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Exploring the utility of the stages of change model to promote natural shorelines

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Abstract

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Increased residential development around lakeshores in the Upper Midwest is associated with reduced wildlife habitat, lower biodiversity, and degraded water quality. Subsequently, it is important to identify strategies that encourage property owners to adopt more natural shorelines. One potential framework for understanding property owners' attitudes and intent toward adopting natural shorelines is the Stages of Change Model (SCM). The model suggests people will be differentially ready to adopt a new behavior based on their respective knowledge, beliefs, and motivations and will move through a progression of stages before adopting a new practice. The specific stages include precontemplation, contemplation, preparation, action, maintenance, and relapse. The purpose of this study was to examine whether stages specified by the SCM may be useful in identifying lakeshore property owners' attitudes and intent toward adopting more natural shorelines. Surveys were mailed to 212 property owners on 2 lakes in northwest Wisconsin; 165 were returned for a 78% response rate. Sixteen measures representing the 6 stages of change were created building on scales previously used in health-related behavior change research. Exploratory factor analysis indicated the scales were correlated strongly with, and reliable measures of, 5 underlying factors representing the different stages of change. Results provide preliminary support that the SCM may represent a useful framework for understanding property owners' propensities toward adopting more natural shorelines. The authors suggest additional research will improve the external reliability of the SCM as adopted in an environmental context.

Key words: lakes, natural shorelines, shoreline restoration, stages of change, transtheoretical model, wildlife habitat

Residential development around lakeshores in the Upper Midwest has increased significantly in recent decades (Baker et al. 2008), with a number of ecological concerns coinciding with this trend (Henning and Remsburg 2009). Pristine riparian zones around lakes are biodiversity hotspots, with a wider range of native plant species found in undeveloped as compared to developed lakeshore property parcels (Elias and Meyer 2003). More highly developed lakeshores have also been associated with greater prevalence of algae in adjacent lakes, which may be due in part to runoff from lawn fertilizer (Rosenberger et al. 2008).

In addition to contributing to reduced levels of biodiversity and algae propagation, higher levels of lakeshore development can also have an impact on wildlife that depends on shoreline vegetation for habitat, and residential impacts near the shore may disrupt lake food dynamics by altering the presence of some species (Lindsay et al. 2002, Rosenberger et al. 2008). For example, research has found a relationship between the presence of forest understory by the shoreline and abundance of both frogs (Woodford and Meyer 2003) and birds (Henning and Remsburg 2009). Another study found a reduced level of vegetative cover in littoral areas adjacent to developed shores was associated with lower mean sizes for northern pike (*Esox lucius*) and other fish species (Radomski and Goeman 2001). Other research has found the removal of coarse woody debris such as fallen trees can

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reduce the prevalence of other fish species such as yellow perch (*Perca flavescens*) (Helmus and Sass 2008). When fish are smaller and less plentiful, anglers may experience a lower quality fishing experience as well.

It is important to identify communication strategies that may encourage property owners to adopt and maintain more natural shorelines. One such model for understanding lakeshore property owners' attitudes and intent toward adopting natural shorelines may be the Stages of Change Model (SCM; also known as the Transtheoretical Model). The SCM posits that people will differentially adopt a new behavior based on their respective knowledge, beliefs, and motivations relative to the specific behavior (Prochaska 1997). The model also assumes that individuals must move through a natural progression of stages before adopting a new practice.

The specific stages of progression include precontemplation, contemplation, preparation, action, maintenance, and relapse (Prochaska and Norcross 2001). The model, rooted in explaining health behavior change, offers a potentially useful framework for understanding that people are not monolithically motivated toward adopting or maintaining any type of behavior, whether it relates to health, the environment, or any other domain (Shaw 2010). Using this model, behavior change is conceptualized as an ongoing process in which people progress through a series of stages. For example, people's dispositions can range from being uninformed or even antagonistic toward recommended practices on their lakeshore property to actually adopting a new behavior and maintaining it. They can even regress to earlier stages after having successfully adopted a new behavior (Kreuter et al. 2000). A number of psychosocial factors such as awareness, knowledge, attitudes, and social norms can all influence who is in what stage and what outreach strategies may influence people to proceed along this trajectory. Other more stable characteristics such as demographic variables (e.g., age, education, income) and intrapersonal resources (e.g., skills, self efficacy) can also influence how people progress along this continuum of change (Shaw 2010).

The SCM has received broad attention in the health communication literature related to influencing behavior change. A few examples include smoking cessation (Erol and Erdogan 2008), weight loss (Logue et al. 2004), dental hygiene (Tillis et al. 2003), increased vegetable consumption (Di Noia et al. 2008), and condom use (Wallace et al. 2007). However, the SCM has received little empirical examination by communication researchers and natural resource outreach professionals focused on changing behaviors to improve the environment (Shaw 2010). This is the first empirical study we are aware of that examines whether SCM may be useful in identifying attitudinal and behavioral factors associated with behavior change among lakeshore property owners.

The 6 stages of change make linkages to what previous health behavior research suggests may be optimal strategies to encourage lakeshore property owners within each stage of change to maintain natural shorelines to protect water quality and wildlife habitat. All references to the SCM are cited from Prochaska and Velicier (1997) unless otherwise noted.

Precontemplation

Precontemplation refers to the earliest stage in which people do not intend to take action in the foreseeable future related to a specific behavior. In the context of environmentally sustainable behaviors, this may be because members of this audience segment are unaware, uninformed, or underinformed about the consequences of their existing behaviors and therefore do not see a need to consider or pursue behavior change. Although information alone may not be able to produce behavior changes (McKenzie-Mohr and Smith 1999), providing relevant information may lead to increased awareness, which can precipitate behavior change, particularly when lack of knowledge may be a barrier to action (Stern 2002). For instance, contexts exist in which people simply have little or no idea about the negative consequences of their behavior. Some lakeshore property owners may not be aware that mowing down to the beach, fertilizing lawns, or removing natural vegetation from their land may have negative impacts on wildlife habitat and water quality, particularly if overt environmental problems are not visible or easily perceived. For example, if property owners see wildlife on a regular basis, perceive the fishing is good and the water is relatively clear, it may be difficult to make a connection that changing their behaviors may prevent the resources they value from being degraded over time. In such a case, communication campaigns might focus on increasing awareness about the scientific links between specific aspects of the environmental problem that the audience cares most about to make it more personally relevant. Other lakeshore property owners in the precontemplation stage may be antagonistic toward lake managers trying to influence what they do on their land. In this case, outreach strategies may focus on the reasons behind their antagonistic attitudes and try to explain the benefits to these precontemplators in a way that addresses their own self-interest (e.g., property values, quality of fishing).

Contemplation

Contemplation refers to the stage in which people are considering making a change in their behavior. The SCM asserts that contemplators are aware of the pros and cons of changing, but the cons likely continue to outweigh the pros. Early contemplators are just beginning to think about adopting a

new behavior, so it is particularly important to emphasize benefits to people in this group. This is a strategically important consideration because if target audience members do not think they will see significant personal benefits, they are less likely to proceed to the next stage. The balance between the costs and benefits of adopting a new behavior can produce ambivalence in contemplators that may keep them in this stage for long periods of time (Andreasen 2006).

An example of an audience segment in the contemplation phase might be lakeshore property owners who know about and agree with the basic premise that natural shorelines can help protect water quality and wildlife habitat. Although contemplators may believe that maintaining natural shorelines can provide these benefits, they may also believe that natural shorelines look untidy or that they will diminish recreational opportunities such as relaxing at the beach with their family or engaging in various recreational activities by the lakeshore. Subsequently, when targeting contemplators, an important strategy may be to shift the decisional balance such that the pros of adopting a behavior clearly outweigh the cons (Andreasen 2006). For example, potential communication to contemplators would emphasize that adopting more natural shorelines can improve fishing from the dock or shore, even if some beach area is lost to natural vegetation.

Preparation

People within the preparation stage are intending to take action in the immediate future. Perhaps they have decided that they are willing to stop mowing natural vegetation or stop raking the beach along the lakeshore in the coming year, and they have looked into the possibility of planting native plants on their property to help it return to a more natural state. This segment may already be adequately educated about the benefits of doing so, but they need a little extra motivation to adopt the new behavior. This is where marketing tactics such as reducing monetary costs to encourage the desired behavior may be especially useful (Kotler and Lee 2008). For instance, residents may be offered coupons to offset the initial costs of purchasing native plants at local nurseries or offered the opportunity to meet with a consultant who can advise them about the most cost effective way to obtain a natural shoreline while taking into account other goals such as the ability to relax or recreate by the lakeshore.

To encourage people in the preparation stage to adopt more natural shorelines, encouragement to publicly express commitment to a behavior may influence them to adopt an identity consistent with that behavior, resulting in long-lasting attitude and behavior change (Bator and Cialdini 2000). Making a public commitment may influence whether people adopt a new behavior because they fear looking bad in front of others (Perloff 2008) or desire to maintain good

standing within a particular reference group (Prislin and Wood 2008), such as neighbors or their local lake association. Asking people to sign written contracts to adopt a new practice, as well as encouraging them to commit in public or online spaces, may motivate preparers who may otherwise slip backward rather than progressing toward adopting the desired behavior (McKenzie-Mohr and Smith 1999).

Action

Action refers to the stage in which people have made specific overt modifications in their lifestyles, although typically this stage has been operationalized, as when people have adopted the change for 6 months or less (Prochaska et al. 1994). For most behaviors, people still need to work to keep up their new practice, and such changes are not assumed to be permanent. For example, property owners may allow the vegetation to grow at the lake's edge as they attempt to adopt this new practice while still maintaining a highly manicured lawn. Realistically, many people who earnestly try to adopt more natural shorelines may not strive for or achieve the "ideal" all at once. Where monitoring of such actions is possible, an example of an outreach strategy might be to set up a website that keeps track of increasing percentages of natural vegetation along specific lakes and how these improvements might be expected to benefit water quality and wildlife habitat. Other proactive outreach techniques such as postcards, email, or phone calls reminding people in the action stage about the immediate, short-term benefits that may have occurred (e.g., improved fishing, more nesting areas for desired birds such as loons or song birds) may be helpful.

Maintenance

Maintenance is the stage in which people are continuing with a new behavior. They have been successful for 6 months or more and are no longer actively involved in the deliberative processes associated with the contemplation or action phases (Prochaska et al. 1994). The behavior is relatively stable by this point as it becomes more habitual (Ajzen 1991), although opportunities for people in this stage to revert to former behaviors still remain. Previous studies have shown that perceived barriers to starting a new behavior seem to differentiate between successful and unsuccessful adopters (Rhodes and Plotkinoff 2006). This suggests that social marketers might continue with communication strategies that reduce perceived and real barriers even after a target audience segment has adopted a new behavior. To encourage people to remain committed, outreach materials may continue to remind them about the long-term environmental benefits of the practice. Reminders about the benefits that

have accrued at the individual and community levels may also be highlighted.

Ongoing emotional appeals that strengthen or maintain associations between natural shorelines and desired outcomes (e.g., water quality and wildlife habitat) may also encourage lasting behavior change in the maintenance stage. These may include associating natural shorelines with positive imagery, such as loons, eagles, or healthy fisheries. Some of the strategies used in the maintenance stage are similar to those employed for people in the action stage, but distinguishing between the stages reminds researchers and communicators that long-term behavior change may be enhanced or maintained by ongoing communication efforts.

Another possible effective maintenance strategy is the use of social support. Borrowing from the health behavior change literature, research indicates that a lack of actual and perceived positive social support or the existence of social pressure is associated with a relapse or return to previous behaviors (Beattie and Longabaugh 1999, Broome et al. 2002). Conversely, people in other behavior change contexts who stay involved with self-help groups have superior outcomes (Oimette et al. 2001, 2003, Dobkin et al. 2002). Feasible tactics to maintain behavior change efforts may include offering neighborhood support groups where individuals get together to exchange ideas; providing support related to protecting local lakes; using an email listserv; or creating a social networking presence (e.g., Facebook) where people can participate in a virtual community committed to promoting behavioral choices to protect their local lake ecosystems.

Relapse

The SCM also discusses relapse, in which people return from action or maintenance to an earlier stage. We might think of relapse in the context of addiction—the individual who smokes a cigarette after having successfully quit for a few months or has a drink after a successful period of abstinence following addiction treatment. However, the idea that people might relapse following adoption of behaviors to protect the environment has numerous parallel examples. In the above example, people who have sustained behavior change for a time are not immune to the pull of old behaviors such as mowing, using lawn fertilizer, or removing vegetation from their shoreline when doing so may seem more desirable than keeping the shore more natural (e.g., if they are having a social gathering where they want their lakeshore to look more “tidy” for their guests).

Notably, in the case of health-related behaviors, relapse is considered to be an integral part of the behavior change process (Prochaska and Velicer 1997). For example, despite numerous advances in the treatment of addiction, some re-

lapse to previous substance use behaviors remains common, sometimes as high as 80% (McKay and Weiss 2001, McLellan 2002, Dennis et al. 2003, Witkiewitz and Marlatt 2004). However, according to Prochaska and Velicer (1997), individuals seldom regress to the precontemplation phase; and the majority return to contemplating or preparing for another serious attempt at action. Therefore, as described above, it is imperative that communicators seeking lasting behavior change among their target audiences persevere after an audience segment has adopted the desired behaviors.

Research objectives

The primary objective of this study was to examine whether the stages specified by the SCM may be useful in identifying lakeshore property owners’ attitudes and intent toward adopting more natural shorelines. If the answer to this research question is affirmative, the SCM could improve outreach initiatives designed to encourage natural shorelines among lakeshore property owners. Such improvements could occur by targeting communication strategies to property owners based on their stage of change using audience segmentation principles common to social marketing in other behavior change contexts. The assumption is that motivations will vary among audience segments (Angelina and Hull 2005), and that knowing where a segment is on a temporal basis—relative to their understanding and adoption of a new behavior—may have implications for effectively tailoring strategic communications designed to influence environmental behavior change. Below we address whether the stages specified by the SCM may be useful in identifying attitudinal and behavioral factors associated with lakeshore property owners’ attitudes and intent toward adopting more natural shorelines. If these constructs specified by the SCM were to represent a valid framework for segmenting lakeshore property owners, future research could explore whether these insights lead to stage-matched communications to enhance outreach initiatives focused on encouraging the adoption of more natural shorelines.

Methods

Shoreline property owner surveys were mailed to 212 property owners on Long and Des Moines lakes in Burnett County located in northwest Wisconsin. These lakes were selected because they were representative of other lakes in the county, including shoreline development and lake associations that had relatively normal activity and leadership for the region. Both lakes were also soft water seepage lakes, which are typical of lakes in the area.

Return survey envelopes were coded to determine which households returned surveys. Reminder post cards were sent

a week later to 180 property owners who had not returned a survey. Two weeks later a second survey was sent to 155 property owners who failed to return the survey after the reminder post card.

Measures

In conducting social science surveys, researchers typically present a series of statements in the data collection instrument instead of a list of questions, which in this study included the stages of change including contemplation, preparation, action, maintenance, and relapse. Respondents were asked to indicate their degree of agreement or disagreement with these statements, collectively known as an attitude scale. We then combined responses to create a composite score.

Sixteen measures representing the 6 stages of change were based on the conceptual frameworks and scales previously used in the context of health-related behavior change research (Fava et al. 1995, Prochaska and Velicer 1997, Tillis et al. 2003, Logue et al. 2004, Spencer et al. 2006, Prochaska 2007, Wallace et al. 2007, Di Noia et al. 2008, Erol and Erdogan 2008). Based on this earlier research, 3–4 survey questions were created to represent each conceptually distinct stage of change.

Respondents were asked to rate their level of agreement with each using a 5-point Likert-type scale (Likert 1932). The Likert scale is one of the most popular attitude scales because it is easy to prepare and to interpret and simple for respondents to answer (Schiffman and Kanuk 1997). The response options offered for each statement were 1 = Not at all, 2 = Slightly, 3 = Somewhat, 4 = Very much, and 5 = Extremely. Four of the statements were created to measure precontemplation and contemplation together (the issue of natural shorelines was introduced at the beginning of the survey, making it impossible that respondents would be completely unaware of the issue. Because the relevant statements occurred toward the end of the questionnaire, we believe this justified combining precontemplation with the contemplation stage). Three additional statements for the 4 remaining stages were created to measure of the 4 remaining stages of change: preparation, action, maintenance, and relapse (Table 1)

When multiple statements or attitude items are combined to represent a respondent's evaluation of an attitude object (e.g., one of the stages of change), certain statistical methods can indicate how well the multiple statements or items measure what they are purported to measure (i.e., do they all measure the same concept?). These statistics are known as internal consistency or reliability statistics (Eagly and Chaiken 1993), the most appropriate measure for Likert

scales being Cronbach's alpha coefficient (Cronbach 1951). Cronbach's alpha coefficient is essentially the average correlation between the items in a particular scale; correlations can range from 0.0 (nonexistent correlation) to 1.0 (perfect correlation), with 0.8 being conventionally considered a good reliability coefficient (Cohen 1988). Reliability statistics measured with Cronbach's alpha were conducted on the items comprising each of the 5 stages.

Additionally, a factor analysis was conducted, which is an interdependence technique whose primary purpose is to define the underlying structure among a group of variables (Hair et al. 2010). Broadly speaking, factor analysis provides a tool for analyzing the structure of the interrelationships (correlations) among a large number of variables (e.g., test scores, questionnaire responses) by identifying groups of variables that are highly interrelated, known as factors. These factors represent dimensions within the data (Hair et al. 2010). In this study, a principal components factor analysis was performed on 16 measures deemed to represent the 5 relevant stages of change as conceptualized by the SCM. Principal components analysis was used because the primary purpose was to identify the factors underlying the 16 measures. Varimax rotation was employed (meaning that the resultant factors are orthogonal or mathematically independent), and the 5-factor solution was deemed *a priori* the best factor structure considering (1) the goals of the study and (2) that the SCM is an established model with a known factor structure (see Freyer et al. 2006). All statistical analysis was conducted using SPSS software v. 18.

Results

Respondents returned 165 surveys, a response rate of 78%; 17% lived on the lake year-round; 83% were seasonal residents; and the average age was 59, ranging from 40 to 84.

The average responses and standard deviations for each of the 16 component statements were compiled (Table 1). In addition to showing how each statement was worded, statements were grouped according to which stage they represent. Higher mean scores indicate greater agreement with the statement and higher standard deviations indicate a wider distribution of responses (i.e., a higher standard deviation indicates more variability among respondents in how they rated a particular statement). Statements in the maintenance scale had generally higher mean scores than the other scales, yet there was substantially more variability among the responses as indicated by higher standard deviations (Table 1). Further, the preparation and relapse scales generally had lower mean scores (indicating relatively less agreement with these statements) yet had smaller standard deviations (indicating less variability in responses and that most respondents tended to rate these statements similarly low).

Utility of stages of change model

Table 1. Means and standard deviations for responses to 16 statements. Derived from survey of 212 property owners on Long and Des Moines Lake in Burnett County located in northwest Wisconsin.

Statements from survey		Mean	Standard Deviation
Contemplation			
A1.	I mow or cut the shore area of my property and will continue to do so.	2.04	1.16
A2.	I currently mow or cut the shoreland part of my property but I understand the benefits of leaving it more natural.	2.28	1.29
A3.	I currently mow or cut the shoreland part of my property but I understand the disadvantages of doing so.	2.16	1.27
A4.	I currently mow or cut the shoreland part of my property because the advantages outweigh the disadvantages.	2.11	1.32
Preparation			
B1.	I currently mow or cut the shoreland part of my property but have determined that letting it go natural might be better.	1.92	1.19
B2.	I currently mow or cut the shoreland area of my property but plan to let it go more natural.	1.86	1.12
B3.	I currently mow or cut the shoreland part of my property but I'm ready to stop doing so in the near-term future.	1.70	1.10
Action			
C1.	Over the past year or so, I let some of the shoreland part of my property that was mowed or cut return to a more natural state.	2.39	1.45
C2.	I've recently let the shoreland part of my property that was mowed or cut start to return to a natural state, and I'll wait and see how it goes to see if I keep it that way.	2.01	1.33
C3.	I've recently let the shoreland part of my property that was mowed or cut start to return to a natural state, and I'm hopeful it will have a positive impact on water quality and wildlife habitat.	2.32	1.54
Maintenance			
D1.	I've let shoreland part of my property that was previously mowed or cut return to its natural state, and I'm noticing native plants starting to grow there.	2.37	1.42
D2.	The shoreland area of my property has been left in a natural state without much mowing or cutting it for over a year now.	3.13	1.64
D3.	I've let the shoreland part of my property that was previously mowed or cut return to a more natural state and I feel good about this decision.	2.62	1.57
Relapse			
E1.	I let the shoreland area of my property return to a more natural, uncut state but plan to mow or cut it again soon.	1.51	0.95
E2.	The shoreland area of my property is in a basically natural, uncut state but it looks messy.	2.11	1.30
E3.	The shoreland part of my property is in a natural, uncut state preventing me from doing some of the activities I enjoy at the lake.	1.67	1.01

Cronbach's alpha for each of the 5 scales (representing the 5 stages) ranged between 0.69 and 0.92 (Table 1 and 2). Using Cohen's (1988) standards for judging the strength of correlations, most of the scales were reliably comprised using the 16 statements, in other words if they "held" together well with strong Chronbach's alpha coefficients of 0.80 or above (Table 1). The alphas were very strong for contemplation (0.89), preparation (0.92), action (0.89), maintenance (0.83), and moderate for relapse (0.69).

Factor analysis showed that the first factor accounted for 19.6% of the variance, the second 19.3%, the third 16.5%, the fourth 12.5%, and the fifth 12.0%, for a total of 80%

variance in the 16 statements explained by these 5 factors. Squared factor loadings indicate what percentage of the variance in an original variable is explained by a factor (e.g., a factor loading of 0.5 indicates that 25% of the variance in the variable is explained or shared with the factor). Within each factor, all individual statements had positive primary factor loadings of over 0.5, and they loaded (or correlated) with their respective stages. There were only 3 exceptions: statements A2 and A3 loaded positively with both contemplation and preparation; statement D2 loaded negatively with the contemplation stage and positively with the maintenance stage (see below for discussion).

Table 2.-Factor loadings derived from a principle components analysis with varimax rotation for 16 items (N = 165). Numbers in parentheses are Cronbach's Alpha. *Derived from survey data of 165 property owners on Long and Des Moines Lake in Burnett County located in northwest Wisconsin.

Stages of Change	Alpha if item removed	Rotated Factor Loadings			
		A. Contemplation (0.89)	B. Preparation (0.92)	C. Action (0.89)	D. Maintenance (0.83) E. Relapse (0.69)
A1. I mow or cut the shore area of my property and will continue to do so.	0.87	0.875			
A2. I currently mow or cut the shoreland part of my property but I understand the benefits of leaving it more natural.	0.84	0.676	0.568		
A3. I currently mow or cut the shoreland part of my property but I understand the disadvantages of doing so.	0.85	0.662	0.609		
A4. I currently mow or cut the shoreland part of my property because the advantages outweigh the disadvantages.	0.85	0.863			
B1. I currently mow or cut the shoreland part of my property but have determined that letting it go natural might be better.	0.91		0.882		
B2. I currently mow or cut the shoreland area of my property but plan to let it go more natural.	0.82		0.871		
B3. I currently mow or cut the shoreland part of my property but I'm ready to stop doing so in the near-term future.	0.91		0.773		
C1. Over the past year or so, I let some of the shoreland part of my property that was mowed or cut return to a more natural state	0.83			0.841	
C2. I've recently let the shoreland part of my property that was mowed or cut start to return to a natural state, and I'll wait and see how it goes to see if I keep it that way.	0.86			0.886	
C3. I've recently let the shoreland part of my property that was mowed or cut start to return to a natural state, and I'm hopeful it will have a positive impact on water quality and wildlife habitat.	0.83			0.805	
D1. I've let shoreland part of my property that was previously mowed or cut return to its natural state, and I'm noticing native plants starting to grow there.	0.76			0.860	
D2. The shoreland area of my property has been left in a natural state without much mowing or cutting it for over a year now.	0.87	-0.636		0.506	
D3. I've let the shoreland part of my property that was previously mowed or cut return to a more natural state and I feel good about this decision.	0.66			0.835	
E1. I let the shoreland area of my property return to a more natural, uncut state but plan to mow or cut it again soon.	0.69				0.606
E2. The shoreland area of my property is in a basically natural, uncut state but it looks messy.	0.52				0.847
E3. The shoreland part of my property is in a natural, uncut state preventing me from doing some of the activities I enjoy at the lake.	0.53				0.835

Note: Factor loadings <0.5 are not shown.

Discussion

Using the SCM as a way to understand lakeshore property owners' attitudinal and behavioral dispositions toward natural shorelines offers potentially valuable insights to develop more efficacious stage-matched outreach strategies that influence behavior-change to protect water quality and wildlife habitat. The data provided evidence of strong internal consistency within each of the 5 stages in the form of high positive alpha coefficients. Further evidence of the reliability of the SCM in this context was found in the factor analysis of the ratings of all 16 statements simultaneously, in which we reported all factor loadings above 0.5. In contrast to internal consistency analysis, which assumes *a priori* the items comprising each scale, exploratory factor analysis tests how distinct the proposed items are in representing each scale. Our factor analysis of the 16 statements found that these scales correlated strongly with the 5 factors representing the different stages of behavior change.

Some caveats and limitations related to this study are also worth noting. The primary contribution of this study is extending the potential utility of the SCM from health behavior change to the environmental behavior change context of encouraging natural shorelines among lakeshore property owners. While it is beyond the scope of this paper, further research should examine the external as opposed to internal reliability of the SCM. The current study is not meant to be a confirmatory factor analysis. It has not been related to externally valid similar measures. Rather, this study uses a template in the SCM theory of behavioral change to suggest survey applications of the SCM theory, which has empirical validation (see Freyer et al. 2006), in an environmental context. As such, we believe this survey is illustrative but not definitive.

While this study demonstrates the potential of adapting the SCM to an environmental context, additional components could be improved. The only scale with relatively poor reliability was the relapse stage (see Table 1), indicating weak reliability and needs further refinement. This lower reliability score may have been because relapse in the context of lakeshore management is inherently somewhat ambiguous. The relapse stage implies that property owners have pursued a course of action—allowing more natural shorelines—but are questioning their own judgment. Furthermore, only 25% of respondents had properties categorized as most natural. Having a natural shoreline, or at least being committed to allowing a return to natural shoreline on their property, may be a prerequisite for answering the relapse question, and the questions would not be applicable to those who had not yet adopted more natural shorelines. Consistent with this premise, examination of the means of the relapse scale statements indicated that few respondents agreed with these statements. The reliability analysis also

provided some potential remedies for improving the relapse scale. The removal of one item (E1, Table 1) from the relapse stage would not affect the overall reliability of the scale.

Another relatively poorly performing item in the maintenance stage (D2, Table 1) was, "The shoreland area of my property has been left in a natural state without much mowing or cutting for over a year now." The reliability of the maintenance scale would improve from 0.83 to 0.87 if it were removed. Further evidence of the ambiguity of this statement was found in the factor analysis, in which D2 was negatively correlated with the contemplation factor and positively related to the maintenance factor. This statement seems to be defining a desired behavior (maintenance) that needs no further coaxing or information to actualize (contemplation). It is also the only item among the 16 to specifically mention a long-term time period (over a year). One possible way to address this issue would be to revise the wording by removing the reference to a specific time period. This temporal aspect of the statement may be crucial in its ability to discriminate between maintenance and contemplation.

Two other statements (A2 and A3, Table 1) had high positive factor loadings on multiple factors (contemplation and preparation), indicating the statements are not specific to a single stage and could be further refined so that they loaded highly on one or the other factor, but not on both. A careful reading of these 2 statements shows that they may be measuring both factors; in other words, they are akin to double-barreled questions (ones that combine two or more issues in a single question, making it unclear which attitude is being measured) in which 2 measures are conflated (Converse and Presser 1986). Both statements refer to mowing the shoreline and understanding the consequences of doing so.

The scales used in this survey to measure property owners' different attitudinal and behavioral orientations toward adopting more natural shorelines were correlated strongly with, and reliable measures of, 5 factors representing the different stages of behavior change. Results provide some preliminary support that the SCM may represent a useful conceptual framework for understanding shoreline property owners' propensities toward adopting more natural shorelines to protect water quality and wildlife habitat. Specifically, results preliminarily support the idea that there may be a natural progression of stages lakeshore property owners pass through related to their adopting more natural shorelines. This more nuanced view of behavior change—as compared to the simpler, dichotomous notion that people either change their behavior or do not—can potentially inform outreach and education work targeting lakeshore property owners.

A next step in advancing this line of research inquiry would be to test whether stage-matched communication strategies are more effective than one-size-fits-all approaches to outreach intended to encourage natural shorelines. Such support, if generated, would represent a useful advancement in helping lake managers and researchers influence property owners to adopt behavioral practices that protect the ecological balance of lakes. Suggestions for what these stage-matched strategies might look like are highlighted in the introduction of this article.

How else can the current study provide insights to improve outreach to encourage lakeshore property owners to adopt more natural shorelines? Another way the SCM might be leveraged in the future to enhance outreach strategies encouraging natural shorelines is to conduct assessments (e.g., with online, phone-based, or face-to-face surveys) of property owners and then use this information to provide tailored action plans to respondents suggesting strategies that directly address where they are on the stages of change continuum. Individualized reports or action plans could be generated by entering data from assessments into computer-based programs, which could in turn provide feedback to property owners based on their particular situation and characteristics (e.g., awareness, knowledge, attitudes, social norms, skills, financial resources, recreational goals). Encouragingly, stage-matched interventions have received some support in the health behavior change literature (Spencer et al. 2006), although such preliminary support has yet to be produced in environmental behavior change campaigns so far as we are aware.

The introduction suggests types of outreach strategies that might be most effective based on the particular stage of change of an audience segment as informed by previous stages of change and behavior change research conducted in health-related contexts. However, future research should test whether outreach campaigns employing particular communication strategies targeting each audience segment, based on their stage of change, produces improved outcomes for influencing the adoption of more natural shorelines compared to a one-size-fits all outreach strategy targeting an entire population of lakeshore property owners. The suggestions for stage-matched strategies included in the introduction are surmised based on previous research in a health context, but as for the environmental behavior change context of adopting natural shorelines, these are merely speculative and would need to be implemented and evaluated in future studies to explore the potential of the SCM to empower more effective approaches to outreach and educational campaigns.

Some researchers argue that human behavior change processes do not work as simply as the SCM suggests (e.g., Davidson 1992). Even if this is the case, the SCM may offer a useful framework to researchers and practitioners

concerned with planning, implementing, and evaluating outreach campaigns designed to encourage the adoption of natural shorelines among lakeshore property owners. Other potential applications of the SCM that emerge from previous studies suggest that progressing from one stage of change to the next may be as important as actual behavior change (Prochaska et al. 1992). Future studies will hopefully advance beyond the preliminary findings in this study to test the potential of the model in producing more effective outreach approaches to encouraging shoreline property owners to adopt behaviors that protect the ecological integrity of their local lakes.

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