Barua, 2015; Simberloff, 1998).	14
Theory of change (ToC)	Theory of Change is a process for mapping programs and initiatives working for social and political change (Taplin et al., 2013).	3
Familiarity principle	People develop preferences for things because they are familiar with them (Reder and Ritter, 1992).	2
Behavioral decision-making theories:	Self-efficacy is an individual's belief in their own innate ability to achieve goals (Bandura, 1977, 1986).	1
Self-efficacy	TPB links an individual's beliefs with their behavior. The theory states that attitude toward behavior, subjective norms, and perceived behavioral control all shape an individual's behaviors (Ajzen, 1991).	2
Theory of planned behavior (TPB)	The TRA is a model of persuasion which links the relationship between attitudes and behavior to actions. It is used to predict how people will behave based on their pre-existing attitudes and behavioral intentions (Fishbein and Ajzen, 1975).	2
Theory of reasoned action (TRA)		
Elaboration likelihood model (ELM)	The ELM is a model of persuasion which suggests that there are two routes of processing stimuli: the central route and the peripheral route, which influences people's attitudes (Petty and Cacioppo, 1986).	2
Risk perception**	People make subjective judgments about the severity and likelihood of a risk. Some of these judgments may be predictable (Starr, 1969; Wildavsky and Dake, 1990).	2
Connection to nature	Nature connectedness is the extent to which people feel integrated with all aspects of nature. This includes an individual's sense of care for nature, and their commitment to protecting it. When someone feels connected to nature they may be more inclined to protect it (Nisbet et al., 2009; Schultz, 2002).	2

* There are multiple theories of marketing. Social marketing was the most widely applied.

** There are multiple theories of risk perception, articles did not differentiate between them.

provide a wealth of information about the processes of human behavior change and decision making. For example, one review details over 60 social-psychological theories and models relevant to understanding behavior change (Darnton, 2008) and research has discussed their application in the context of conservation (Monroe, 2003; St John et al., 2011). In addition, research in environmental psychology has integrated a range of psychological theories to develop a comprehensive understanding of the determinants of pro-environmental actions that can inform environmental behavior change (Bamberg and Möser, 2007; Klöckner, 2013; Steg et al., 2014; Steg and Vlek, 2009). Future conservation messaging research aiming to change behavior should draw on appropriate behavioral models and theories to inform conservation messaging, as is best practice in other well-established disciplines such as public health (Noar, 2006). This work could also benefit from considering specific decision-making research, such as goal framing theory

(Lindenberg and Steg, 2007).

Many of the articles we reviewed used a specific disciplinary approach (e.g. marketing) or drew from communication theories (e.g. framing theory). Identifying relevant disciplinary approaches is useful for establishing research context, and communications theories are key for strategic message design. Indeed, in studies where the aim is to increase people's knowledge and awareness of a conservation related issue (over one third of studies in this review), marketing theories and communication theories may be appropriate. However, if the ultimate aim of a study is to change behavior, another model or theory would provide a more fitting overarching framework. Theory should be used to determine which approach is appropriate for meeting the aims of a communication campaign (Fig. 1), and a wealth of literature can be drawn from for future theory-driven research into effective conservation messaging.

4.2. Audience segmentation

A major research gap highlighted by this review relates to a lack of audience segmentation. Only one third of reviewed studies targeted a segmented audience. This is particularly notable given the degree to which marketing approaches were employed in the reviewed literature. Audience segmentation is a key component of any marketing campaign, and research indicates that careful definition of the target audience is critical for effective communications (Grunig, 1989; Rogers and Storey, 1987). A large multidisciplinary literature has been devoted to audience segmentation techniques, and common methods for segmenting audiences include on demographic, geographic, psychographic, attitudinal, cultural and behavioral bases (Albrecht, 1996; Slater, 1996). For example, the most well-known climate change audience segmentation program is the Yale Project on Climate Change Communication that identifies six distinctive segments of the American public with regards to global warming: Alarmed, Concerned, Cautious, Disengaged, Doubtful, and Dismissive (Maibach et al., 2009). This segmentation has been used as the basis for climate change communication research worldwide (Leiserowitz et al., 2013; Morrison et al., 2013) and experiments show that the efficacy of messages varies among audience segments (Myers et al., 2012). Furthermore, in their review, Hine et al. (2014) detail over 25 climate change communication studies that employ audience segmentation techniques.

Multiple studies that segment people into different typologies exist in the context of conservation, including research on landowners, agricultural producers and wildlife recreationists (Cooper et al., 2015; Dayer et al., 2014; Kabii and Horwitz, 2006; Sweikert and Gigliotti, 2018; Teel et al., 2005). For example, one study identified four different audience segments in the western United States on the basis of different wildlife value orientations; people in different segments differed in their geographic distribution and wildlife-related attitudes and behaviors (Teel and Manfredi, 2010). These typologies can help researchers understand similarities and differences among audiences, allowing more targeted communications (Dayer et al., 2014). However, the findings from this review suggest that many conservation messaging research studies are not applying results from previous conservation-related audience segmentation research.

Emerging from the communication discipline, the Situational Theory of Publics can also provide a strong theoretical basis for conservation communication researchers to segment audiences (Grunig, 1997; Kim and Grunig, 2011; Xifra, 2015). The Situational Theory of Publics defines four main publics through their communication behaviors and issue involvement: non-publics, latent publics, aware publics, and active publics. This theory has been successfully applied to climate change and pollution to establish effective communication strategies for different segments of the public that are more or less engaged with the issue (e.g. Featherstone et al., 2009; Jiang et al., 2017), but to date it has not been specifically applied to biodiversity conservation. Grounding studies in theory, such as the Situational Theory of Publics, should assist in improving audience segmentation methods, resulting in more reliable and effective communications.

4.3. Evaluation

Targeted, theory-based communications will also assist in evaluation; it is difficult to evaluate the aims of a messaging strategy without a clear idea of the intended audience, or the mechanism by which the message is proposed to affect behavior. Over one third of conservation messaging case studies undertook no evaluation. Although some progress is being made in the evaluation of conservation communications (Jenks et al., 2010; Veríssimo et al., 2018; Veríssimo et al., 2014), the evaluation of conservation messages will benefit greatly from adopting a more strategic approach from the outset. Evaluating the efficacy of any messaging strategy is only possible when the research aims and target audience are clearly defined to begin with. A useful approach is a

pre-post experimental design with a control and treatment group. Lessons can be drawn from public health, which has achieved high standards of campaign evaluation where researchers use experimental designs with pre-defined inclusion criteria to evaluate campaign outcomes (Gordon et al., 2006).

4.4. Raising awareness to encourage behavioral change

Traditionally, the most common communication strategy for encouraging behavioral change to benefit biodiversity has been to share information to raise awareness. This ‘deficit’ approach to communication is based on the assumption that people do not conserve biodiversity because they do not know how (Schultz, 2002). The effectiveness of this model of communication for encouraging behavior change in the conservation context has long been questioned, because behaviour is determined by multiple complex factors (McKenzie-Mohr, 2011). Initial calls for a move away from awareness raising were made over a decade ago, and similar repeated calls continue (Jacobson et al., 2015; Schultz, 2002, 2011; Toomey et al., 2017). While research has moved away from education and awareness raising as a main communication strategy (Veríssimo, 2019), our results show that many studies investigating conservation messaging still aim to increase awareness and educate people. Eliminating knowledge gaps through increased awareness and education may be a useful first step in conservation communication campaigns, but conservationists should consider other factors that may influence behavior such as social norms (Mengak et al., 2019). Recent research shows that consumers are more likely to engage in pro-environmental behaviors when messages leverage psychological factors such as social influence and habit (White et al., 2019).

5. Conclusion

Changing people's attitudes and behavior is a multifaceted task benefitting from a range of disciplinary perspectives. Our results suggest that researchers are drawing from multiple disciplines when undertaking research into conservation messaging. However, there is the opportunity to draw more effectively from the long-standing expertise of other disciplines. Specifically, to advance conservation messaging, researchers should aim to incorporate theory and audience segmentation methods. We suggest that conservation messaging presents exciting opportunities for further research. To date, very few studies have explicitly compared the immediate effectiveness of different message types on different audience segments. Empirical comparisons of messaging approaches are essential for progress in this area and we encourage those with an already established knowledge of effective messaging to consider biodiversity conservation issues. The process of messaging may already be familiar to conservation researchers; there is a clear link between elements of strategic messaging and biodiversity conservation (Bogart et al., 2009). Both processes should involve planning, implementation, and evaluation through monitoring and research. Advancing the understanding of conservation messaging is of global importance and relevant to anyone communicating with audiences of all kinds about the conservation of biodiversity.

Acknowledgements

This research was conducted with funding support from the Threatened Species Recovery Hub of the Australian Government's National Environmental Research Program and the Australian Research Council Centre of Excellence for Environmental Decisions. SAB is supported by an ARC Future Fellowship. This review emerged from a workshop supported by the Australian Research Council Centre of Excellence for Environmental Decisions. We acknowledge the valuable contribution of each of the attendees at the workshop in stimulating the ideas presented in this review, and the contributions of two anonymous reviewers whose feedback improved the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.biocon.2019.05.020>.

References

- Abrahamse, W., Steg, L., Vlek, C., Rothengatter, T., 2007. The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *J. Environ. Psychol.* 27, 265–276.
- Ajzen, I., 1991. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50, 179–211.
- Albrecht, T.L., 1996. Advances in segmentation modeling for health communication and social marketing campaigns. *J. Health Commun.* 1, 65–80.
- Bamberg, S., Möser, G., 2007. Twenty years after Hines, Hungerford, and Tomera: a new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* 27, 14–25.
- Bandura, A., 1977. Self-efficacy: toward a unifying theory of behavioral change. *Psychol. Rev.* 84, 191.
- Bandura, A., 1986. The explanatory and predictive scope of self-efficacy theory. *J. Soc. Clin. Psychol.* 4, 359–373.
- Berk, R.A., Cooley, T.F., LaCivita, C., Parker, S., Sredl, K., Brewer, M., 1980. Reducing consumption in periods of acute scarcity: the case of water. *Soc. Sci. Res.* 9, 99–120.
- Bogart, R.E., Duberstein, J.N., Slobe, D.F., 2009. Strategic communications and its critical role in bird habitat conservation: Understanding the social-ecological landscape. In: Texas, USA: Fourth International Partners in Flight Conference/Tundra to Tropics: Connecting Birds, Habitats and People, pp. 441–452.
- Bostrom, A., Böhm, G., O'Connor, R.E., 2013. Targeting and tailoring climate change communications. *Wiley Interdiscip. Rev. Clim. Chang.* 4, 447–455.
- Cooper, C., Larson, L., Dayer, A., Stedman, R., Decker, D., 2015. Are wildlife recreationists conservationists? Linking hunting, birdwatching, and pro-environmental behavior. *J. Wildl. Manag.* 79, 446–457.
- Darnton, A., 2008. GSR behaviour change knowledge review. In: Reference report. An overview of behaviour change models and their uses, . Available at: <http://jpkc.ujn.edu.cn/xljkjy/jxzy/ywlv/37.pdf>.
- Davis, J.J., 1995. The effects of message framing on response to environmental communications. *J. Mass Commun. Q.* 72, 285–299.
- Dayer, A.A., Allred, S.B., Stedman, R.C., 2014. Comparative analysis and assessment of forest landowner typologies. *Soc. Nat. Resour.* 27, 1200–1212.
- Entman, R.M., 1993. Framing: toward clarification of a fractured paradigm. *JC* 43, 51–58.
- Featherstone, H., Weitkamp, E., Ling, K., Burnet, F., 2009. Defining issue-based publics for public engagement: climate change as a case study. *Public Underst. Sci.* 18, 214–228.
- Fielding, K.S., Spinks, A., Russell, S., McCrear, R., Stewart, R., Gardner, J., 2013. An experimental test of voluntary strategies to promote urban water demand management. *J. Environ. Manag.* 114, 343–351.
- Fishbein, M., Ajzen, I., 1975. Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.
- French, J., HE, D., Blair-Stevens, C., 2006. From snake oil salesmen to trusted policy advisors: the development of a strategic approach to the application of social marketing in England. *Soc. Mark. Q.* 12, 29–40.
- Goldstein, N.J., Cialdini, R.B., Griskevicius, V., 2008. A room with a viewpoint: using social norms to motivate environmental conservation in hotels. *J. Consum. Res.* 35, 472–482.
- Gordon, R., McDermott, L., Stead, M., Angus, K., 2006. The effectiveness of social marketing interventions for health improvement: what's the evidence? *Public Health* 120, 1133–1139.
- Grunig, J.E., 1989. Publics, audiences and market segments: Segmentation principles for campaigns. In: *Information Campaigns: Balancing Social Values and Social Change*, pp. 199–228.
- Grunig, J.E., 1997. A situational theory of publics: Conceptual history, recent challenges and new research. In: *Public Relations Research: An International Perspective*. vol. 3. pp. 48.
- Heimlich, J.E., Ardoin, N.M., 2008. Understanding behavior to understand behavior change: a literature review. *Environ. Educ. Res.* 14, 215–237.
- 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 Interdiscip. Rev. Clim. Chang.* 5, 441–459.
- Jacobson, S.K., McDuff, M.D., Monroe, M.C., 2015. *Conservation Education and Outreach Techniques*. Oxford University Press.
- Jenks, B., Vaughan, P.W., Butler, P.J., 2010. The evolution of rare pride: using evaluation to drive adaptive management in a biodiversity conservation organization. *Eval. Program Plann.* 33, 186–190.
- Jepson, P., Barua, M., 2015. A theory of flagship species action. *Conserv. Soc.* 13, 95–104.
- Jiang, H., Kim, J.-N., Liu, B., Luo, Y., 2017. The impact of perceptual and situational factors on environmental communication: a study of citizen engagement in China. *Environmental Communication* 1–21.
- Kabii, T., Horwitz, P., 2006. A review of landholder motivations and determinants for participation in conservation covenanting programmes. *Environ. Conserv.* 33, 11–20.
- Kidd, L.R., Bekessy, S.A., Garrard, G.E., 2019. Neither hope nor fear: empirical evidence should drive biodiversity conservation strategies. *Trends Ecol. Evol.* 34, 278–282.
- Kim, J.-N., Grunig, J.E., 2011. Problem solving and communicative action: a situational theory of problem solving. *J. Commun.* 61, 120–149.
- Klöckner, C.A., 2013. A comprehensive model of the psychology of environmental behaviour—a meta-analysis. *Glob. Environ. Chang.* 23, 1028–1038.
- Kotler, P., Armstrong, G., Saunders, J., Wong, V., 1999. *Principles of Marketing*, 2nd European ed. Prentice Hall Europe, Harlow.
- Kusmanoff, A., 2017. Framing the Conservation Conversation: An Investigation into Framing Techniques for Communicating Biodiversity Conservation.
- Leiserowitz, A., Thaker, J., Feinberg, G., Cooper, D., 2013. *Global Warming's Six Indias*. Yale project on climate change communication Yale University, New Haven.
- Lindenberg, S., Steg, L., 2007. Normative, gain and hedonic goal frames guiding environmental behavior. *J. Soc. Issues* 63, 117–137.
- Loss, S.R., Will, T., Marra, P.P., 2013. The impact of free-ranging domestic cats on wildlife of the United States. *Nat. Commun.* 4, 1396.
- Maibach, E., Roser-Renouf, C., Leiserowitz, A., 2009. *Global Warming's Six Americas 2009: An Audience Segmentation Analysis*.
- Mascia, M.B., Brosius, J.P., Dobson, T.A., et al., 2003. Conservation and the social sciences. *Conserv. Biol.* 17, 649–650.
- Maxwell, S.L., Fuller, R.A., Brooks, T.M., Watson, J.E., 2016. Biodiversity: the ravages of guns, nets and bulldozers. *Nature* 536, 143–145.
- McKenzie-Mohr, D., 2011. *Fostering sustainable behavior: an introduction to community-based social marketing*. New Society Publishers, Gabriola Island (184 pages).
- Mengak, L., Dayer, A.A., Stern, M.J., 2019. The role of social norms in conservation outreach. *Hum. Dimens. Wildl.* 1–4.
- Monroe, M.C., 2003. Two avenues for encouraging conservation behaviors. *Hum. Ecol. Rev.* 113–125.
- Morrison, M., Duncan, R., Sherley, C., Parton, K., 2013. A comparison between attitudes to climate change in Australia and the United States. *Aust. J. Environ. Manag.* 20, 87–100.
- Myers, T.A., Nisbet, M.C., Maibach, E.W., Leiserowitz, A.A., 2012. A public health frame arouses hopeful emotions about climate change. *Clim. Chang.* 113, 1105–1112.
- Newton, B.J., 2001. Environmental education and outreach: experiences of a Federal Agency: lessons learned by NRCS conservationists about the effectiveness of various education and outreach techniques can help scientists communicate better with the general public. *AIBS Bull.* 51, 297–299.
- Nisbet, E.K., Zelenski, J.M., Murphy, S.A., 2009. The nature relatedness scale: linking individuals' connection with nature to environmental concern and behavior. *Environ. Behav.* 41, 715–740.
- Noar, S.M., 2006. A 10-year retrospective of research in health mass media campaigns: where do we go from here? *J. Health Commun.* 11, 21–42.
- Noar, S.M., Benac, C.N., Harris, M.S., 2007. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychol. Bull.* 133, 673.
- Partelow, S., Schlüter, A., von Wehrden, H., Jänig, M., Senff, P., 2018. A sustainability agenda for tropical marine science. *Conserv. Lett.* 11, e12351.
- Petty, R.E., Cacioppo, J.T., 1986. *The Elaboration Likelihood Model of Persuasion*. Pp. 1–24. Communication and persuasion. Springer.
- Pietsch, J., McAllister, I., 2010. 'A diabolical challenge': public opinion and climate change policy in Australia. *Environ. Politics* 19, 217–236.
- Reder, L.M., Ritter, F.E., 1992. What determines initial feeling of knowing? Familiarity with question terms, not with the answer. *JEXPLMC* 18, 435.
- Rogers, E.M., Storey, J.D., 1987. *Communication Campaigns*.
- Roloff, M.E., Miller, G.R., Roloff, M.E., 1980. *Persuasion: New directions in theory and research*. Sage, Beverly Hills.
- Schultz, P.W., 2002. Inclusion with nature: The psychology of human-nature relations. In: *Psychology of Sustainable Development*. Springer, pp. 61–78.
- Schultz, P.W., 2011. Conservation means behavior. *Conserv. Biol.* 25, 1080–1083.
- Selinske, M.J., Garrard, G.E., Bekessy, S.A., Gordon, A., Kusmanoff, A.M., Fidler, F., 2018. Revisiting the promise of conservation psychology. *Conserv. Biol.* 36 (6), 1464–1468.
- Simberloff, D., 1998. Flagships, umbrellas, and keystones: is single-species management passé in the landscape era? *Biol. Conserv.* 83, 247–257.
- Slater, M.D., 1996. Theory and method in health audience segmentation. *J. Health Commun.* 1, 267–284.
- Smith, R.J., Veréssimo, D., MacMillan, D.C., 2010. Marketing and conservation: How to lose friends and influence people. In: *Trade-offs in Conservation: Deciding What to Save*, pp. 215–232.
- St John, F.A., Edwards-Jones, G., Jones, J.P., 2011. Conservation and human behaviour: lessons from social psychology. *Wildl. Res.* 37, 658–667.
- Starr, P.C., 1969. Social benefit versus technological risk. *Science* 1232–1238.
- Steg, L., Vlek, C., 2009. Encouraging pro-environmental behaviour: an integrative review and research agenda. *J. Environ. Psychol.* 29, 309–317.
- Steg, L., Bolderdijk, J.W., Keizer, K., Perlaviciute, G., 2014. An integrated framework for encouraging pro-environmental behaviour: the role of values, situational factors and goals. *J. Environ. Psychol.* 38, 104–115.
- Steinhorst, J., Klöckner, C.A., Matthies, E., 2015. Saving electricity—for the money or the environment? Risks of limiting pro-environmental spillover when using monetary framing. *J. Environ. Psychol.* 43, 125–135.
- Stern, P.C., 2005. Understanding individuals' environmentally significant behavior. *Environmental law reporter news and analysis* 35, 10785.
- Stiff J.B., Mongeau P.A. (2016) *Persuasive communication*. Guilford Publications.
- Sturgis, P., Allum, N., 2004. Science in society: re-evaluating the deficit model of public attitudes. *Public Underst. Sci.* 13, 55–74.
- Sweikert, L.A., Gigliotti, L.M., 2018. A values-based private landowner typology to improve grassland conservation initiatives. *Soc. Nat. Resour.* 1–17.
- Tamir, D., Polachek, D., Zivlin, O., Amikam, Y., Weinstein, R., 2001. Smoking prevention campaign for youth in Israel. *Public Health Rev.* 29, 185–194.
- Taplin D.H., Clark H., Collins E., Colby D.C. (2013) *Theory of change*. Technical Papers: A Series of Papers to Support Development of Theories of Change Based on Practice in the Field Available online: <http://www.acknowledge.org/resources/documents/ToC-Tech-Papers.pdf> (accessed on 27 October 2016).

- Teel, T.L., Manfredo, M.J., 2010. Understanding the diversity of public interests in wildlife conservation. *Conserv. Biol.* 24, 128–139.
- Teel, T., Dayer, A., Manfredo, M., Bright, A., 2005. Wildlife values in the west. In: Project Report for the Western Association of Fish and Wildlife Agencies Human Dimensions in Natural Resources Unit. Colorado State University, Fort Collins, CO.
- Thorson, K., 2013. *Strategic Communication*. Oxford University Press.
- Toomey, A.H., Knight, A.T., Barlow, J., 2017. Navigating the space between research and implementation in conservation. *Conserv. Lett.* 10, 619–625.
- Veríssimo, D., 2019. *The Past, Present, and Future of Using Social Marketing to Conserve Biodiversity*. SAGE Publications Sage CA, Los Angeles, CA.
- Veríssimo, D., Fraser, I., Girão, W., Campos, A.A., Smith, R.J., MacMillan, D.C., 2014. Evaluating conservation flagships and flagship fleets. *Conserv. Lett.* 7, 263–270.
- Veríssimo, D., Vaughan, G., Ridout, M., Waterman, C., MacMillan, D., Smith, R.J., 2017. Increased conservation marketing effort has major fundraising benefits for even the least popular species. *Biol. Conserv.* 211, 95–101.
- Veríssimo, D., Bianchessi, A., Arrivillaga, A., Cadiz, F.C., Mancao, R., Green, K., 2018. Does it work for biodiversity? Experiences and challenges in the evaluation of social marketing campaigns. *Soc. Mark. Q.* 24, 18–34.
- White, K., MacDonnell, R., Dahl, D.W., 2011. It's the mind-set that matters: the role of construal level and message framing in influencing consumer efficacy and conservation behaviors. *J. Mark. Res.* 48, 472–485.
- White, K., Habib, R., Hardisty, D.J., 2019. How to SHIFT consumer behaviors to be more sustainable: a literature review and guiding framework. *J. Mark.*(00), 22242919825649.
- Whitmarsh, L., O'Neill, S., 2010. Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *J. Environ. Psychol.* 30, 305–314.
- Wildavsky, A., Dake, K., 1990. Theories of risk perception: Who fears what and why? In: *Daedalus*, pp. 41–60.
- Wright, A.J., Veríssimo, D., Pilfold, K., et al., 2015. Competitive outreach in the 21st century: why we need conservation marketing. *Ocean Coast. Manag.* 115, 41–48.
- Xifra, J., 2015. Climate change deniers and advocacy: a situational theory of public approach. *Am. Behav. Sci.* 60, 276–287.
- Zimicki, S., Hornik, R.C., Verzosa, C.C., et al., 2002. Improving vaccination coverage in urban areas through a health communication campaign: The 1990 Philippines experience. In: *Public Health Communication: Evidence for Behavior Change*, pp. 197–218.