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A Meta-Analysis of Social Marketing Campaigns to Improve Global Conservation Outcomes

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Abstract

The rapidly increasing rate of biodiversity and habitat loss across the globe can be largely attributed to human behaviors. Conservation practitioners have struggled to influence behaviors through traditional awareness-raising efforts and been slow to adopt techniques from the behavioral sciences such as social marketing to change behaviors and improve conservation outcomes. We conducted a meta-analysis of 84 social marketing campaigns that applied the same theory of change for human behavior to disrupt patterns of destructive activities such as illegal hunting and overfishing. Questionnaires of more than 20,000 individuals across 18 countries measured changes in behavioral variables pre- and post-campaigns, including knowledge, attitudes, interpersonal communication, behavior intention, and behavior. For each campaign, we extracted data and validated data for behavioral variables, estimated mean effect sizes for each variable across all campaigns, and used path analysis to measure relationships among variables included in seven different models. On average, all behavioral variables increased significantly ($p < .001$) from 16.1 to 25.0 percentage points following social marketing campaigns. The full model used a combination of all variables and had the highest explained variation in behavior change (71%). Our results highlight the importance of (a) incorporating behavioral theory and social marketing into traditional conservation programs to address threats to biodiversity across the globe; (b) designing interventions that leverage a combination of community knowledge, attitudes, and communication about a behavior; and (c) facilitating more opportunities for interpersonal communication as a main driver of behavior change. We conclude with potential applications for practitioners interested in behavior change campaigns.

Keywords

behavior change, conservation, social marketing, interpersonal communication, meta-analysis

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Introduction: The Role of Behavioral Science and Social Marketing in Conservation Efforts

Current species extinction rates are estimated to be 100–1,000 times pre-human background rates (Millennium Ecosystem Assessment, 2005 Pimm, Russell, Gittleman, & Brooks, 1995), and some species have lost over 50% of their historic range (Ceballos & Ehrlich, 2002). Threats such as overfishing, illegal timber harvesting, ivory poaching, and bushmeat hunting are at the core of species losses across the globe (Ceballos & Ehrlich, 2002; Schultz, 2011). Most experts now agree that these worsening environmental conditions are largely the result of human behaviors (e.g., St John, Edwards-Jones, & Jones, 2010; Schultz, 2011) and that achieving conservation outcomes is fundamentally about changing behavior (Ehrlich & Kennedy, 2005). Although awareness-raising initiatives have been a common tool applied to address human behavior–driven threats, information alone rarely translates into behavior change (Crohn & Birnbaum, 2010; McKenzie-Mohr, 2011).

The field of social marketing draws on human behavioral sciences and techniques from commercial marketing to achieve a specific social goal focused on the public good (Andreasen 1995; Kotler & Zaltman, 1971; McKenzie-Mohr, 2011). Public health practitioners in particular have applied targeted campaigns grounded in theory from the behavioral sciences and social marketing (Evans et al., 2014; Tabanico, Schmitt, & Schultz, 2015). For instance, health behavior change interventions have been effective at motivating people to eat healthy (Sweitzer et al., 2011), lose weight (McConnon et al., 2012), exercise, and avoid risky behavior (Prochaska et al., 2008). Conservation practitioners have made less progress in this direction, but calls for integrating behavior change and social marketing principles into traditional conservation programs are appearing more often in the literature (e.g., St John et al., 2010; McKenzie-Mohr, Lee, Kotler, & Schultz, 2011; Schultz, 2011; Mastrangelo, Gavin, Laterra, Linklater, & Milfont, 2014). In 2014, a *viewpoint* article published in *Conservation Letters* declared that the field of conservation science "has largely failed to embrace the notion that the study of human choice about nature conservation is potentially the most important research topic in the world of today" (Cowling, 2014, p. 147-148).

Research in the behavioral sciences and social marketing offers critical insights for more effectively integrating the role of people into conservation solutions and achieving desired behavioral outcomes (Heimlich & Ardoin, 2008; Lee & Kotler, 2015; McKenzie-Mohr et al., 2011; Reddy et al., 2017). For example, Reddy et al. (2017) present a series of six questions to help program and campaign designers think more critically about conservation and behavior change. These questions help researchers approximate the target audience, goal behavior, behavioral trends, local perceptions, potential interventions, and ways to evaluate change. In addition, numerous behavior change models have been developed to explain paths to behavior and been applied to conservation challenges. For example, human attitudes, social identity, and perceived barriers can all impact behavior. Through this process, researchers continue to demonstrate that providing knowledge and awareness is insufficient to achieve pro-environmental outcomes, even when those outcomes may be beneficial to the individual (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Ardoin, Heimlich, Braus, & Merrick, 2013; De Young, 1993; McKenzie-Mohr, 2011; Steg & Vlek, 2009).

There have also been discussions about the potential of other strategies to generate lasting, sustainable behavior. A recent issue of *Social Marketing Quarterly* included a special section on Policy, Systems, and Environmental Change, where they presented cases of "downstream" efforts (e.g., affecting attitudes, knowledge) that were less effective than "upstream" efforts (e.g., policy, choice architecture) in changing behavior (Biroscak, 2018). In this article, we do not argue against the use of "upstream" approaches to behavior change (which in some cases also draw from behavioral insights, as in the case of choice architecture); instead, we advocate for how social marketing campaigns, when involving and learning from key stakeholders, can effectively address complex contexts and systems for behavior. Moreover, we believe campaigns like the ones we share here have the potential to

complement policy work that increases community resources or removes barriers to change. Finally, the social marketing campaigns included here are of a particular spatial and temporal scale; they were designed to address community-based behavior change in small and/or remote communities in developing or emerging nations. They demonstrate the power of social marketing techniques in cases where policies or incentives may not be feasible and where individual behavior change can make a significant difference in conserving natural resources and biodiversity. This meta-analysis thus demonstrates clearly where social marketing methods succeed in achieving conservation results.

Applying Theories of Behavior Change

Prochaska's (1979) transtheoretical model of behavior change, Rogers' (2010) diffusion of innovations theory, and Ajzen's (1991) theory of planned behavior are among the most well-known approaches that provide us with frameworks for human decision-making and have informed social marketing strategies (Brennan, Binney, Parker, Aleti, & Nguyen, 2014). The transtheoretical model of behavior change suggests that individuals move through a series of cognitive stages, beginning with contemplation and preparation, in the transition to any new or different behavior (Prochaska, 1979; Prochaska, DiClemente, & Norcross, 1999). Rogers's diffusion of innovations theory demonstrates how ideas and products spread through a specific population as well as how people adopt new ideas and change their behaviors. The theory predicts higher rates of behavior change when people are engaged in communication about the behavior and when they observe its performance by others in the same social group (Bandura, 1986; Vaughan & Rogers, 2000). Rogers's theory demonstrates that interpersonal communication is an increasingly influential aspect of behavior change over time.

Ajzen's (1991) theory of planned behavior posits a different model, emphasizing the importance of perceived behavioral control on behavior, derived from self-efficacy theory (Bandura, 1977). This model argues that multiple psychological factors, including attitudes, influence behavioral intentions, which in turn shape our actions (Bamberg & Möser, 2007). The theory of planned behavior model is considered the most influential attitude–behavior model in social psychology (Kollmuss & Agyeman, 2002), where the model's key variables include attitudes toward the issues and solutions, an individual's perceived control to bring about change, and social norms identified as critical prerequisites for pro-environmental behavior (Ajzen, 1991). For example, an individual's intention to recycle depends on not only his or her attitude toward recycling (e.g., positive or negative) but also his or her perceived behavioral control (e.g., whether the individual can afford recycling or there is recycling infrastructure), as well as salient social norms (e.g., other people in the neighborhood are recycling as well). Although there are a few applications of this approach in a conservation context (e.g., Mastrangelo et al., 2014), there has been increased demand to apply these models to behaviors that have a large impact on biodiversity (Gardner & Stern, 1996; St John et al., 2010). Prochaska's (1979), Rogers's (2010), and Ajzen's (1991) models, among others, have been extended into various alternative models in order to increase their explanatory power in different contexts (e.g., Mastrangelo et al., 2014).

These three models, rather than being irreconcilably distinct, offer key insights that can be integrated, applied, and tested to improve the practice of conservation programs and campaigns. Together, they help to define the variables that comprise the theory of change (Figure 1) for the social marketing campaigns in this study and our resulting meta-analysis. More specifically, we propose that some of the knowledge, attitudes, and interpersonal communication factors identified in previous models can be refined into distinct variables that have been shown to have varying influences on behavior change (Hines, Hungerford, & Tomera, 1987). We call these "behavioral variables" because they all have an effect on behavior, although some may be considered behavioral antecedents. Within the variable of knowledge, systems knowledge (i.e., knowledge of the socioecological dynamics contributing to the issue) and solutions knowledge (i.e., knowledge of how to solve the issue) have each been found to influence attitudes and behaviors (Frick, Kaiser, & Wilson, 2004). Similarly, although attitudes

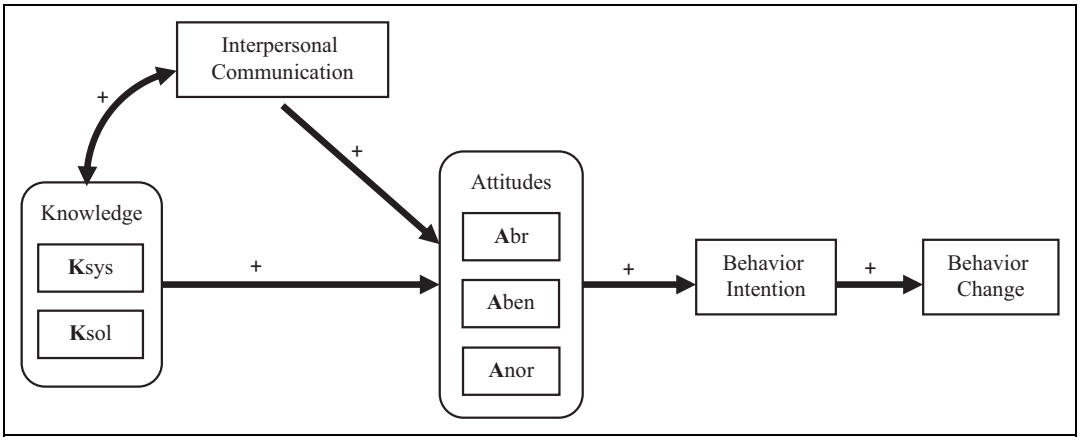

Figure 1. Social marketing campaigns' theory of change. This theory of change hypothesizes that increases in systems and solutions knowledge fostered by interpersonal communication can lead to positive shifts in attitudes and behavior intention that ultimately support changes in behavior. Ksys = systems knowledge; Ksol = solutions knowledge; Abr = barrier removal attitudes; Aben = benefits attitudes; Anor = normative attitudes.

generally reflect one's beliefs about the benefits and consequences of a behavior (Kollmuss & Agyeman, 2002), they can be further disaggregated to include two additional constructs: normative attitudes and barrier attitudes. The former reflects one's beliefs about social norms or what is expected or acceptable among a larger community of peers to which the person belongs. The latter denotes feelings of perceived behavioral control about obstacles to a behavior that are either intrinsic (e.g., the personal skills and/or knowledge required to perform the new behavior) or extrinsic (e.g., the resources and infrastructure available in the community to facilitate behavior adoption and effectiveness). Finally, we acknowledge the importance of behavioral intention as a mediator that is influenced by various types of knowledge and attitudes; this in turn has the strongest direct influence on behavior and resulting behavior change (Bamberg & Möser, 2007). Understanding and applying how different types of knowledge and attitudes in combination with interpersonal communication have an impact on behavior change will be crucial to the development of effective behavior change strategies in the conservation field. With all of this in mind, the campaigns' theory of change and implementation hinges upon contributions of social marketing through its attention to a target audience and individuals' needs and goals (McKenzie-Mohr, 2011).

In this study, we conducted a meta-analysis of targeted social marketing campaigns that combined insights from behavioral science and social marketing to drive behavior change in a variety of socio-ecological contexts. This research presents a rare opportunity to analyze and evaluate a large sample of social marketing campaigns specifically aimed at affecting conservation behaviors. Each social marketing campaign applied a consistent theory of behavior change in order to replace the prevailing consumptive pattern of natural resource use with more sustainable behaviors. We assessed the changes in behavioral variables pre- and post-campaigns across sites and then tested seven distinct models of behavior change using different combinations of behavioral variables to determine the relative explanatory power of each. This is the first study of its kind and scale to comprehensively apply and evaluate the potential of targeted behavior change strategies to tackle complex biodiversity conservation challenges across the globe. Our results offer evidence that integrating behavioral theory and social marketing into traditional interventions can create a powerful approach for improving global conservation outcomes.

Method

We evaluated questionnaire data from 84 targeted social marketing campaigns at sites in 18 countries between 2009 and 2012. These campaigns were systematically implemented by the non-profit organization, Rare, and its non-governmental and local government agency partners at each location (Jenks, Vaughan, & Butler, 2010). Each campaign employed standardized sociological questionnaires pre- and post-campaign tailored to the conservation, social, and behavioral context at the site. Using a meta-analytic approach, we (1) extracted and validated data for behavioral variables, (2) estimated mean effect sizes for each variable across all campaigns, and (3) used path analysis to measure relationships among variables included in seven different models.

About the Social Marketing Campaigns: Pride Campaigns

The social marketing campaigns analyzed in this study, otherwise known as Pride campaigns, seek to promote a specific conservation behavior in a given community through a unified theory of change for reducing threats and achieving conservation results, based on a number of behavioral principles explained in Rare's Principles of Pride (Butler, Green, & Galvin, 2013). Pride campaigns meet the six benchmark criteria set by Andreasen (2002) for identifying social marketing: First, they use behavior change as the baseline for data collection and analysis; second, they use extensive audience research to guide a marketing strategy; third, they segment audiences in order to maximize resources and target primary users; fourth, they create a specific benefits exchange with the new and old behaviors; fifth, they use a standard marketing mix (i.e., the four Ps); and sixth, they are aware of competing motivations and barriers to behavior. Common campaign materials include creating banners, posters, radio and television (TV) programs, songs, and apparel that help to distribute the message of the campaign (Butler et al., 2013; DeWan, Green, Li, & Hayden, 2013; Martinez, Green, & DeWan, 2013).

For example, a social marketing campaign in the Yuhe Nature Reserve in the Gansu province of China aimed to influence household adoption of fuel-efficient cookstoves and conservation of forest habitats for the Sichuan golden snub-nosed monkey (DeWan et al., 2013). Pre- and post-survey data directly measured the change in behavior after both a 1- and 2.5-year period. Local campaign managers used the data from pre-campaign surveys as well as site visits to better understand the knowledge, attitudes, interpersonal communication, and barriers for the target audience as well as to segment communities who would be most receptive to a campaign and to which types of messaging (Lee & Kotler, 2015). They discovered their target audience was adult community residents and that fuel-efficient stoves can save them time in cutting wood and cleaning the kitchen as well as increase health benefits from cleaner indoor air quality. Through decreasing fuelwood consumption, the campaign further showed how adults would decrease pressure on the forest habitat for the golden monkey. Survey data revealed the following barriers: (1) cost of the stoves; (2) knowledge of how to make, use, and maintain them; and (3) development of a sustainable forest management plan. The campaign sought to overcome these obstacles through providing subsided stove prices, training, and advisory support for the forest management plan. Campaign managers identified the local market as the ideal place for disseminating materials; they employed a combination of posters, calendars, and a telefilm to distribute the campaign's message and incorporated culturally and socially relevant elements from the community (DeWan et al., 2013). The use of TV as a promotion tactic emerged as another key insight from the audience research process. Post-campaign surveys showed an increase of 28.0% and 43.1% adoption, after 1 and 2.5 years, respectively.

Data Collection and Coding

We selected campaigns to include for the meta-analysis based on guidelines provided by Rare's U.S.-based monitoring and evaluation team responsible for establishing consistent protocols for

research, monitoring, and evaluation methods across the entire range of campaigns. In order to be included in the meta-analysis, each study needed to meet their minimum criteria, and those that did not, or did not contain sufficient data relevant to the behavioral models we tested, were excluded from the analysis. Next, we compiled a database from questionnaire data obtained pre- and post-campaigns measuring changes in community knowledge, attitudes, interpersonal communication, and behaviors (DeWan et al., 2013; Green, DeWan, Arias, & Hayden, 2013). We included data from all campaigns conducted by Rare between 2009 and 2012 that used the same theory of behavior change. All campaigns collected behavior change data from the primary audience—community members directly involved in the conservation issue (e.g., fishers)—via direct questioning methodologies and did not directly measure observed behaviors. Although some studies have found discrepancies between self-reported and observed environmental behaviors, especially when the behavior is socially desirable (Corral-Verdugo, 1997; Kormos & Gifford, 2014), most researchers continue to rely on questionnaire data in the absence of reliable, cost-effective techniques to measure actual behavior frequencies (Steg & Vlek, 2009).

On-site researchers converted primary responses (originally on "yes"/"no" or "agree"/"disagree" scales) into binary data where responses indicating the targeted outcomes of campaigns (e.g., respondent was aware of conservation solutions, agreed with efficacy of proposed behavior solution, or reported behavior change) = 1 and neutral or negative responses = 0. Thus, all data collected for the meta-analysis included the number of people in each response category and the sample size for pre- and post-campaign questionnaires. We reviewed all original questionnaire questions and assigned corresponding data to one of the eight variables associated with our theory of change (Table 1); all variables were mutually exclusive and grounded in behavioral theory. Most questions distinctly measured one variable in the theory of change, and there were multiple items to measure each variable, all of which was determined by coding agreement among the authors to increase reliability. We further validated agreement between the questionnaire item and the construct represented by a behavioral variable in our model. When the authors deemed a question ambiguous, it was not included in the analysis; therefore, we did not extract data for every variable from all campaigns (Table 2). Additionally, a significant part of Pride campaigns is for campaign managers to design campaigns according to the specific needs of the project and community as discovered during the research phase. This resulted in the theory of change being tailored to each field site, which could alter questions included in the questionnaire. We confirmed a causal link between the conservation issue and the targeted behavior in all questions measuring each variable within a campaign (e.g., systems and solutions knowledge, behavior change) that were included in the analysis. In addition to the eight variables included in this study, campaigns incorporated techniques to remove tangible external barriers to behavior change (to improve the benefit exchange), but we did not formally analyze campaigns' effects on this variable. Instead, barrier removal activities were considered to be a constant process across all campaigns, and we accounted for any influence of this variable by incorporating campaign heterogeneity through random effect for campaign in our modeling methods.

Effect Size Analysis

We calculated mean effect sizes for campaigns as the percentage point (pp) difference (post − pre campaign) in community members exhibiting pro-environmental states of each variable (e.g., knowing about a behavior solution, believing in its benefits, adopting behavior). We define our study as quasi-experimental as described by Firestone, Rowe, Modi, and Sievers (2017), where a pre–post test can serve in place of a control to measure effects. We used random-effects meta-regression models with the DerSimonian–Laird method within the "metafor" package in R (R Core Team, 2013; Viechtbauer, 2010), which do not assume one true effect and instead estimate the mean effect size from a distribution of effects that can vary across studies (Borenstein, Hedges, Higgins, & Rothstein, 2011). We

Table 1. Definitions and Representative Examples of Behavioral Model Variables.

Variable	Definition	Representative Questionnaire Item
Knowledge		
Systems	Cognition of environmental objects (e.g., species, habitats) or threats (e.g., overfishing)	Deforestation in the highlands decreases water availability in the lower basin (true/false)
Solutions	Cognition of strategies designed to reduce environmental threats	Upstream landholders can receive incentives for not cutting down the forest on their properties (true/false)
Attitudes		
Barrier removal	Beliefs about the presence and efficacy of skills, resources, or infrastructures needed to implement the conservation strategy	The community has adequate infrastructure, equipment, and facilities to enforce the rules of the no-take zone (agree/disagree)
Benefits	Feelings regarding the benefits of the conservation strategy	The implementation of the co-management strategy will improve fishing production in the Hanjiang river (agree/disagree)
Normative	Beliefs about the moral obligations of a person and others to perform the conservation behavior	The Arbor-Granada marine sanctuary regulations need to be followed by all people (agree/disagree)
Interpersonal communication	Statements about communicating and validating information among community members regarding current human impacts and the conservation behavior	Have you talked with other villagers about joining the community co-management committee during the past 6 months? (yes/no)
Intention	Statements about the intention to adopt the conservation behavior	How willing are you to implement land conservation mechanisms on your farm? (willing/unwilling)
Behavior	Conservation behavior is adopted by person	In the last 6 months, have you released gravid females and under-sized lobsters during live lobster fishing? (yes/no)

Table 2. Overall Summary Effects of Campaigns on Variables in a Full Behavior Change Model as Estimated by Random-Effects Meta-Regression.

				% Point Change (Post−Pre)		
	Sample Size Information					
Model Variable	K[a]	N[b] Pre	N[b] Post	Mean Estimate	95% CI	Range[c]
Knowledge						
Systems	53	15,617	14,781	18.1	[12.8, 23.5]	−23.5, 76.0
Solutions	73	18,228	17,415	19.9	[8.8, 30.9]	−23.2, 98.7
Attitudes						
Benefits	51	14,401	13,543	19.3	[14.1, 24.4]	−13.0, 78.0
Normative	48	13,550	12,552	17.9	[13.1, 22.8]	−16.9, 60.6
Barrier removal	30	8,186	7,977	16.1	[8.4, 23.9]	−11.5, 73.8
Interpersonal communication	79	19,109	18,165	25	[18.2, 31.8]	−20.9, 90.5
Intention	48	14,318	13,420	16.2	[7.8, 24.58]	−23.0, 87.1
Behavior	76	19,485	18,383	18.1	[12.1, 24.0]	−33.3, 93.9

Note. CI = confidence interval.
[a]Number of campaigns. [b]Number of community members sampled. [c]Minimum and maximum percentage point changes in a campaign.

Table 3. Goodness-of-Fit Results for the Full Behavior Change Path Model (Top Two Models) and Alternative Models.

Model Name	Description	χ^2	*df*	*p* Value[a]	CFI[b]	RMSEA[c]	AIC[d]
Full model (trimmed)	Nonsignificant paths removed	16.2	9	.440	.95	.08	−7.999
Full model	Includes all behavior antecedents in study	10.8	12	.544	.94	.10	−1.707
IC4	IC[e]/knowledge affect attitudes	8.2	6	.220	.94	.10	−1.040
IC3	IC affects knowledge/attitudes	9.8	7	.201	.92	.11	−0.645
IC1	IC removed	11.0	5	.051	.83	.15	3.813
IC2	Knowledge/attitudes affect IC	11.0	6	.088	.87	.15	4.435
Knowledge-only model	Knowledge affects behavior change	4.2	1	.040	.72	.29	5.904

Note. See Figure 2 for path diagram and results for the top model. IC = interpersonal communication.
[a]Nonsignificant values indicate adequate fit between models and observed data. [b]Bentler's comparative fit index; values of 0.9 or above indicate adequate fit. [c]Root mean square error of approximation; values of 0.1 or below indicate adequate fit. [d]Akaike information criteria; lower values indicate better model fit while accounting for parsimony. [e]Interpersonal communication.

suspected substantial heterogeneity to exist between campaigns in our data set due to variation in specific implementation methods, variation in the new behavior's degree of difficulty, and community variation in geography, demography, and culture that we have not or could not capture completely by including additional factors in our models. This procedure pooled effect sizes of each variable using inverse variance weighting that incorporates within- and between-campaign variance, which gives more weight to effects derived from campaigns with larger sample sizes (Borenstein et al., 2011). Since we had access to all campaign data regardless of their use in publications or other reports, we did not perform any tests for publication bias frequently used by other meta-analyses (Bamberg & Möser, 2007).

Path Analysis

To test relationships among behavioral variables measured in the theory of change for campaigns, we specified and analyzed several path models (Table 3) including a full model containing all eight variables and several, simpler alternatives in EQS 6.2 (Bentler, 2000). Meta-analyses employing path models (i.e., meta-analytic structural equation modeling) typically collect correlations between variables from primary studies, pool correlations into a combined matrix, and test path models on this matrix (e.g., Bamberg & Möser, 2007). We had to adapt these methods due to limitations of the primary data currently available. Data collected from Rare contained metrics suitable for meta-regression analyses, including counts of people responding affirmatively to questionnaire items and total sample sizes; however, correlations between variables were never calculated and reported for any individual campaign. Retroactively obtaining correlations from primary data files was not possible due to time and logistical constraints (e.g., older campaign data are not centrally stored, questionnaires are in several languages). Therefore, we used the observed effect sizes as inputs to calculate correlations between all variable pairs using pairwise deletion. This approach allowed us to generate a pooled correlation matrix to test hypothesized path models using the campaign as the unit of analysis ($N = 84$; Table 4). For all path models, we used robust maximum likelihood methods to estimate path coefficients, similar to regression weights, which correct for small sample sizes, missing data, and moderate multivariate kurtosis that were present in our data set, and we report resulting robust statistics (Byrne, 2001). We evaluated goodness of fit for all path models with several standard metrics (Bentler, 2000) using the following criteria to indicate acceptable model fit: non-significant Yuan–Bentler residual χ^2 (Bentler & Yuan, 1999), Bentler's comparative fit index ≥ 0.9 (Hu & Bentler, 1999), and root mean square error of approximation < 0.1 (Cheung & Chan, 2005). We compared the fit of models relative to

Table 4. Number of Campaigns (Upper Triangular Matrix) That Measured Each Pair of Variables and 95% Confidence Intervals (Lower Triangular Matrix) of Pooled Correlations.

Variable	1	2	3	4	5	6	7	8
1. Knowledge–systems	53	44	46	19	34	50	36	48
2. Knowledge–solutions	**.17**	73	43	27	41	67	40	64
	.65	—						
3. Attitudes–barrier removal	**.07**	−.04	30	19	15	27	12	26
	.78	.64	—					
4. Attitudes–benefits	**.36**	**.12**	**.02**	51	31	48	32	44
	.78	**.63**	**.76**	—				
5. Attitudes–norms	−.02	−.12	−.10	**.38**	48	45	25	43
	.59	.47	.77	**.81**	—			
6. Interpersonal communication	**.05**	**.47**	−.03	**.34**	**.13**	79	44	71
	.55	**.76**	.65	**.74**	**.63**	—		
7. Intention	**.44**	**.19**	−.21	**.56**	**.40**	**.31**	48	42
	.82	**.68**	.80	**.88**	**.85**	**.73**	—	
8. Behavior change	**.40**	**.01**	**.02**	**.47**	**.33**	**.18**	**.62**	76
	.76	**.47**	**.68**	**.80**	**.74**	**.57**	**.87**	—

Note. Intervals in bold indicate significant correlations ($p < .05$).

each other while accounting for parsimony using Akaike information criteria (AIC), where lower values indicate better fit relative to other candidate models (Akaike, 1974). We followed these methods to test relationships among variables leading to behavior change in three sets of path models and describe hypotheses behind each model set using the model names in Table 3.

First, we tested a knowledge-only approach to serve as a baseline for comparison by specifying a path model where only systems and solutions knowledge were included as direct predictors of behavior change. Numerous studies have shown awareness-raising initiatives—sometimes referred to as environmental education programs—do not result in behavior changes (e.g., Crohn & Birnbaum, 2010; McKenzie-Mohr, 2011). Still, conservation practitioners and researchers commonly call for increasing environmental education to mitigate human–wildlife conflicts. Therefore, we tested a simple hypothesis to compare against the more complex models that follow.

Hypothesis 1 (knowledge-only): Increased knowledge of conservation behaviors will lead to pro-environmental behavior change.

Second, we specified a set of four alternative models to determine the best-supported relationships between interpersonal communication with knowledge and attitudes (IC1-4) that leads to behavior change. For each model in this set, we followed Ajzen's (1991) theory of planned behavior and similar models (Bamberg & Möser, 2007; Hines et al., 1987; McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995) to include all three attitude variables—barrier removal, benefits, and normative attitudes—to mediate the influence of knowledge types on behavior change. While we did not include interpersonal communication in IC1, we included this variable in IC2-4, given that communication has been proposed as an important antecedent to behavior change when people are exposed to information and influenced by communication with peers and respected leaders (Vaughan & Rogers, 2000). Specific relationships between interpersonal communication and other behavioral antecedents have not been tested, so we developed and tested different hypotheses.

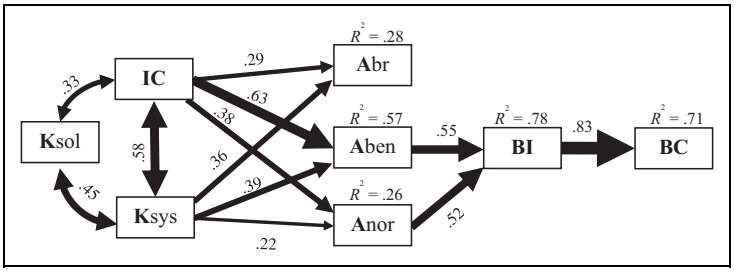

Figure 2. Path analysis of full model of behavior change. Effects between variables in the best-performing full model of behavior change with nonsignificant paths ($p > .05$) removed. Numbers adjacent to single-headed arrows are standardized path coefficients, expressing the direction and strength of relationships between variables, similar to regression weights. Numbers next to double-headed arrows are correlations, expressing reciprocal relationships specified in the model. Arrow width is proportional to the relationship's strength. The proportion of explained variance (R^2) is given for all variables with antecedents. Goodness-of-fit statistics, where nonsignificant results indicate the model is consistent with the observed data, $\chi^2_9 = 16.2$, $p = .44$; comparative fit index = 0.95; root mean square error of approximation = 0.08. Model fit and selection results are presented for the full set of tested models in Table 3. Ksys = systems knowledge; Ksol = solutions knowledge; Abr = barrier removal attitudes; Aben = benefits attitudes; Anor = normative attitudes; IC = interpersonal communication; BI = behavior intention; BC = behavior change.

Hypothesis 2.1 (IC1): Increased knowledge leads to supportive attitudes, which lead to pro-environmental behavior change. This hypothesis posits that knowledge and attitudes are sufficient predictors of behavior change without the influence of interpersonal communication.

Hypothesis 2.2 (IC2): Increased knowledge leads to supportive attitudes, which lead to greater interpersonal communication, which lead to pro-environmental behavior change. This hypothesis posits that communication about a new behavior between two people occurs after one has more knowledge about a behavior and is supportive of that behavior.

Hypothesis 2.3 (IC3): Increased interpersonal communication leads to increased knowledge, which lead to supportive attitudes, which lead to pro-environmental behavior change. This hypothesis posits that greater communication facilitates increases in knowledge of a behavior.

Hypothesis 2.4 (IC4): Increased interpersonal communication and knowledge will covary, representing a bidirectional relationship, where increased knowledge and communication lead to supportive attitudes, which lead to behavior change. This hypothesis posits that communication required some prior knowledge but could also increase each person's knowledge of the subject; alternatively, a particular attitude is not a prerequisite for communication, but discussing behaviors with peers will likely influence attitudes.

Third, we created a full model that included all eight variables measured in our study using the best-performing relationships between knowledge, attitudes, and interpersonal communication found in IC1-4. The full model included behavior intention as a mediator between behavior change and all other variables, given that previous studies have estimated a strong, direct influence of intention on behavior change (e.g., Bamberg & Möser, 2007). We tested a final model in this set by removing non-significant paths found in the full model to improve goodness of fit (see Figure 2).

Hypothesis 3 (full model): Increased knowledge, supportive attitudes, and greater interpersonal communication lead to pro-environmental behavior intention, which leads to pro-environmental behavior change.

See Supplemental Materials for additional methodological details.

Results

Effect Size Analysis

From each of the 84 campaigns (K), we extracted data for three to all eight behavioral variables (median = 5) defined in the theory of change for campaigns. Mean sample size for campaign questionnaires measuring variables was 261 respondents from the primary audience (range = 31–1,192). Between-campaign heterogeneity in effect sizes was statistically significant for all variables ($Q_{29–78}$ ranged from 1,102 to 19,496, all $p < .001$), which justified the use of random-effects models. Across campaigns, mean effect sizes were significant and positive for all behavior change variables ($p < .001$) ranging from 16.1 to 25.0 pp, including an 18.1 pp increase in behavior change (Table 2).

Path Analysis

The number of campaigns (of 84) that measured each variable pair ranged from 12 (barrier removal attitude and behavior intention) to 71 (interpersonal communication and behavior change; Table 4). The 95% confidence intervals around estimated pooled correlation coefficients were positive and did not include 0 for most variable pairs (indicating significance at the $p < .05$ level). Variables that did not correlate significantly were systems knowledge with normative attitudes, solutions knowledge with normative attitudes, and barrier removal attitudes with solutions knowledge, normative attitudes, interpersonal communication, and behavior intention.

The full behavior change model (Figure 2) performed best, supporting Hypothesis 3, given goodness-of-fit criteria and a ΔAIC value > 2 of the next best model (Table 3), and explained 71% of the observed variance in behavior change. We specified the final model by removing nonsignificant path coefficients for the influence of barrier removal attitudes on behavior intention and the influence of solutions knowledge on all three attitude variables. All remaining path coefficients were significant ($p < .05$) and positive in sign for the full model, indicating direct relationships between the effects of campaigns on predictor and response variables in behavior change models. Behavior intention moderated the influence of all other variables on behavior change and had the largest effect of any predictor variable in the model. The influences of benefits and normative attitudes on behavior intention were relatively equal in magnitude, and interpersonal communication and systems knowledge, but not solutions knowledge, influenced each of the three attitude types. Our results did not support Hypothesis 1: The knowledge-only model performed poorly in all criteria measuring goodness of fit and significantly departed from the observed data. Among the interpersonal communication model set (IC1-4), our results supported Hypothesis 2.4 over other hypotheses: IC4 was the best-performing model that met all goodness-of-fit criteria, where interpersonal communication and knowledge covaried while directly influencing attitude variables, and these relationships were present in the full model (see Supplemental Materials for additional details).

Discussion

Our study employed a uniquely large sample of systematic social marketing campaigns to evaluate relationships among variables in a theory of change for influencing human behavior as applied to biodiversity conservation strategies. The campaigns' theory of change is supported by social–psychological models and social marketing strategies that help to explain the drivers of behavior change in some of the world's most threatened ecosystems. Behavioral variables in the theory of change and resulting models were inspired by Ajzen's (1991) theory of planned behavior and Rogers's (2010) diffusion of innovations theory in highlighting the roles of attitudes, knowledge, perceived behavioral

control (including barrier removal), social norms, and interpersonal communication in effecting behavior change. There are three lessons from our results that can be applied to existing and future programs to better address the behavioral precursors that underlie conservation problems.

First, our results demonstrated large overall changes in behavior across campaigns, providing new evidence that social marketing campaigns that focus on each behavioral variable in our full model can be effective for addressing challenging and widespread conservation problems. These changes exceed those found in other studies of behavior change interventions for public health and safety concerns including smoking, cancer screening, and seat belt usage (Snyder et al., 2004). These changes also rank among the highest observed for environmental or conservation campaigns toward behavior change over a short period of time (McKenzie-Mohr et al., 2011; Steinmetz, Srirattanaporn, Mor-Tip, & Seuaturien, 2014). Moreover, campaigns conducted in our study targeted behaviors that could be considered more difficult and personally costly (e.g., adhering to stricter fishing regulations, participating in community reciprocal watershed agreements) relative to previous environmental/conservation interventions (e.g., recycling, reducing littering or electricity usage). However, our findings do align with previous work in emphasizing the importance of community outreach, engagement, and partnership in achieving changes in behavior for conservation outcomes.

Second, when compared to a standard knowledge-only model or others employing just a couple variables, our findings demonstrate the importance of multiple points of intervention in achieving behavior change. Path analysis offers a useful tool for testing the relationships among traditional behavior change variables as well as comparing the ability of the full model to predict conservation behavior change relative to simpler, alternative models. Our full model was the best predictor of behavior changes measured in campaigns with an explained observed variation of 71%. Meanwhile, the knowledge-only model, which only included two knowledge variables, poorly fit the data. This outcome supports findings of previous studies that a combination of intervention strategies that address different behavioral variables is more effective than one alone (Abrahamse et al., 2005; Ardoin et al., 2013; De Young, 1993; Steg & Vlek, 2009). Moreover, these results highlight the importance of strengthening basic awareness and education programs to include more comprehensive efforts to target changes in a community's values, norms, communication, and willingness to try a new behavior (Blumstein & Saylan, 2007; Heimlich & Ardoin, 2008). The contribution of social marketing to attitude–behavior models is the targeted focus on a specific audience, time frame, and behavior that takes into account local needs, values, challenges, and goals (McKenzie-Mohr, 2011). Our full model incorporates aspects from both approaches, recognizing what each contributes as well as what each cannot do on its own. Social marketing is an application of behavioral theory, where social marketing is an approach and accumulation of best practices, behavior models ground why these work through research in the behavioral sciences.

Third, in the full model, changes in knowledge and interpersonal communication were mutually reinforcing and provided a critical pre-condition to changes in attitudes. These hypothesized relationships (Hypothesis 2.4 [also included in IC4]) were based on a plausibility that communication about a new behavior between two people required some prior knowledge but could also increase each person's knowledge of the subject; alternatively, a particular attitude is not a prerequisite for communication, but discussing behaviors with peers will likely influence attitudes. Attitudes may not always be a pre-cursor to behavior but rather doing or discussing a behavior may lead to changed attitudes, which influences future behavior (Festinger, 1964; Olson & Stone, 2005). This configuration highlights the important role of community social interaction to share, refine, and/or reinforce knowledge while simultaneously nurturing attitudes targeted by conservation campaigns.

Concomitant to these results, mean campaign effect sizes were highest for interpersonal communication, indicating that campaigns were especially effective at promoting peer-to-peer discussions about local conservation issues and behavioral solutions. This is likely at least in part due to low baseline conditions where conversations about the problem or the solution were less common and activities were specifically tailored to increase these types of discussions. Overall, the variable of

interpersonal communication was vital for explaining behavior changes observed in this study and supports the strength of social marketing techniques in conservation campaigns.

Applications

In addition to those implicated above, there are many applications of these findings to other small-scale and community-based campaigns on conservation challenges around the world. The meta-analysis of campaigns provided evidence that certain combinations of behavioral variables as shown in the theory of change can work across locations, contexts, and topics in bringing about desired behavior change. The design of the social marketing campaigns studied here also advocate for developing messaging strategies with the support of target community members to enable long-lasting behavior change.

While not addressed in this study, we recognize the potential for institutional and policy-level change to be supporting, and even driving, factors for behavior change programs. It is worth researching how "upstream" stakeholders influencing local actions and decisions could complement community-based work and vice versa. Pride campaigns have shown to be effective in areas of limited resources and connections, making them highly accessible to organizations and initiatives who may not have the benefits of government or private partnerships. If these partnerships were available, there is great potential for additional scaling of these campaigns across communities around the globe. Additionally, our meta-analysis demonstrates consistent trends of human behavior that can be applied at all scales of human organization and decision-making, such as the role of attitudes, social networks, and supportive contexts and systems for change. Therefore, Pride campaigns and other successful behavior change and conservation programs can serve as a model for what works to motivate humans to make more sustainable choices regarding preserving their natural resources. Finally, we believe these findings can be applied outside of natural resource conservation. The significant relationships among behavioral variables could be useful for practitioners working on a number of challenges related to sustainable behavior such as waste reduction, plant-rich diets, organic agriculture, green transportation, clean energy, and more. We encourage such applications of this work to add to the research base on the effectiveness of behavior change strategies in the broader environmental field.

Limitations and Future Research

There are several limitations of this work. First, the duration of behavior change campaigns reflected in this study lasted fewer than 3 years. As De Young's (1993) evaluation metrics of interventions suggest, success will ultimately need to be reflected in the persistence of these changes over time, without repeated intervention. Although those data are not currently available, future efforts should evaluate the persistence of documented changes over time. We also acknowledge that these data were collected 6 years ago and that we cannot claim to know the status of these behavior change campaigns today. Regardless, the findings remain highly relevant and demonstrate important relationships among variables as applied to conservation behaviors. We would encourage scholars to explore a sample of the communities and campaigns in our meta-analysis today and report on the degree to which target behaviors are present or to experiment with the theory of change to test its relevance in other contexts.

Additionally, we used a proxy variable for perceived behavioral control, which describes an individual's perceived ability to perform a behavior, whether due to personal skills, the local context, or available infrastructure. While we accounted for this variable through identifying and measuring barrier attitudes, we feel it is important to systematically plan for incorporating this variable prior to campaigns. Therefore, we would suggest conducting studies that can more concretely measure the variable of perceived behavioral control and its changes over time.

Another limitation is the reliance on a direct questioning method for retrieving data on model variables, which is known to suffer from multiple forms of bias creation (Gavin, Solomon, & Blank,

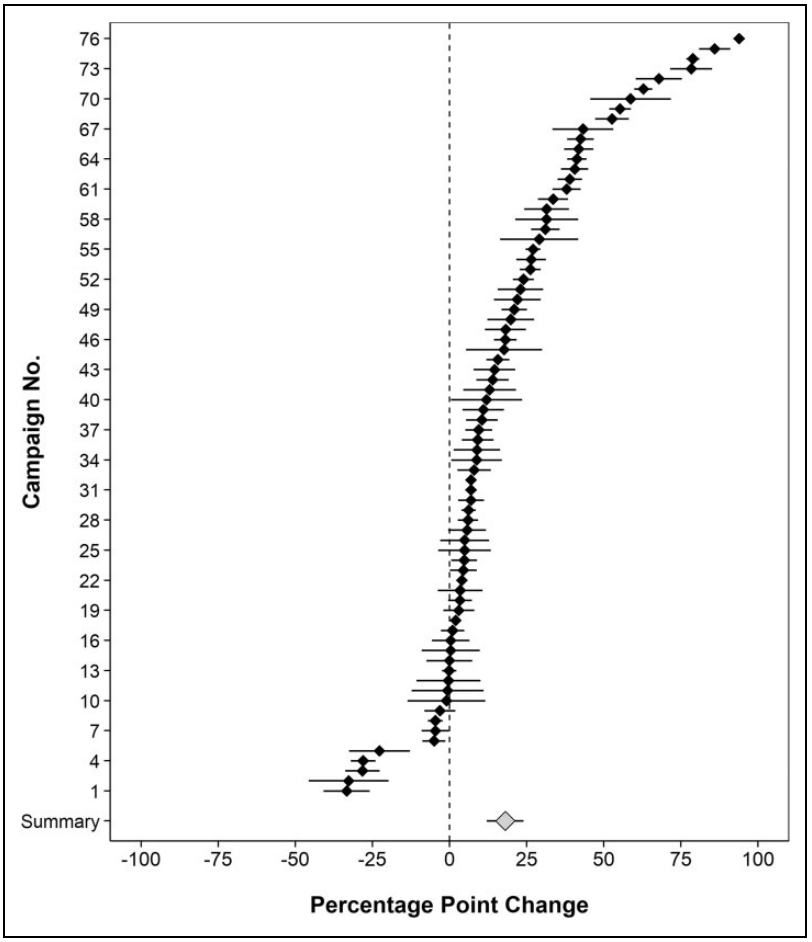

Figure 3. Mean effect sizes of behavior change (percentage point change [post − pre campaign]) and 95% confidence intervals for each campaign where this variable was measured ($K = 76$), as estimated by random-effects meta-regression. The gray diamond indicates the grand mean effect size across all campaigns.

2010) including recall bias (Sudman & Schwarz, 1989) and social desirability bias (Grimm, 2010), which can inflate findings. In the latter case, efforts to minimize bias included careful selection and training of interviewers and thoughtful survey design (Catania et al., 1996). Direct questioning remains common in the literature on program evaluation (Steg & Vlek, 2009) in large part due to the convenience of face-to-face interviews and many of the challenges associated with measuring objective psychometric indicators of knowledge, attitudes, and other related variables, particularly in rural environments with limited resources. That being said, improvements to direct questioning such as randomized response technique show a great deal of promise for reducing bias (Gavin et al., 2010; Solomon, Jacobson, Wald, & Gavin, 2007) and deserve further testing in the context of this work.

We further acknowledge the substantial heterogeneity among campaigns (e.g., community demographics, difficulty of the target behavior; ecological context) and account for this using a random-effects model, which generally increases the variation around estimated effect sizes. Similarly, we recognize there is a limitation in the quasi-experimental design of the campaigns, which lacked a control for calculating cause and effect relationships. Despite the heterogeneity among campaigns, we still estimated significant mean increases in each of the behavioral variables (see Figure 3). However,

we would encourage future work that explores the observed differences in behavior variables, as those are worth understanding in greater detail. For example, estimating the effect of community size on rates of interpersonal communication or the type of targeted behavior on behavior change would more clearly identify contexts where applying social marketing campaigns are especially effective.

Conclusion

The strategic theoretical framework and social marketing methodology used in these campaigns go beyond previous efforts to promote behavior adoption, demonstrating some of the highest observed changes for environmental or conservation campaigns (McKenzie-Mohr et al., 2011). These approaches may be more effective than others because of the intense focus on driving interpersonal communication through public events and community engagement or because they are being applied to smaller, close-knit communities where social norms play a stronger role in defining individual behavior. This study applies insights previous behavior change models and social marketing approaches to clearly demonstrate that targeted campaigns that capitalize on changing attitudes and conversations in key biodiversity areas offer a unique solution to some of the world's most challenging conservation problems. The results of the meta-analysis described here offer evidence of the potential power of rapidly integrating behavioral science into global conservation campaigns.

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Supplemental Material

Supplemental material for this article is available online.

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