Sustainability Knowledge and Attitudes—Assessing Latent Constructs

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Abstract

The majority of sustainability related social science research conducted to date has primarily focused on individual level behaviors occurring within the environmental domain. In order to achieve the advancements needed to move towards a truly sustainable society, this interdisciplinary field must grow to not only include the social and economic domains, but also expand in scope to study groups and institutions. Sustainability research has paused at the brink of this needed growth and expansion because it has failed, thus far, to build new theories specifically tailored to the three domain model of sustainability. The purpose of this chapter is to encourage scientists to begin identifying and measuring sustainability latent constructs in order to do just that, and to submit two such measures to the academic community. This chapter introduces a revised Assessment of Sustainability Knowledge (ASK) and the Sustainability Attitudes Scale (SAS), and discusses when and how to use them for applied and theoretical purposes. Building theoretical models using these (and other) latent constructs will allow social scientists to test a new and diverse set of hypotheses and push the field to create cutting edge, sustainability-tailored theories.

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1 Introduction

Understanding what motivates people to behave sustainably is a necessary step towards making the societal changes needed in order to avoid the environmental, social, and economic catastrophes associated with natural resource depletion and climate change. This needed societal shift also presents a fertile ground for research in the fields of psychology, sociology, economics, and political science (among others), yet this interdisciplinary field of "sustainability research" remains underdeveloped and disjointed. Given that sustainability issues are multidimensional and interest a wide range of people, it is no surprise that scholars from a variety of backgrounds have conducted sustainability research from a variety of vantage points, stemming from their own theoretical and methodological backgrounds. Sustainability research, then, stands to gain much from the diversity of these research traditions.

Other fields of inquiry have developed and benefited from a similar situation. Gerontology, for example, became and remains a multidisciplinary field because scholars from different disciplines (e.g. psychology, medicine, sociology, social work) collaborated on a common interest. Kenyon (1988) noted that his vibrant field had a variety of perspectives, yet each discipline studying aging was limited due to its particular framework, history, and methodology. Nonetheless, each discipline contributed valuable knowledge to understanding the aging process albeit less organized and comprehensive than desired (Kenyon 1988). Gerontology's vibrancy and value have only increased in the past decades as the field has expanded its research, improved cross-disciplinary work, and shown its applicability to real-world problems. Sustainability research finds itself facing the same challenges and opportunities. This example illustrates the rationale behind this chapter; that by utilizing and coordinating the strengths of the disciplines contributing to sustainability research, the field will be strengthened and legitimized as an area of scientific inquiry and practice. This chapter serves as a call to encourage more cross-disciplinary collaborations aimed towards building new theory that encompasses the environmental, economic and social domains and can be applied at the individual, group, and societal level.

1.1 Perceived Lack of Agreement Over Definitions of Sustainability

One reason for this lack of focus and direction in sustainability research is the perceived lack of agreement on how to actually define "sustainability" (Toman 2006; Vos 2007). This perceived failure to come to a consensus has impeded budding research from moving much beyond the starting gate. Although a variety of definitions have been put forth and are being used, the definitions arguably are speaking of the same thing. First mentioned in the 1990's was the economic centered idea of the "triple bottom line" (Elkington 1997). The three bottom lines that

successful businesses should be focusing on were also referred to the as the three P's: people, planet, and profit. These P's have also been referred to as E's: Environment, economic, equity/ethical. While different terms are commonly used, it is clear that there is general agreement that sustainability consists of three overlapping domains which focus on environmental, economic, and social factors, and that any effort towards sustainability must address each of these domains.

The first and best attempt at an overarching definition of sustainability came in the Brundtland Report on environment and development. Sustainable development was defined as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development 1989, p. 43). The Brundtland definition provided a long-term temporal focus that the other, more common, uses do not explicitly state. For something to be truly sustainable it is necessary that it sustain indefinitely. The only way to ensure that an effort, policy, or society sustains over time, is to ensure that it does not negatively impact the environment, the economy, or the social well-being of those involved. The authors encourage the academic (and larger) community to accept the broad and encompassing Brundtland definition of sustainability, recognize that it contains these three separate, but intertwined, dimensions, and move forward. An agreed upon understanding on what comprises sustainability is not only necessary for the creation of future social science research, but such a consensus arguably has already been reached.

1.2 Current State of Sustainability Research

To date, much of the sustainability research conducted has been heavily focused on either observable behaviors or limited to the environmental domain. This is understandable, as observable actions are easiest to measure, and the environmental domain is most closely linked to climate change and resource depletion. If "sustainability research" can be thought of as an emerging paradigm (Kuhn 2012), then these initial areas of focus can be analogous to early studies in other past developing fields. Straightforward, inductive studies that may be primarily exploratory in nature describing observed phenomena. Thought of in this light, what is needed next in order to expand our knowledge beyond the individual and beyond the environmental domain is to begin building and testing theory. These theoretical advancements will require a better understanding of the latent forces influencing individual and group decisions and behavior. Disciplines that study other aspects of behavior offer methods and insight that will complement existing research on overt sustainability behaviors.

1.2.1 Lack of Research in Economic and Social Domains

The vast majority of sustainability research has focused on environmental domain, largely failing to address the economic and social domains. Two reasons for this unbalanced level of research is that the environmental dimensions is both easier to understand and easier to observe. Environmental sustainability is a relatively

straight forward concept when compared to economic and social sustainability. In terms of natural resources, sustainable use consists of withdrawing the resource at a rate equal to or less than the rate of replacement. In regards to ecosystem health, sustainability may simply mean the continuation of the structure and function of the landscape in its current or native state. Coming to a consensus on what is economically or socially sustainable, however, will be a contentious process.

Positive and negative examples of economic and socially sustainability will likely vary based on an individual's ideological values. Some may believe that a smaller publicly funded social safety net and a greater reliance on capitalism are keys to maintaining a healthy society, while others may believe a more egalitarian society achieved thru greater wealth redistribution (taxation) are hallmarks of social and economic sustainability. Identifying successful models of social and economic sustainability will be difficult, perhaps impossible, to separate from political ideology, but it is likely that the argument over what is sustainable, in itself, will be a productive step. Such a discussion could identify the salient values playing a role in an individual's or group's idea of sustainability. The identification of these values in turn could help guide public discourse beyond acceptance of the problem (i.e., the climate "debate") and on to debate over desired solutions.

In these two domains questions of scope also become a complicating factor, as what is sustainable at the community level is not necessarily sustainable at the state or global level. Where this boundary is drawn will influence the outcome of any kind of assessment effort. Is a wealthy suburb socially sustainable because of its well-funded and high performing schools? Or is it unsustainable because of its lack of socioeconomic diversity and high property values?

If establishing a definition for these two overlooked dimensions of sustainability is even possible, both the process and the outcome will be controversial. This controversy, however, needs to be had and can be quite beneficial. By going through this intellectual and ideological struggle, the research community may identify societal features which may facilitate, or impeded, sustainable develop at any scope or scale. Perhaps some ideological issues which are often culturally or politically considered to be taboo (e.g., alternatives to capitalism) may be questioned as to if they are truly good for long term state or global health.

1.2.2 Focus on Individual Behaviors

The majority of the research focused on environmental behaviors has been at the individual level, even though major motivational factors often come from a larger social group. Robert Cialdini's groundbreaking and extensive research into social norms and their influence on pro-environmental behavior is the primary example in this category. Cialdini's initial work in this field used recycling as the dependent variable as an avenue for understanding the different effects of both injunctive and descriptive social norms had on individual's behavior (Cialdini et al. 1990). Much later research suggested specific ways to use those different social norms effectively in a study focused on reducing household energy consumption (Schultz et al. 2007). But, while these individually focused studies may be useful for understanding the motivations behind a person's behavior, they arguably lack the efficacy of

addressing society scale problems. Cialdini's studies focused on personal behavioral change and were conducted at the neighborhood level. Would they work at the state or national level? More importantly, what are the barriers to implementing such a program at such a scale, and how can they be overcome?

Some research has extended the implications of Cialdini's (and others) theoretical advancements one step beyond the individual, testing whether the same effects of social norms apply to group behaviors (for a meta-analysis of the breadth of interventions tested, see Osbaldiston and Schott 2012). These studies have primarily focused on the use of messaging, feedback and group competitions to encourage a specific environmental behavior. While this approach of harnessing the power of descriptive and injunctive norms to encourage change is useful in the short term, there is consistent evidence that unless a prolonged intervention is made, participants typically fall back into old habits once the attention and incentive is removed (Allcott and Rogers 2014). This line of research, however, arguably suffers from the same limited efficacy of the earlier studies it is built upon. While it is true that if an entire society transformed their behavior in a similar manner to that achieved through these interventions the results would be at a meaningful scale; it may also be true that to achieve such a societal change would require an entirely different methodological and theoretical approach. In the words of Thomas A. Heberlein, there is no cognitive fix for an unsustainable society (Heberlein 2012).

1.2.3 Lack of Latent Assessment

With a couple very notable exceptions, the majority of social science sustainability research has failed to move beyond the measurement of observable behaviors in an effort to map and understand important latent constructs such as attitudes, values, beliefs, motivations, etc., that may play a role in an individual or societal shift towards a more sustainable future. The clear quantification of observed behaviors makes them an ideal dependent variable to test the effects of other, unobservable latent constructs. Definitions of latent constructs vary partly due to the mathematical models from which they arose (Bollen 2002). Consistent with Bollen (2002), the authors agree that the best definitions are those that are useful in understanding the phenomenon at hand. Furthermore, at this point of sustainability research using a simplified definition is most likely the best to allow more researchers to collaborate on common sustainability phenomena. Therefore, for our purposes latent constructs are defined simply as variables that are not directly observable. Knowledge of these unseen influences is important, as it provides a foundation for theoretical advancements which would otherwise not be possible.

Arguably the most important area of research which has looked into sustainability related latent constructs is Riley Dunlap's New Ecological Paradigm (Catton and Dunlap 1978; Riley E Dunlap 2008; R. E. Dunlap et al. 2000). Over time Dunlap and colleagues research has looked into a slow societal shift away from the "dominant social paradigm" (Pirages and Ehrlich 1974) and adopting beliefs, to some extent, about limits to growth and living "in harmony with nature" (R. E. Dunlap et al. 2000). While some of the facets of the NEP can be thought of as measuring sustainability, it is important to note that the NEP was neither designed

nor intended to be used to measure anything other than one's subscription to an ecological worldview. It has, however, been used to measure environmental concern, environmental values, and environmental attitudes. Increasingly, and appropriately, it is used to measure environmental beliefs (Riley E Dunlap 2008).

The NEP's ability to measure a person's worldview, a directly unobservable latent construct, has been a boon for environmental social science. Being able to quantify one's environmental beliefs and use that data to conduct statistical analyses enables researchers to test new hypotheses and put forward new theory. One example of this is the creation of the Value-Belief-Norm theory (Stern et al. 1999), which used the NEP, among other latent constructs, to produce a social-psychological map of the primary motivating factors necessary for an individual (and society) to support a social movement. Like the NEP, the VBN theory has since been applied to many different contexts, some of them directly related to sustainability, such as sustainability efforts in multi-national corporations (Andersson et al. 2005), sustainable behaviors among college students (Whitley et al. 2016), and educating for transformative sustainable action (Frisk and Larson 2011).

Both the NEP and VBN theory pinpoint cognitive, emotional, and attitudinal factors that influence behavior. In doing so they also illustrate why defining and measuring latent constructs is important; enabling greater comprehension beyond simply whether one does, or does not behave a certain way, to begin to explain why. Gaining in-depth knowledge of relevant latent constructs within sustainability research will have two immediate effects. First, researchers can expand our knowledge by including more factors in conjunction with studying directly observable behaviors. When looking to explain why people engage (or fail to engage) in sustainable behaviors, including sustainability attitudes, values, or motivations will allow researchers to account for greater variability in the dependent variable of interest. For example, when explaining recycling behavior, researchers typically examine external factors such as promotion of a recycling program, the availability of recycling bins, and ease of recycling (e.g. comingled recycling). Yet, if results did not reveal the expected impact of these external factors, the next logical explanation points to within-group variance; individual differences. Studying latent constructs would explore this within-group variance, as beliefs, knowledge, and emotions related to recycling vary between people. Given the range of multivariate data analytic techniques available, researchers can discern the individual and combined contributions of each variable. Thus, by including these latent constructs in research efforts, scientists can better understand why recycling rates are what they are.

Second, latent constructs would broaden social scientific investigations of sustainability overall. Given the science's cyclical nature of idea creation and exploration, an increase in the diversity of sustainability related inquiry opens up the field for more scientists to conduct cutting edge research. Advances in methodology arguably lead to theoretical development as well. Gerontology, again, offers an example of this progress. As new ideas, research questions, and methodologies developed with advancing data analytic techniques, theory developed as well (Schaie 1988). The same could occur in sustainability research because studying

latent constructs would broaden the range of testable questions researchers can ask. Our call echoes Dunlap (2008), who notes that the NEP was useful in the advancement of other, perhaps unexpected theories of risk perception, predicting willingness to pay, and the reasonable developmental differences in sustainability thoughts and concepts between children of different ages.

Including latent structures in research does increase the complexity of conducting research because latent structures are more difficult to study than directly observable, overt behaviors. Nonetheless, other areas of research (e.g. cognition) have succeeded in developing valid and reliable means for defining and studying latent phenomena. The task before us, then, is to create measures and methods to do the same within sustainability research. A task that the authors believe is necessary and attainable.

2 Measuring Sustainability Knowledge and Attitudes

Motivated by these possibilities, the authors endeavored to measure two important latent constructs with a specific focus on sustainability. The resulting Assessment of Sustainability Knowledge (ASK) and Sustainability Attitudes Scale (SAS) were created and tested with the help and expertise of many colleagues. These scales are humbly put forward to be used, criticized (with hope, constructively!), debated and improved. The authors do not pretend that these measurements are without flaws, but do believe they represent a strong step forward towards building social science theory that equally incorporates the three domains of sustainability. Each scale was developed, treating sustainability as a single underlying construct comprised of three factors, pre-tested, and tested independently across different institutions to best assess their validity. A brief description of the development of the two scales, what precisely each is and is not measuring, and how to best use them for research and evaluation is presented below.

2.1 Assessment of Sustainability Knowledge (ASK)

The ASK was first developed in 2014 with input from a large pool of subject experts (Zwickle et al. 2014). This original 16 question measure has been used for variety of purposes and in a range of academic settings. In the following years the question pool was expanded to 28 as a result of fruitful collaboration with colleagues at the University of Maryland. Where the original ASK had intentionally focused on domain specific knowledge items (questions that were strictly focused on environmental, economic, or social concepts), researchers at the University of Maryland had taken the opposite approach. The items created for their knowledge assessment focused on concepts that blended two and sometimes all three domains together. As the broader subject of sustainability contains some concepts that may

be specific to a single domain and others that integrate multiple systems, combining some of each question increased the construct validity of the ASK.

This expanded question set was then tested, shortened, and retested in multiple waves of surveys administered to undergraduate students *(publication forthcoming)*. Decisions to remove questions from the pool were based on both their content as well as confirmatory factor analysis and item response theory, following the same procedure used in Zwickle et al. (2014). The final result is a 12 item scale with a blend of questions of varying difficulty covering the environmental, economic, and social domains (Table 1). Obviously many important concepts will be left out of a knowledge assessment containing only a dozen questions. However, the concepts that are covered in the ASK have been found to be correlated with a greater amount of sustainability knowledge overall. Just as the National Science Foundation has been measuring the public's understanding of science for years with only nine true or false questions (Natinoal Science Board 2016; Miller 1998, 2004), not every concept needs to be directly assessed in order to accurately measure the extent of one's knowledge. Identifying those concepts which serve as an indicator, or keystone, for numerous others makes it possible to use fewer items to return the essentially the same score. Finally, the ASK has demonstrated strong convergent validity, with students majoring in sustainability related areas averaging higher scores than other students, seniors averaging higher scores than freshmen, and ASK scores significantly correlated with measures of environmental concern and attitudes (Zwickle et al., *forthcoming)*.

Table 1 Revised 12 question assessment of sustainability knowledge (ASK; Zwickle, Koontz, Hamm, *forthcoming*). *correct answers in bold, a "Don't know" option was also given*

1. What is the most common cause of pollution of streams and rivers?
a. Dumping of garbage by cities **b. Surface water running off yards, city streets, paved lots, and farm fields** c. Litter near streams and rivers d. Waste dumped by factories
2. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from?
a. Acid rain b. Climate change c. Sudden changes in temperature **d. Harmful UV rays**
3. Which of the following is an example of sustainable forest management?
a. Setting aside forests to be off limits to the public **b. Never harvesting more than what the forest produces in new growth** c. Producing lumber for nearby communities to build affordable housing d. Putting the local communities in charge of forest resources

(continued)

Table 1 (continued)

4. Of the following, which would be considered living in the most environmentally sustainable way?
a. Recycling all recyclable packaging **b. Reducing consumption of all products** c. Buying products labeled "eco" or "green" d. Buying the newest products available
5. Which of the following is the most commonly used definition of sustainable development?
a. Creating a government welfare system that ensures universal access to education, health care, and social services b. Setting aside resources for preservation, never to be used **c. Meeting the needs of the present without compromising the ability of future generations to meet their own needs** d. Building a neighborhood that is both socio-demographically and economically diverse
6. Over the past 3 decades, what has happened to the difference between the wealth of the richest and poorest Americans?
a. The difference has increased b. The difference has stayed about the same c. The difference has decreased
7. Many economists argue that electricity prices in the U.S. are too low because…
a. They do not reflect the costs of pollution from generating the electricity b. Too many suppliers go out of business c. Electric companies have a monopoly in their service area d. Consumers spend only a small part of their income on energy
8. Which of the following is the most commonly used definition of economic sustainability?
a. Maximizing the share price of a company's stock **b. Long term profitability** c. When costs equal revenue d. Continually expanding market share
9. Which of the following countries passed the U.S. to become the largest emitter of the greenhouse gas carbon dioxide?
a. China b. Sweden c. Brazil d. Japan
10. Which of the following is a leading cause of the depletion of fish stocks in the Atlantic Ocean?
a. Fishermen seeking to maximize their catch b. Reduced fish fertility due to genetic hybridization c. Ocean pollution d. Global climate change

(continued)

Table 1 (continued)

11. Which of the following is the best example of environmental justice?
a. Urban citizens win a bill to have toxic wastes taken to rural communities b. The government dams a river, flooding Native American tribal lands to create hydro-power for large cities **c. All stakeholders from an indigenous community are involved in setting a quota for the amount of wood they can take form a protected forest next to their village** d. Multi-national corporations build factories in developing countries where environmental laws are less strict.
12. Put the following list in order of the activities with the largest environmental impact to those with the smallest environmental impact:
A. Keeping a cell phone charger plugged into an electrical outlet for 12 h B. Producing one McDonald's quarter-pound hamburger C. Producing one McDonald's chicken sandwich D. Flying in a commercial airplane from Washington D.C. to China
a. A, C, B, D b. D, A, B, C c. D, C, B, A **d. D, B, C, A**

2.1.1 Using the ASK

It is important to remember that by design the ASK only measures knowledge. It does not measure anything related to one's behavior, nor their capacity for bringing about behavioral change. Keeping this strict focus in mind is imperative when deciding when to administer the ASK. The most logical and practical use is to evaluate the effectiveness of an educational program through either a pre and post-test, or by comparing a treatment group to a control. For example, if a new sustainability-focused major or minor is being created, the ASK can be given to students prior to its implementation and again after students complete the program. Alternatively, if a student's major is known, comparisons can be made between programs to assess their relative effectiveness at teaching the core concepts of sustainability knowledge (see Zwickle et al. 2014 for example analyses).

The limitations of using each approach should be well understood, to avoid making unjustified claims based upon the data. Unless the targeted population is both well-known and homogenous, knowledge gains measured via pre-post tests may not be solely attributable to the academic program of interest. In other words, if students in a sustainability major commonly take outside elective courses that also are oriented towards sustainability, it is possible that students learned those core concepts elsewhere. This limitation can be addressed by either controlling for courses taken outside the major (if the sample size is sufficiently small), obtaining a

large enough sample (if possible) to introduce more random variance, or selecting a related group of students to compare knowledge gain to (Did students in the sustainability major show greater gains in sustainability knowledge than students in, say, environmental science?).

The importance of finding a appropriate comparison group highlights the primary limitation of comparing a sustainability major or minor to another academic program: the fact that students who choose a sustainability major likely have higher levels of sustainability knowledge than the general population prior to entering the classroom. Therefore the entire difference in knowledge scores between sustainability majors and non-majors cannot be attributed to classroom instruction alone. The exact magnitude of this bias can be easily measured however, by comparing scores of incoming students (who have chosen the sustainability major but not yet taken a class) to their peers in other fields. This value may be subtracted from the overall score of students who have completed the program for a more accurate evaluation of a sustainability curriculum when comparing to peers in other majors.

More related to our previous discussion, the ASK's exclusive focus on knowledge enables social scientists to test the effect that sustainability knowledge has in theoretical models. If a single measure were to address multiple constructs (e.g., knowledge, mindset, behavioral intention), the individual effect of each variable cannot be parsed out analytically. In order to test the influence of each of these on a dependent variable, each one must be measured individually and entered as a separate independent variables in a regression model.

This analytical approach was used to test the "information deficit model," which suggests that if students only knew more about sustainability they would adopt more sustainable behaviors. This model of behavioral change has been found to be ineffective by risk communication (and other) scholars, though some researchers have concluded that adding sustainability related learning goals into the curriculum will lead to more sustainable behaviors among students. This assumption was empirically tested by measuring knowledge in conjunction with other latent constructs in a single study. Heeren et al. (2016) conducted a survey of university undergraduate students using the theory of planned behavior (TPB) to predict one's willingness to engage in various pro-environmental behaviors. The ASK was included in addition to the TPB to measure to the extent that knowledge played a role in a student's behavior after taking into account attitudes, norms, and perceived behavioral control. As past research had predicted, knowledge was found to have very little influence in students' behavior. By using the ASK to test existing theory in this new context, it was shown that one cannot simply expect students to change their behavior after receiving sustainability oriented curricula.

2.2 Sustainability Attitudes Scale (SAS)

The development of the SAS began in 2010 with an interest to measure the three-domain model of sustainability presented by Brundtland et al. in 1987. The initial aim was to measure both the independent domains (ecological, economic,

and social) as well as the intersections of those domains. An initial pool of 74 items was created at Central College by consulting experts in the three domains with the intent to reduce the number items in the scale. The first wave of participants (college students) completed the measure in 2011 in an exploratory examination of potential structures within the SAS. Schutte and Jones (2012) reported three structures across 26 items that did not conceptually align exactly with the theoretical model. Although the three structures (social justice, social-economic, self-entitlement/privilege) were consistent within a larger sustainability framework and showed good convergent validity with other measures (Schutte and Jones 2012), the relatively small sample size in this study necessitated subsequent studies with larger samples to improve reliability and validity of the measure.

A follow-up study using a sample of roughly 400 first-year college students helped address the sample size issue, but it revealed different structures from the 74-item pool (Campbell and Jones 2015). In fact, exploratory factor analysis revealed factors that had multiple plausible conceptual interpretations. Testing the larger pool of SAS items in pre/post-test within-group comparison of a smaller sample of these 400 students after they had graduated revealed a different set of sustainability factors. At this point, the SAS was a potentially beneficial measure of sustainability attitudes but it did not align with the three domain model. Developing the SAS, however, had two needs: obtaining a more representative sample and expanding the statistical analyses for item reduction.

In 2016, the full pool of SAS questions was tested with roughly 1,000 undergraduates at Michigan State University. These data were analyzed using confirmatory factor analysis (confining the data to three environmental, social, economic factors) and Item Response Theory (IRT, used to select better discerning items with a range of difficulty). Thus, the authors were able to address both issues from the previous data sets. These analyses revealed that 11 items could measure the three factors consistent with the three domain model of sustainability with good internal reliability (with Cronbach alpha levels ranging from 0.74 to 0.78) (Jones and Zwickle, *forthcoming*; Table 2). To further test the SAS's validity, a follow-up study of 1,895 undergraduates compared the SAS's predictive ability against the typical measure of sustainability attitudes, the New Ecological Paradigm (NEP). Participants completed the SAS, NEP, and a range of questions pertaining to sustainability behaviors and beliefs (e.g. How actively do you look for ways to reduce electricity use? My university should aspire to carbon neutrality.) This study revealed that while the NEP significantly predicted these behavior and beliefs, the SAS did so with greater correlation coefficients (when controlling for variables such as political party, and social and economic ideology) (Jones and Zwickle 2016). Combined, these two studies show the 11-item Sustainability Attitudes Scale has established both internal reliability, construct and content validity, as well as predictive power that aligns with a view of sustainability that is comprised of ecological, economic, and social domains.

Table 2 Sustainability attitudes scale (SAS; Jones & Zwickle, *forthcoming*)

1. Equal rights for all people strengthens a community
2. Community cooperation is necessary to solve social problems
3. Generally speaking consumerism is not sustainable
4. Access to clean water is a universal human right
5. I am willing to put forth a little more effort in my daily life to reduce my environmental impact
6. An unsustainable economy values personal wealth at the costs of others
7. I believe that many people can work together to solve global problems
8. Clean air is part of a good life
9. Our present consumption of natural resources will result in serious environmental challenges for future generations
10. The well-being of others affects me
11. Biological diversity in itself is good
All items set to a 1—Strongly Disagree, to 6—Strongly Agree, scale *Scoring note:* Overall measure of sustainability attitude: Calculate mean of all 11 items Ecological Sustainability Subscale: Calculate mean for Items 4, 8, 9, and 11 Social Sustainability Subscale: Calculate mean for items 1, 2, 7, and 10 Economic Sustainability Subscale: Calculate mean for items 3, 5, and 6

2.2.1 Using the SAS

One of the benefits of the SAS is its combined precision and scope. Like the ASK, the SAS measures a single construct, sustainability attitudes, enabling statistical analysis and hypothesis testing. The contents of the SAS have high construct validity for the commonly accepted definition of sustainability, so it provides a wider, multidimensional scope than other measures. The relatively few number of items also allows for efficient, yet reliable, insight to people's views towards sustainability.

The SAS also would be applicable in both narrow and wide efforts to understand sustainability attitudes. The measure is suitable for detecting individual dispositions and more general population perspectives. Thus, the SAS is appropriate for one-time assessment of individuals and groups, but it also is useful for detecting development or change over time in situations evaluating the effectiveness of pro-sustainability efforts (e.g. curricula, institutional programming).

The practical usability of the measure is complimented by its theoretical basis. The three domain conceptualization of sustainability has shown to be, well, sustainable. The stability of this conceptualization is reflected in the SAS, as the SAS

shows that the three domains are cognitively linked among individuals. Thus, an individual's score for the three separate domains, or a combined score, can be used to predict related sustainability outcomes. In fact, as new theoretical models of sustainability develop the SAS can be used as one method of assessing their validity.

2.3 Limitations and Constraints

While the sustainability knowledge and attitudes measures submitted here have been shown to be valid and reliable enough to be used for relevant theory testing, they are not without flaws. Two of the ASK items (#6 and #9) are bounded in time, as they reference somewhat current events. This is simply a limitation in question making ability, as the pool of experts were unable to craft questions addressing income disparity and global emissions that were as context neutral as the other items. Similarly, it is possible that the environmental impacts associated with the activities listed in #12 may change over time. The primary constraint associated with the SAS is the effect that social desirability bias may have on respondents. Currently the extent to which this influences responses is not known, but it is possible that respondents may feel that answering more favorably to the items will be perceived in a more positive light.

3 Conclusion

The current state of sustainability focused social science research has undoubtedly benefited from the diverse pool of disciplinary fields it has drawn from. The interdisciplinary research conducted by scientists from various backgrounds has successfully laid a solid foundation of literature largely focused on exploratory and inductive studies. One negative, yet understandable, by-product of this academic diversity is that the sustainability "wheel" has been redesigned a number of times as research published in various disciplinary journals has pursued similar goals, with similar methods, yielding similar results (see the numerous studies on campus energy competitions as one example). It is on this plateau that the field now rests; elevated by this initial research but lacking the theoretical foundation to climb much higher.

Substantial, quality sustainability research certainly is being conducted, research that brings existing and relevant theories to test in the sustainability domain in order to paint a fuller picture of individual behavior. The work of Shahzeen Attari and colleagues, for example, have used numeracy and the NEP to explain inaccurate perceptions in water and energy use (Attari 2014; Attari et al. 2010) and framed behavioral barriers in terms of existing theory (Lute et al. 2015). The authors hope to add this number with the ASK and SAS presented in this chapter. The ASK has already been used to challenge the assumption that sustainability education will

result in behavioral change (Heeren et al. 2016), echoing past findings in communication research. Moving forward, the SAS provides an attitudinal measure specifically targeted to the three domain definition of sustainability. This focus increases its construct validity compared to past studies which have used the NEP as a proxy measure for sustainability attitudes. Looking forward, as the number of new sustainability focused academic journals continues to grow, the authors are optimistic that the amount of theoretically focused research will increase as well.

Testing existing theory is an effective way to learn how the current extent of our knowledge does, or does not, translate to the realm of sustainability. But when these theories perform differently than expected, it signals that new theory is needed. For example, using the NEP as proxy measure for sustainability attitudes is not theoretically valid, and doing so would impede future research. As the NEP can effectively measure environmental beliefs, perhaps the differences between the SAS and the NEP can shed light on what it means to be socially and economically sustainable. Developing measures for other latent constructs unique to sustainability (such as values, beliefs, perceptions, etc.) will help us discern the extent that this field is different than others. As these boundaries are delineated it will become clearer what is, and what is not, sustainable.

Therefore the authors contend that it is time for sustainability research to take a bold step forward. As a research community, let us accept the Brundtland definition of sustainability and recognize that in order for a society to be sustainable it needs to meet today's environmental, economic, and social needs without comprising the ability of future generations to do the same. Uniting behind this definition may be a mere formality at this point, but doing so will hopefully free some researchers to pursue the more difficult (and basic) questions like: What is social sustainability? The authors call on a thick-skinned sociologist or political scientist to make an initial attempt at a definition (and call on the rest of the field to be kind in their criticism!). Likewise for economic sustainability: the time is ripe for a brave economist to put forth suggested guidelines for a sustainable economy. This work will require moving beyond basic interdisciplinary research towards a transdisciplinary approach (Kumar Giri 2002; Max-Neef 2005) in order to fully incorporate the accumulated knowledge of each of our academic traditions. By doing so we, as a community of scholars, can begin to work towards some form of consilience; a necessary first step in the overall goal of achieving a truly sustainable society.

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