Queensland University of Technology
Brisbane Australia

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Sustaining and Improving the Social Condition of River Ecosystems

ABSTRACT

This study uses and extends the theory of planned behavior to develop and empirically test a model of the social condition of riparian behavior. The theory of planned behavior is applicable to understanding the complexity of social conditions underlying waterway health. SEM identified complex interrelationships between variables. Aspects of respondent's beliefs impacted on their stated intentions and behavior and were partially mediated by perceived behavioral control. The way in which people used waterways also influenced their actions. This study adds to theoretical knowledge through the development of scales that measure aspects of the social condition of waterways and examines their interrelationships for the first time. It extends the theory of planned behaviour through the incorporation of an objective measure of participants knowledge of waterway health. It also has practical implications for managers involved in sustaining and improving the social condition of river ecosystems.

KEYWORDS

Sustainability, trust management, social innovation, community partnership

Length: 3303 words

Governments and waterway managers internationally and in Australia have long recognized the importance of water security and maintaining a healthy water supply. Australian benchmarking of the environmental condition of waterways, for example, has been conducted in the state of Victoria in 1999 and 2004 through an index of stream condition (ISC) which has been used to monitor the biophysical health of waterways. The ISC provides an assessment of the health of Victoria's waterways by measuring the change in five bio-physical indices including hydrology, streamside zone, physical form, water quality and aquatic life (Victorian Department of Sustainability and Environment 2005). There have been many other indices of waterway health developed elsewhere (Gordon, McMahon, Finlayson, Gippel & Nathan et al. 2004). For example, RISKBASE, a European project for integrated risk-based management of rivers based on the premise that river basins are complex and dynamic social-ecological systems where the central objective is the sustaining of ecosystem services rather than ecological status (van der Meulen & Brils 2008).

Regional Natural Resource Management (NRM) bodies know that the success of implementing planning decisions depends on how well communities, agencies and industries understand and manage these waterways. Governments recognize and invest in community capacity because they understand that the task is too big for them alone (Colliver 2006).

The emphasis on broader conceptions of ecosystems services has developed since the Millennium Ecosystem Assessment (Alcamo & Bennett, 2003). Booth, Karr et al. (2004) call for a better understanding of the links between human actions and changing waterway health. Meyer (1997) and Karr and Rossano (2001) also suggest a broader definition of waterway health that includes social values, services and uses is needed. Karr and Rossano (2001) suggest that waterway rehabilitation in urban areas for example, fails because waterway managers do not recognize the value of interdisciplinary aspects of biophysical and social knowledge, or do not address the changes that occur in rivers due to human activities.

Despite the call for a focus on the social aspects of waterway health as well as the biophysical, very few researchers have specifically examined social aspects of river health (see Cox, Johnstone & Robinson (2004) on well-being, Meyer (1997) on community values, Wilson, Jansen, Curtis & Robertson (2006) on landholder knowledge of riparian condition, Curtis & Robertson (2003) on landholder management of river frontages and Thomson & Pepperdine (2003) on community capacity and riparian restoration).

The literature describing these social aspects can be grouped into three approaches, those that examine waterway health descriptively; those that develop theoretical or conceptual frameworks and those that develop theoretical frameworks and empirically test them. Many researchers believe it is essential to draw social indicators from a theoretical framework (Land 2001; Lockie, Lawrence, Dale & Taylor 2002). While some researchers have empirically evaluated their theoretical models (Cary, Webb & Barr 2002; Fielding, Terry, Masser, Bordia & Hogg 2005; Hurlimann, Dolnicar & Meyer 2009; Larson 2009; Lockie, Rockloff, Helbers, Lawrence & Gorospe-Lockie 2005; Marshall, Blackstock & Dunglinson 2010; Po, Nancarrow, Leviston, Porter, Syme & Kaercher 2005), it is difficult in practice to find achievable methods for collecting the necessary data to inform these indicators variables.

Ajzen and Fishbein (1980) developed a theory of reasoned action that links beliefs to intentions, then to actions or behavior. They discovered that when questions on attitude surveys are very specific, they can predict specific behavior or actions. For example, specific attitudes to waterway health will be better at predicting people's waterway behavior than asking a general question about attitudes to the environment. This general question may however, predict their interest in the topic of waterway health as part of a healthy environment. An action or behavior will be more likely to occur when the 'social norm', that is, the person believes significant others (peers, family, society) support the behavior, they have no negative attitude towards the behavior, and that their actions are within their control. The model of reasoned action was later modified and became Ajzen's (1989), theory of planned behavior, by incorporating the person's belief about how easy or difficult it is to perform the action, their abilities, opportunities and resources. Incorporating perceived control improved the prediction accuracy for both intentions and actions (Ajzen & Fishbein 2005). For example, if a person believes they have the ability to participate in creating healthy waterways and the resources to do so, that their local community supports it, and they have no negative attitudes towards it, and it will be beneficial, then their intention to act should increase resulting in action, such as participation in maintaining works that have been done to improve the health of their waterway frontage. The stronger an attitude, the more it is expressed and the more impact the attitude has on behavior (Zanna 2005). A criticism levelled at these theoretical frameworks, however, is their assumption that attitudes are rational and that socially significant behaviors are intentional, reasoned and planned which may not always be true (Vaughan & Hogg 2002). Nonetheless, they are extremely helpful frameworks in understanding the relationship between attitudes, intentions and subsequent action or behavior.

These theoretical frameworks are used in this study to examine community dispositions and behavior related to waterway health. Social dispositions and behavior regarding rivers and waterways are important because of the major impact of humans on waterway health. Such dispositions towards waterways have not previously been measured in a formal way. Managers being able to assess such trends may enable these ‘indicators’ to act as warning signals for unsustainable resource use (Azar, Holmberg & Lindgren 1996) and assist managers in planning community engagement strategies to facilitate sustainable use.

Insert Figure 1 about here

As described in figure 1 above, the aim of this research was to use the theory of planned behavior to develop and empirically test a model of the social condition of healthy and unhealthy waterway frontage, that is, riparian behavior. The social condition is defined as the social patterns and social structures exhibited by individuals, groups and communities. These patterns and structures offer insights into and an appreciation of how people use, value, understand and behave in relation to waterways. It was hypothesized that:

Hypothesis 1a. Beliefs in relation to waterway health will impact on waterway health intentions which in turn will impact on people's waterway health actions or behaviors.

Hypothesis 1b. The impact of beliefs and intentions on actions or behaviors will be mediated by perceived behavioral control.

Hypothesis 1c. The way in which people use waterways will impact on their behavior.

METHOD

Participants and Procedure

An Australian state-wide study of all Victorian Catchment Management Authorities was undertaken in 2009. Sampling of respondents was purposive and aimed to capture riparian landholders in each of 10 catchment management areas across the state of Victoria, Australia. To access riparian respondents the population of all Crown frontage license holders and Crown land riparian license holders were surveyed. From a population of 15,981 potential riparian respondents 3046 respondents 19% response rate) completed useable questionnaires. The survey was administered as a paper-based questionnaire and electronically via a web-based questionnaire. This paper examines the responses of these 3046 riparian respondents.

Constructing the Social Benchmark Measures

The identification and development of 14 measures was based on data from 900 respondent's in a previous study that included a pilot survey, literature review, interviews with experts, a review of reports relevant to social aspects of river health provided by regional Catchment Management Authorities (CMAs), and interviews and focus groups with people involved in waterway management (Riedlinger, Metcalfe, Pisarski & Cary, 2007). Multiple item statements weredeveloped to operationalize the scales for each variable or indicator. The validity and reliability of the groups of items comprising each of the multiple-item variables was confirmed by principal axis factor analysis and examining the Cronbach's alpha of the data derived in the pilot study (see Nunnally & Bernstein 1994; Pisarski, Cary & Metcalfe 2008).

Two different actions or behaviors are examined see figure 1). Firstly, the general engagement behavior of respondents, including: actively seeking information, attending events about waterways; participation in local waterway projects or encouraging others to change their waterway behavior. These activities can be considered 'active engagement'. Secondly, the specific behavior of respondents who live, work or manage waterway frontage property riparian respondents) and the specific actions or behaviours' that improve waterway health such as preventing stock from accessing waterways, removing weeds, seeking advice on managing their section of waterway, removing willow trees and maintaining on the ground works done by their Catchment Management Authorities.

RESULTS

The means, standard deviations and reliability coefficients for the variables in this study are shown in table 1 below.

Insert Table 1 about here

To determine the relationships between the variables structural equation modelling, using maximum likelihood procedure, was employed Kline (1998). The structural equation model, excluding path coefficients, is presented in Figure 2. The model revealed a good fit ($\chi^2$745.21, *df* 63, *P* > .59, CFI=.91, IFI=.92, NFI=.91, TLI NNFI =.89, RMSEA=.061, AASR=.04) explaining 48% of riparian holders waterway health behavior (n=3046). The distribution of residuals was symmetrical and approached zero, and the standardized off diagonal residuals were low. The standardized path coefficients for all direct and indirect pathways in the model were significant.

A complex set of direct and mediated significant interrelationships between the predictor variables and riparian respondents' waterway health behavior were evident in the structural equation model (Figure 2). The most important direct pathways were between general waterway engagement activity such as actively seeking information about waterway health, and other activities that can be considered engagement in waterway health, using waterways for the rehabilitation of native habitat, respondents' contact with their CMA and membership of a community Natural Resource Management (NRM) group, in particular Landcare. The model generally supports the theory of planned behavior.

Insert Figure 2 about here

As seen in figure 2 above as general waterway engagement activities or actions increased there was a corresponding increase in healthy riparian behavior $\beta = .319$, $p < .001$).

There was partial support for *Hypothesis 1a* in that aspects of respondent's beliefs impacted on their stated intentions which in turn impacted on their actions. There was a direct positive relationship between perceptions of government responsibility and waterway intentions or respondent's aspirations ($\beta = .220$, $p < .001$). There was a strong relationship between how much responsibility respondents thought government and waterways users should have for waterway health ($\beta = .374$, $p < .001$). The more riparian respondents saw this as a partnership between government and users the more they tended to trust recommended practice ($\beta = .216$, $p < .001$).

Hypothesis 1b was partially supported. The impact of beliefs and intentions on actions or behaviors was partially mediated by perceived behavioral control. These variables also directly impacted on one or both behaviors. There was a direct positive relationship between waterway knowledge and general waterway health engagement activities. This relationship was also mediated by aspirations ($\beta = .044$, $p < .05$). Waterway knowledge of riparian respondents was directly related to trust in recommended practices ($\beta = .196$, $p < .001$), however, this belief did not directly impact on intentions or action. As waterway knowledge ($\beta = .044$, $p < .05$), and aspirations for waterway health ($\beta = .107$, $p < .05$), increased general waterway engagement activity also increased which, in turn, led to healthier riparian behavior. The financial capacity to do the right thing for waterways had a direct influence on riparian behavior ($\beta = .147$, $p < .05$). Those respondents who had contacted their CMA most recently had better riparian behavior. Contact with a CMA had a direct influence on riparian behavior ($\beta = .147$, $p < .05$) but also operated indirectly on riparian behavior through general waterway engagement activity ($\beta = .227$, $p < .001$). Membership in community based NRM groups had a stronger influence on healthy riparian behavior indirectly through general waterway engagement activity ($\beta = .386$, $p < .001$), CMA contact ($\beta = .210$, $p < .001$) and waterway knowledge ($\beta = .107$, $p < .05$). As general waterway engagement activity improved and contact with CMAs and knowledge increased so did healthy riparian behavior.

The way in which people used waterways did impact on their actions or stated behavior giving support to *hypothesis 1c*. Respondents who reported on-water use were often beside water users ($\beta = .282$, $p < .001$). Those respondents who reported higher beside water use had higher general waterway engagement activity ($\beta = .082$, $p < .05$) and higher aspirations relevant to waterway health ($\beta = .180$, $p < .001$) which, in turn, was linked to better riparian behavior.

There was a negative relationship between respondents who used waterways for stock and irrigation and those who planted native habitat (β = -.231, $p < .001$), as respondents who accessed waterways for stock and irrigation were less likely to be engaged in planting native habitat beside waterways. This indicates two distinctively different stories in relation to waterway uses. First, respondents who used waterways for stock and irrigation and did not plant native habitat had poorer waterway knowledge (β = -.163, $p < .001$) and did not think government should have much responsibility for waterway health (β = - .191, $p < .001$). This led to poorer general waterway engagement activity and poorer riparian behavior.

Second, those engaged in rehabilitating native habitat tended to have other healthy riparian behaviors (β = .252, $p < .001$), better general waterway engagement activity (β = .195, $p < .001$), better knowledge (β = .191, $p < .001$) and aspirations (β = .180, $p < .001$) for waterway health. Riparian respondents engaged in planting native habitat also had higher membership in community based NRM groups (β = .275, $p < .001$) reported greater financial capacity to do the right thing for waterways (β = .228, $p < .001$) and increased contact with their CMA (β = .298, $p < .001$).

DISCUSSION

The aim of this research was to use the theory of planned behavior to develop and empirically test a model of the social condition of healthy and unhealthy riparian behavior. The results offer insight into the complex interrelationships between the variables that comprise the social aspects of waterway health. Firstly, the model shows that all of the identified variables play a role in determining riparian's actions or behavior. Therefore the variables chosen for this model are helpful in understanding riparian behavior, providing a better understanding of social variables influencing waterway health. Although not wholly supported the model of planned behavior does seem applicable to understanding the complexity of the social conditions underlying waterway health. The study not only adds to theoretical knowledge it also has practical implications for managers involved in sustaining and improving the social condition of river ecosystems.

General waterway health engagement activities are the most important predictor of riparian behavior. So, as people engage in activities such as actively seeking information, attending events about waterways; participate in local projects or encourage others to change their behavior then their healthy riparian behaviors also improve. This suggests that any attempts by waterway managers to improve active engagement may directly improve riparian behavior.

The findings provide some insight into groups that waterway managers can leverage to continue to improve waterway health behaviors. The model shows that people who rehabilitate native habitat, and to a lesser extent beside water users both have direct relationships with both knowledge and aspirations. People's knowledge of what makes a waterway healthy, and their aspirations together improve engagement activities. Therefore, if waterway managers have a high-priority target to increase these behaviors, they would look to maximize waterway health knowledge, people's aspirations and these uses of waterways. For example, they could increase beside-water recreational use of its waterways through actions such as providing better picnic facilities and walking or cycling tracks. We also understand from the data that most people do their recreational activities in public parks so the provision of interpretative displays in parks should result in improved knowledge. Waterway managers encouraging events such as community planting of native vegetation will also result in more engagement leading to better behavior.

The model also shows that membership in community based NRM groups improves general waterway engagement activity, improves peoples waterway knowledge and results in positive contact with government authorities. Therefore, waterway managers need to collaborate with these groups and foster their activities and encourage membership which should also result in increased healthy waterway behavior.

The model also shows that there is no direct link between ‘on and in’ water activities and healthy behavior. However, there is a strong link to beside water use and this suggests the way to target on and in water users potentially is when they are using waterways for beside water use. The demographics show that many on and in water users are recreational fishers and so waterway managers targeting these users through boating and fishing clubs may result in more fruitful engagement and better general waterway health. The provision of interpretative displays at boat ramps and popular fishing spots should result in improved knowledge of recreational fishers, especially if targeted at their areas of poorest knowledge.

It is also important to see that as rehabilitating native habitat increases all other riparian behaviors also increase. These specific behaviors include actively restoring waterway health, removing weeds, seeking advice on managing their section of waterway, removing willow trees and maintaining on the ground works done in partnership with Catchment Management Authorities. This is important as if waterway managers can get improvement in one type of behavior; their chances of riparian’s engaging in other healthy behavior greatly increase.

The model tells two distinctively different stories in relation to two types of waterway users. The first in relation to respondent’s who use waterways for stock and irrigation and do not plant native habitat which is a fairly negative story. The modelling showed that respondents using waterways for stock and irrigation had poorer waterway knowledge and did not think government should have much responsibility for waterway health. This led to poorer general engagement behavior and in turn poorer riparian behavior. This group tends to be less involved in planting native habitat and other healthy riparian behavior and therefore need to be an ongoing target for waterway managers' engagement. Secondly, when riparian's rehabilitate native habitat they are more likely to have a financial capacity to engage in other healthy riparian behaviors. The provision of grants is an important mechanism for increasing riparian's financial capacity and therefore these schemes should be encouraged as a means of increasing healthy riparian behavior. One third of respondents did not maintain the on-ground works that had been done in partnership with their Catchment Management Authorities. Catchment Management Authorities or community based NRM groups monitoring the on-ground works that have been done may provide waterway managers with an opportunity to provide advice, increase the membership of such organisations and increase the maintenance of on ground works. The data clearly indicates that the more riparian's are engaged with a community NRM group the more likely they are to engage in healthy riparian behavior.

However, a limitation of this research is the model presented is derived from correlational data and it is now important that longitudinal or quasi-experimental research be conducted to establish whether the relationships identified are genuinely causal and also whether they generalize to other people who contribute to waterway health.

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FIGURE 1: Proposed model based on the theory of planned behavior

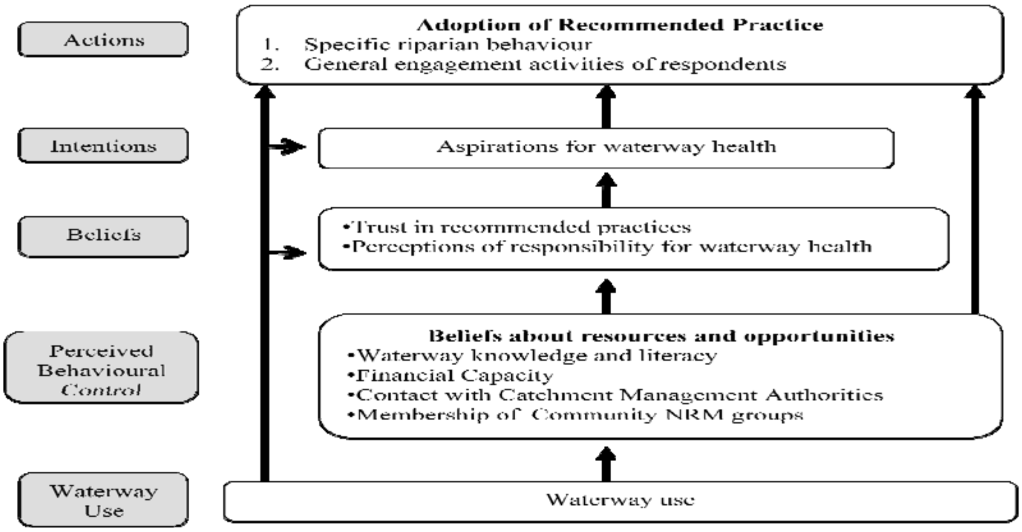

TABLE 1: Means, standard deviations for variables and scale reliabilities

Variables	Number of Items	Mean	Std. Deviation	Scale Reliabilities α
DEPENDENT VARIABLES (Actions)				
General waterway health engagement activities (stated general waterway health behaviour)	6	2.64	0.56	0.85
Specific riparian behavior (stated waterway	4	3.50	0.94	0.75

health behaviour of people with waterway frontage property)				
PREDICTOR VARIABLES				
Intentions				
Aspirations for waterway health	11	4.41	0.54	0.86
Beliefs				
Trust in recommended practices	9	3.33	0.84	0.92
Perceptions of government responsibility	9	3.57	0.82	0.91
Perceptions of user responsibility	4	3.53	0.69	0.81
Actual Knowledge				
Waterway knowledge and Literacy	12	3.79	0.67	0.79
Perceived Behavioral Control				
Financial capacity	1	2.86	1.15	n/a
Contact with Catchment Management Authority (CMA)	1	2.15	0.91	n/a
Membership of community Natural Resource Management (NRM) group	1	2.01	1.46	n/a
Waterway Usage				
On and in water use	5	2.09	0.87	0.78
Beside water use	4	3.51	0.89	0.79
Rehabilitate native habitat	1	2.29	1.23	n/a
Accessing water for stock use or irrigation	1	1.97	1.40	n/a

FIGURE 2: Model of reported waterway health behavior for riparian respondents