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Article

Synthesizing the Experiments and Theories of Conservation Psychology

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Abstract: Within the field of environmental psychology, there are two distinct bodies of literature. First, there are experimental studies that have evaluated techniques for getting people to perform conservation behaviors. Second, there are theoretical studies that have surveyed people to create some type of theoretical model that explains conservation behaviors. These two types of research almost never overlap. This research project attempts to bridge these two literatures. Specifically, we coded over 100 environmental experiments for the type of treatment that each one employed and the effect size that was reported. Then we mapped the ten leading treatments on to the main components of six leading theoretical models. Our findings indicate that a moderate amount of variance in the effect sizes of the experimental literature is explained by the theoretical models and that one of the strongest predictors of conservation behavior is the situation or context. While we acknowledge the limitations of our method, this research raises a fundamentally important question: Why are our theories somewhat limited at predicting the behavior patterns that we see in our experiments? Are our theories built on the wrong set of psychological constructs, or are our experiments manipulating the wrong set of variables?

Keywords: conservation psychology; conservation behaviors; meta-analysis; experimental studies; theoretical studies; synthesizing

1. Introduction: Overview of the Literature of Conservation Psychology

The field of conservation psychology (or environmental psychology, see Saunders [1] for a formal definition) has at its foundation the idea that we can use psychological principles to mitigate environmental problems. The urgency of addressing these problems has been documented elsewhere.

There are several approaches that humanity can use to alleviate these problems, including government policies, education programs, and corporate self-regulation, and it is likely that effectively meeting environmental challenges will incorporate all of these approaches [2,3]. However, there is one factor that every approach has in common: ultimately, individual people have to change their behavior. And if we are talking about individual behavior, then we are squarely in the domain of psychology.

A wide variety of scientific research spanning the last several decades has shown that, indeed, the application of psychological principles can influence individual behavior related to environmental issues. This body of research is divided into two approaches based on the method used to collect the data: experimental and theoretical. In the experimental approach, researchers use experimental designs to promote conservation behaviors. Typically, this research compares a treatment or intervention against a control group (or baseline measurement) to test the effectiveness of the treatment at promoting behaviors. These research designs include a measurement of performance of an actual behavior as the dependent variable. In the theoretical approach, researchers use surveys to assess how various psychological constructs are related to conservation behaviors. Typically, this research assesses a variety of underlying psychological constructs (e.g., attitudes, knowledge, motives, values, norms) that are hypothesized to influence conservation behavior. It also relies on participants to self-report how much or how frequently they engage in environmental behaviors. Armed with this correlational data, the researchers attempt to build a theory of conservation behavior.

Rarely do these two approaches overlap. Rarely do the experiments seek to support the theories, and rarely do the theories utilize findings from the experimental research. The purpose of this article is to combine these two approaches together in order to test the theories of conservation psychology.

1.1. Overview of the Experimental Research

There have been hundreds of experiments reported in the literature in which researchers used an experimental methodology to promote conservation behavior. The earliest of these might have been some of the classic work by Kurt Lewin [4] on encouraging people to consume sweetmeats during World War II, although conserving environmental resources might not have been the driving motive behind this research. In the early 1970s, research started appearing on behaviors such as purchasing beverages in returnable bottles [5] and using public transportation [6].

Despite the long history of experiments on conservation behavior, there have been only a few attempts to systematically synthesize this literature (Osbaldiston & Schott [7] summarized 11 reviews completed since 1981). The starting point for the analysis here is a recent meta-analysis [7] that found ten commonly used treatments or interventions for promoting conservation behaviors that have been tested using experimental designs. The ten treatments identified in that meta-analysis are (1) *making it easy* or changing the situational conditions to make the behavior more convenient, (2) using *prompts* or reminders to call attention to when or where it is appropriate to perform the behavior, (3) providing *justifications* or rational reasons as to why the behavior should be performed (this is also called declarative information, why-to information, or awareness of consequences), (4) providing *instructions* on how to perform the behavior (this is also called procedural information or how-to information), (5) providing *feedback* about the extent to which a person has performed the desired behavior, (6) providing *rewards* or incentives for performing the desired behavior, (7) *social modeling* wherein

information about the desired behavior is passed from one group to the other and is modeled or demonstrated, (8) utilizing *cognitive dissonance* to access pre-existing attitudes or beliefs that are consistent with the desired behavior, (9) asking people to make a *commitment* to perform the behavior, and (10) asking people to *set goals* to perform the behavior. Osbaldiston and Schott defined each of the treatments and provided representative examples of research that uses each one of them (pp. 272–273). Osbaldiston and Schott were not trying to find a theory that explained all the data, but they did organize the 10 treatments into 4 larger groupings: convenience, information, monitoring, and social-psychological processes. There are three major shortcomings of the experimental literature. First, although practically every action that we do (or fail to do) has some environmental impact, the experimental research on conservation behaviors has focused heavily on just a small set of behaviors. Recycling has been the most commonly studied behavior, followed by energy conservation (usually operationalized as household energy, be it electricity or heating fuels), water conservation (again, usually at the household level), and gasoline conservation. (Although recycling has been the most studied, it is probably not the most important behavior to change with respect to obviating our environmental problems. For example, Dietz and colleagues [8] did a complete accounting of the carbon emissions of 17 household actions, and the group of actions that has the greatest potential to reduce carbon emissions is fuel conservation through driving fuel-efficient vehicles, carpooling and trip-chaining, and driving behavior.)

Second, as Osbaldiston and Schott [7] noted, the experimental research would be a more complete picture if each of the ten treatments had been factorially crossed with each of the four behaviors. If this were so, then an important research question could be answered, namely "Which treatments are most effective for promoting which behaviors?" However, the research literature is not complete, and there have not been sufficient tests of treatments and behaviors to conclusively answer this question. Said more statistically, there is a large amount of unexplained variance in the data. Osbaldiston and Schott found some general trends, but the study of experimental treatments alone does not completely answer the question "How do we get people to engage in conservation behaviors?"

Third, most of the studies included in the earlier meta-analysis [7] do not employ one and only one treatment; rather, most of the experiments are based on confounding two or more treatments. This is an effective strategy from a conservation behavior perspective. If one hopes to promote conservation behavior, then it makes sense to use multiple treatments because they will be more powerful. Further, it is virtually impossible to not combine some treatments. For example, it is difficult to ask people to make a commitment to engage in a behavior without also providing them justifications for doing the behavior and instructions for how to do it. However, this is a poor strategy from a research methodology perspective. The confounding of treatments makes it very difficult to assess the effect of each treatment independently.

Although there are some shortcomings with the set of experiments that have promoted environmental behaviors, there is one undeniable strength; all of these studies have used an objective measurement of an actual environmental behavior. The outcomes of these experiments were actual behavioral changes that could be measured in objective terms like pounds of paper recycled, kilowatt-hours of electricity conserved, or gallons of gasoline saved. One of the criteria of inclusion in the Osbaldiston and Schott [7] meta-analysis was that the study had to objectively measure actual behaviors. This point stands in contrast to what is done in theoretical research, which we turn to now.

1.2. Overview of the Theoretical Research

There have also been hundreds of studies that examined the underlying variables of conservation behavior using some sort of correlational research design. The general goal of these correlational studies has been to propose a model that explains conservation behavior. Typically, this is done by using linear regression to test a set of predictor variables or by using structural equation modeling (or path analysis) to test a model that includes both exogenous variables and mediator variables. Thus, most of these studies examine the collected data and propose the model that best explains the fit of the data. Each study usually makes some suggestion as to what the strongest predictors of environmental behavior are.

1.2.1. Strengths and Weaknesses of Theoretical Research

The great strength of this approach is that it allows researchers to use multiple predictor variables in the models. Rarely is behavior the product of only one or just a few variables; frequently, a large number of variables are in play when a person is engaging in a new behavior. And many of the variables subdivide in subtle but important ways. For example, norms influence behavior, but there are differences between personal norms, interpersonal norms, and social norms [3]. Similarly, there are differences between how-to information, why-to information, and when-to information. Experiments allow researchers to manipulate just a few independent variables, but correlational designs allow researchers to measure a much larger number of predictor variables.

In terms of weaknesses, unfortunately, the correlational literature is even more piecemeal than the experimental literature. There is wide variability in how variables are defined and operationalized. There are many different operationalizations of standard concepts such as attitudes, knowledge, skills, values, norms, beliefs, and motives.

This variability is most acute when looking at the outcome variable. Because most of these studies are done using surveys, only a small percentage actually observes conservation behavior; rather, most of them are based on self-report measures. Some studies ask globally about conservation behaviors in general, sometimes they use a particular subset of behaviors (that can be either a related set or a deliberately diverse set), and sometimes they focus on just one behavior. Some studies ask about behavior that has been performed in the past or is currently being performed, and other studies ask about intentions to perform behaviors in the future.

As evidence of this point, we have located over 60 studies published since 2000 that have used a correlational approach to building or testing theories of conservation behaviors [9–71]. All of these studies relied on self-report of behaviors; none of them actually measured behaviors. We have also located six published studies that have used an objective measure of behavior [72–77]. We do not claim that we did an exhaustive and comprehensive search of these theoretical studies, but the pattern is fairly clear: the vast majority of theoretical studies that rely on the correlational/survey method do not measure actual behavior.

Why is this situation a concern? Some research has been done that has assessed the relationship between self-reports of environmental behavior and actual performance of the behavior. The results seem to vary by what type of behavior is being reported. For household energy bills, estimates of how

much participants paid were not significantly different than fuel company records [78], but participants tended to underestimate how much they paid for oil and they overestimated how much they paid for electricity and bas. For paper recycling, nearly 90% of college students said they recycled, but when given the opportunity to use an obvious recycling bin, only 14% actually used it [79]. For household recycling of cloth, steel, newspaper, glass, cardboard, and aluminum items, correlations between self-reports and observed measurements were 0.01, 0.03, 0.04, 0.09, 0.22, and 0.44, respectively [80]. Finally, for household water use, a comparison of three measurement techniques found that the free recall method significantly underestimated water use [81]. These four studies call into question the validity of self-reports, and in the discussion section, we have more to say about how to minimize these problems. For now, though, we raise the question, "Can we combine the strengths of the theoretical approach—modeling multiple predictors—with the strengths of the experimental approach—measuring actual behavior?"

1.2.2. Six Theories of Conservation Behavior

Next, we review six theories of conservation behavior. Although there are dozens of theories that have been proposed to explain why people engage in conservation behavior, we feel that these theories are representative of the conservation psychology literature. In the Discussion section, we review several other comprehensive theories and explain why they are not appropriate for the analyses that follow.

Hines, Hungerford, and Tomera [82] were the first researchers to attempt to quantitatively synthesize all the studies in the conservation psychology literature. They meta-analyzed the literature, and they concluded that three primary factors are involved in conservation behaviors: personality traits, knowledge and skills, and situational variables. One point to note about the Hines model is that the term personality traits might not match closely onto the contemporary use of that term. Certainly, they were not thinking of personality traits in terms of the five-factor model or other contemporary personality theories. Rather, they defined personality traits broadly as a "desire to act" and included specific constructs like attitudes, locus of control, and personal responsibility.

Whereas Hines [13] quantitatively analyzed the literature, Stern [83] used a narrative (non-quantitative) approach. Stern advanced the ideas that there are four major types of conservation behaviors (activism, public-sphere behaviors, private-sphere behaviors, and other behaviors) and that there are four types of causal variables that support conservation behavior: attitudinal factors, contextual forces, personal capabilities, and habit or routine. Stern used the term "environmentally significant behaviors," so we call this model Stern's ESB model to distinguish it from two other theories that he advanced. (Stern and colleagues [84] developed the values-beliefs-norms model, arguing that values are the first set of variables that drive beliefs, and beliefs in turn drive personal norms, which ultimately drive conservation behaviors, and they also developed a more comprehensive "causal model of environmentally relevant behavior" [3,85] that shows different levels of causal variables.)

Ajzen [86] developed the theory of planned behavior (TPB) not specifically to explain conservation behaviors, but as a general theory to explain many behaviors. It has been a frequently used theory in conservation psychology research [87,88]. Notably, Bamberg and Moser [89] used it as the framework for their meta-analysis of pro-environmental behavior. TPB proposes that three types of variables are

the precursors of intent to action, which is then the precursor to actually taking action. The three types of variables are attitudes, subjective norms, and perceived behavioral control.

Steg and Vlek [90] reviewed the conservation psychology literature and proposed a four-step model for encouraging pro-environmental behavior. Most important to our current research is their third step, design and application of interventions to change behavior. They identified two broad classes of interventions: informational strategies that are designed to change perceptions, motivations, knowledge, and norms; and structural strategies that are aimed at changing contextual factors such as availability, costs, and benefits to make it easier to engage in behaviors.

Hornik, Cherian, Medansky, and Narayana [91] focused on just the recycling literature, and they proposed a framework of variables that have four categorical groups: intrinsic incentives, extrinsic incentives, internal facilitators, and external facilitators. Within these four groups, there were 11 specific types of interventions, and Hornik computed the mean correlation coefficient for the effectiveness of these interventions. The range of correlation coefficients was from 0.17 to 0.54, and the group that had the highest correlations was internal facilitators like knowledge and commitment. They proposed a model in which each of these four groups of variables predicts recycling behavior.

Finally, McKenzie-Mohr [92,93] has developed a program that he calls community based social marketing. This program is similar to Steg and Vlek's [90] approach, but McKenzie-Mohr identifies eight "nuts and bolts" as part of the "tools of change" program: building motivation, feedback, financial incentives, norm appeals, commitment, overcoming barriers, prompts, and communication [94].

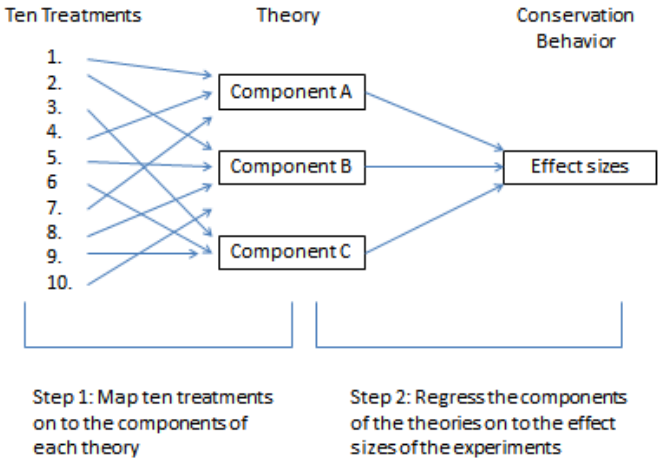
1.3. Purpose of the Present Study and Justification of the Method

Above we have presented information about a meta-analysis of hundreds of experimental studies, and we have also presented information about six theories. An analogy to what we propose to do in this manuscript is the art form of mosaic. A mosaic is a piece of art that is made up of hundreds or thousands of small pieces, perhaps glass or stones, that when viewed from a distance form a meaningful, coherent whole picture. The hundreds of experiments are the pieces of glass, and the theories form the whole picture. We are attempting to assemble the pieces of glass into a whole picture, that is, we will evaluate if the experiments really do support the theories. We think of this as synthetic research; we are attempting to combine individual elements into a meaningful whole.

The present study is an attempt to quantitatively synthesize the experimental studies and the theories on conservation behavior in order to evaluate and compare the competing theories of conservation behavior. We seek to answer the questions "What are the strongest predictors of conservation behaviors?" and "Which theory best explains the variance in the experimental data?" And we seek to answer these questions by using research that has used actual behavioral measurements, not self-reports. We will do this in two steps as illustrated in Figure 1. First, the ten experimental treatments will be mapped on to each of the theories. We call this the synthesis step because the experimental treatments and the theories are combined together. Second, the meta-analysis data set [7] will be used to evaluate the components of the theories. We will regress the theory components on to the effect sizes of the experiments. We call this the meta-analysis step. Our two-step method by which we do this is novel; we know of no other study that has attempted to use this technique. Further,

because we are using results from the published literature, we advance no a priori hypotheses, as is common in meta-analysis.

Figure 1. Diagram of the method used in this study.



Even though our method is novel, each of the steps is commonly done both in the conservation psychology research and in the more general psychology research. For step one, mapping the treatments on to the theories, numerous other published reports have looked at the set of treatments and attempted to form logical groupings of them. For example, Abrahamse, Steg, Vlek, and Rothengatter [95] evaluated all of the studies that examined household energy conservation, and they determined that the treatments could be grouped into six categories: commitment, goal setting, information, modeling, feedback, and rewards. Similarly, Kazdin [96] identified areas that interventions can be built around: education, knowledge and information; message framing; feedback or knowledge of results; decision making; use of the media; incentives and disincentives; social marketing; religion and ethics; and using special contexts and settings. Osbaldiston and Schott ([7], pp. 261–262) created a table that summarizes 11 such reviews. Thus, the process of looking at a set of studies and then forming conceptual groups based on the similarities of the treatments is quite common.

Our approach is unique compared to these other reviews in two ways. First, this research is the first attempt to fit the treatments into categories that other researchers have created. Each of the reviews above started with a blank canvas and created their own categories. However, we started with the theories that have already been developed, and we tried to map the treatments on to those theories. Second, this is the first attempt that we know of in which four experienced researchers each independently coded the treatments on to the theory components. We have computed reliability coefficients for our coding, and we resolved discrepancies before proceeding. Details of this process are presented below in the Method section.

Step two, evaluating the theories using meta-analysis is a common meta-analytic procedure and was developed by Hedges [97,98], and we follow the instructions given by Hedges [99]. The most similar example from the environmental literature is Bamberg's [89] meta-analytic structural equation model where they collected correlation coefficients from the literature and then tested a model of environmental behavior. Our data set did not permit venturing into this type of structural equation modeling, but the point here is that other environmental researchers have used a set of studies to

meta-analytically test an overarching theory. Our research is quite similar to other work in related fields. For example, Barrick, Mount, and Judge [100] meta-analyzed the strength of the Big Five personality traits on work performance. They found the relationship between Big Five traits and work performance from hundreds of studies, and they were able to determine which traits most strongly predict work performance. Similarly, Ozer, Best, Lipsey, and Weiss [101] tested seven predictors of posttraumatic stress disorder symptoms, and they were able to determine which predictors were most strongly related with symptoms. Even though we know of no other study that has used our two-step approach, both of the steps are commonly utilized in the research literature.

2. Method: Synthesis and Meta-Analysis

This research is a two-step process: first, synthesize together the experimental treatments and the theories, and second, meta-analyze the theories for how well they predict conservation behavior. For the synthesis step, each of the ten treatments from the experiments will be mapped on to a component of each theory. For the meta-analysis step, we will use the synthesis step to form the predictor variables, and we will use the effect sizes from our earlier meta-analysis [7] as the outcome variables to evaluate which theories are most effective at predicting conservation behaviors.

2.1. The Synthesis Step

Recall that Osbaldiston and Schott [7] found ten treatments (listed in the Introduction section) that are used to promote conservation behavior in the experimental literature. Further, above we reviewed six theories that explain conservation behavior from the theoretical literature. Each theory includes several concepts that are believed to be necessary to foster conservation behavior. In the synthesis step, we attempt to map the ten treatments on to each theory's components. Specifically, we examined each treatment and tried to determine which component of each theory it falls under or is most relevant to.

As an example of this, consider the theory advanced by Hines [82] that posits there are three main groups of variables that promote conservation behavior: knowledge and skills, personality traits, and situational variables. Looking at the list of ten treatments, treatments like providing instructions, providing justifications, and providing feedback are all treatments that map on to knowledge and skills. Further, treatments like providing rewards, providing prompts or reminders, and making it easier all map on to the situation or context. Finally, treatments like cognitive dissonance and commitment map on to personality traits (recall that Hines used a rather loose definition of personality traits in their model). By mapping the ten treatments on to the components of each theory, we have synthesized the experimental and theoretical literatures.

More formally, four researchers who are knowledgeable of the conservation psychology literature independently mapped the treatments on to the theories. Each researcher was given a sheet that overviewed nine theories (the six discussed above plus three additional theories that we will discuss in the Discussion section), including the actual diagram or definitions of the theory from the original article. Then they independently completed a worksheet wherein they mapped each of the ten treatments on to each of the components of each theory. They were instructed to use the "none or one" criteria in that each treatment could map on to no more than one theory component. The coding

worksheets were collected by the author, the data were entered in to SPSS, and reliabilities were computed. The results of the mapping are presented in Table 1.

Table 1. Mapping the ten treatments on to the major components of the three theories.

	Hines	**Stern ESB**	**TPB**	**Steg & Vlek**	**Hornik**	**McKenzie-Mohr**
Making it easy	Situation	Contextual factors	PBC	Structural strategy	External facilitator	Barriers
Prompts	Situation	Contextual factors	Not included	Structural strategy	External facilitator	Prompts
Justifications	Knowledge	Attitudinal factors	Attitudes	Informational strategy	Internal facilitator	Communication
Instructions	Knowledge	Personal capabilities	PBC	Informational strategy	Internal facilitator	Barriers
Feedback	Knowledge	Personal capabilities	PBC	Informational strategy	Internal facilitator	Feedback
Rewards	Situation	Contextual factors	Not included	Structural strategy	Extrinsic incentives	Financial incentives
Social modeling	Knowledge	Contextual factors	Subjective Norms	Informational strategy	Extrinsic incentives	Norm appeals
Cognitive dissonance	Personality traits	Attitudinal factors	Attitudes	Informational strategy	Intrinsic incentives	Not included
Commitment	Personality traits	Not included	Not included	Informational strategy	Internal facilitator	Commitment
Set goals	Personality traits	Not included	Not included	Not included	Internal facilitator	Building motivation

Regarding the reliabilities, Cohen's kappa is generally the statistic that is computed for coding categorical data like this, but Cohen's kappa is only valid for two coders. Because we have four coders, we had to use the more sophisticated Fleiss kappa, including the special macro written for SPSS [102]. The Fleiss kappa for the codings was 0.64, which is above the 0.60 cut off for "substantial agreement" [103] or "good agreement" [104]. Further, of the 90 codings, each coder was asked to make, all four coders agreed on 43 of them, and three out of four agreed on another 40. After the reliabilities were computed, the four coders met and resolved the discrepancies such that one final set of codings was mutually agreed upon. Even though we achieved a high level of agreement independently and were able to come to consensus on all of the codings, we still feel that there is a lot of gray area here. It is quite reasonable to argue that some of the treatments cross lines of the theory components. We coded using the "none or one" criteria, namely, that each treatment could map on to none or one component of each theory. We felt this criteria was the most parsimonious starting place. Researchers in the future may wish to explore alternative coding criteria. We have presented our results in Table 1 so that other researchers can follow our logic, but we also agree that there are other justifiable outcomes to the coding process.

2.2. The Meta-Analysis Step

The process of forming the predictor variables for the regression analysis of the meta-analysis was more complicated than this mapping system. First, Osbaldiston and Schott [7] coded each study for the extent that it used each one of the ten treatments, using a 4-point scale "coding rating", from 0 to 3, where 0 indicated the treatment was not used in the study at all, and 3 indicated that the treatment was a primary focus of the study. Second, recall that a theory component (e.g., knowledge and skills) can contain one or more treatments (like providing instructions, providing justifications, and providing feedback). We added together the coding ratings for all of the treatments that fell under each study component. Thus, our data set contained all of the components of each theory, and for each experiment there was a numerical value that represented the extent to which that component of the theory was present in that particular experiment.

We acknowledge that there is no methodological precedent for such an analysis, and although this system is rather simplistic, it seemed like an appropriate starting point for these analyses.

The regression analysis used the values of the theory components as the predictor variables and the effect sizes as the outcome variables. Each theory was tested separately to determine the strength of each component's predictive ability; in this way, we could determine which components of each theory are the strongest predictors of conservation behavior. To determine which model has the most explanatory effect, the overall R-squared values for the models were compared. However, there are two important corrections to keep in mind for the regression analysis.

The first correction concerns the standard deviations of the regression coefficients. The computations were performed using a weighted regression technique in SPSS following the instructions of Hedges ([99], pp. 295–296). The studies do not count equally as though they were participants in a normal analysis because the studies have differing sample sizes and variances. Therefore, the studies were weighted by the inverse of the variance of the effect size estimate. For this type of analysis, SPSS correctly reports the regression coefficients, but not the standard deviations and tests of significance; therefore, two corrections need to be made. First, the standard deviation of the slope needs to be corrected by dividing the value provided by SPSS by the square root of the mean squared error of the model. Second, the significance of the regression coefficient can be determined by a Z-test where the coefficient is divided by this corrected standard deviation, and the appropriate *p*-value can be determined.

The second correction concerns the R-squared statistic. In a normal regression analysis, R-squared is the percent of variance in the dependent variable explained by the predictor variables. However, that interpretation does not hold for meta-analysis. Hedges ([99], p. 298) explained the distinction between the total amount of variance and the total amount of *explainable* variance. The total amount of variance in a set of effect sizes is not all explainable by the predictor variables because the set of effect sizes necessarily contains some nonsystematic and sampling error. Thus, the R-squared values that are produced by these regression analyses will seem lower than would have been expected. To correct for this, we first computed the total amount of explainable variance in the data set, and from that we computed the percentage that each of the theories accounted for.

3. Results: Meta-Analysis of the Synthesis

3.1. Evaluation of Each Theory

As noted above, our data set of effect sizes contains some variation that cannot be explained by the predictors. This variation is due to sampling error and other sources of nonsystematic variance. Given that the data set came from a varied set of experimental studies, it is not surprising that there is a large amount of unexplainable variance. To determine the amount of variation in the data set that can be explained by the 10 treatments, we first ran a weighted regression using the 10 treatments as predictors of the effect sizes and the inverse of the variance of the effect size as the weighting variable, in accordance with the Hedge's [99] directions. For this analysis, the percent variance explained in the data set is 19%. This is the total amount of explainable variation in the data set. In the analyses that follow, we will compute the amount of explainable variation due to the models as a percentage of this 19%.

Hines [82] proposed that knowledge and skill, personality factors, and situational factors were the three variables that promote conservation behavior. When the codings from the synthesis step were used as predictors for the effect sizes, the overall model had an R-square of 0.08, and it explained 42% of the explainable variance. Further, the standardized coefficients, corrected standard errors, and *p*-values for knowledge and skills were: −0.16, 0.006, <0.001, for personality traits were 0.19, 0.009, <0.001, and for situational factors were 0.15, 0.008, <0.001.

Stern's [83] ESB model proposed that four causal variables support conservation behavior: attitudinal factors, contextual forces, personal capabilities, and habit. No treatments mapped on to habit. When the codings from the synthesis step were used as predictors for the effect sizes, the overall model had an R-square of 0.08, and it explained 43% of the explainable variance. Further, the standardized coefficients, corrected standard errors, and *p*-values for attitudinal factors were 0.06, 0.008, <0.001, for contextual forces were 0.11, 0.007, <0.001, and for personal capabilities were −0.21, 0.007, <0.001.

TPB [86] posits that three variables are related to intent to act, and they are attitudes, subjective norms, and perceived behavioral control. When the codings from the synthesis step were used as predictors for the effect sizes, the overall model had an R-square of 0.05, and it explained 28% of the explainable variance. Further, the standardized coefficients, corrected standard errors, and *p*-values for attitudes were 0.01, 0.008, <0.001, for subjective norms were −0.01, 0.012, 0.40, and for perceived behavioral control were −0.23, 0.006, 0.13.

Stek and Vleg [90] identified informational strategies and structural strategies as the two main types of interventions that promote conservation behavior. When the codings from the synthesis step were used as predictors for the effect sizes, the overall model had an R-square of 0.03, and it explained 17% of the explainable variance. Further, the standardized coefficients, corrected standard errors, and *p*-values for informational strategies were −0.05, 0.005, <0.001, and for structural strategies were 0.15, 0.008, 0.07.

Hornik [91] proposed that internal facilitators, external facilitators, intrinsic incentives, and extrinsic incentives were the four variables that promote conservation behavior. When the codings from the synthesis step were used as the predictors for the effect sizes, the overall model had an R-square of 0.14, and it explained 74% of the explainable variance. Further, the standardized

coefficients, corrected standard errors, and *p*-values for internal facilitators were −0.13, 0.006, <0.001, for external facilitators were 0.23, 0.008, <0.001, for intrinsic incentives were 0.25, 0.014, <0.001, and for extrinsic incentives were −0.24, 0.009, <0.001.

McKenzie-Mohr [92,93] identified eight tools of change: motivation, feedback, incentives, norm appeals, commitment, overcoming barriers, prompts, and communication. When the codings from the synthesis step were used as the predictors for the effect sizes, the overall model had an R-square of 0.13, and it explained 67% of the explainable variance. Further, the standardized coefficients, corrected standard errors, and p-values for motivation were 0.05, 0.028, <0.001, for feedback were −0.10, 0.010, <0.001, for incentives were −0.05, 0.012, <0.001, for norm appeals −0.00, 0.012, 0.006, for commitment were −0.02, 0.017, 0.48, for overcoming barriers were −0.16, 0.007, 0.006, for prompts were 0.25, 0.011, <0.001, and for communication were −0.03, 0.010, <0.001.

3.2. Technical Points of the Results

Many of the regression coefficients are negative. Care must be taken when interpreting these values. These negative values mean that these components of the theories are not as effective at promoting conservation behavior as the other components of the theories. For example, the regression coefficient for Hines knowledge and skill is negative. This negative sign indicates that the weighted average effect size of experiments that use knowledge and skill is smaller than the weighted average effect size of experiments that use other treatments. These negative values do not mean that as people become more knowledgeable, the amount of conservation behavior they perform decreases.

We have included the p-values of the coefficients, but the statistical significance of these values is not relevant. A coefficient that is close to zero just indicates that the effect sizes of studies do not change as the value of the predictor gets larger. Technically, components that are not statistically different from zero have no effect, but we prefer to retain all of the components for comparative purposes.

4. Discussion

4.1. Summary and Discussion of Findings

4.1.1. Strongest Predictors of Conservation Behavior

To determine which component of the theories is the strongest predictor of conservation behavior, the standardized regression coefficients can be directly compared within each theory. For the Hines [82] theory, the strongest component of the model is personality factors, which includes things like attitudes and responsibility. The situational component is also quite strong. For Stern's [83] ESB model, the strongest component is contextual factors. For TPB [86], the strongest factor is attitudes, but note that TPB does not include any kind of situational or contextual factors. For Steg and Vlek [90], the strongest factor is structural interventions. For Hornik [91], the strongest factors are external facilitators and intrinsic incentives. And for McKenzie-Mohr [92,93], the strongest factor is prompts.

The finding that situational, external, or contextual factors, like making it easy, providing prompts, and providing rewards, are the strongest component of each theory is not entirely consistent with Osbaldiston and Schott [7]. In that report, making it easy and providing rewards were found to have

average weighted effect sizes that fall near the middle of the pack; the values of the average weighted effect sizes are 0.49 and 0.46, respectively, and the average weighted effect size in the entire data set was 0.45. Providing prompts was found to be among the four treatments with the highest effect sizes, but it certainly was not the strongest treatment. The four treatments that were identified as most effective were cognitive dissonance (0.93), setting goals (0.69), social modeling (0.63), and prompts (0.62). Recall that Osbaldiston and Schott analyzed the data by determining the set of experiments that used each treatment as a primary focus of the research, and then they computed the average weighted effect sizes for each of those sets.

However, when the data set is analyzed by theoretical components instead of individual treatments, these situational treatments are most important. Thus, the strength of the novel approach used here for evaluating the theories becomes clear. If one were to only examine the effect sizes for each of the ten treatments separately, one could reasonably come to the conclusion that making it easy, providing prompts, and providing rewards have only modest effects on conservation behavior; these types of treatments certainly would not be the starting point for a campaign to promote conservation. But when the treatments are organized under the rubric of the theories, it is apparent that changing the situation and creating external facilitators are an indispensable part of promoting conservation behavior.

The strength of this theoretical approach comes from looking at the data as a whole rather than as separate subsets. Osbaldiston and Schott [7] used the standard meta-analytic approach of creating subsets, but because of the confounded nature of the treatments used in these experiments, the sets were formed crudely based on the treatments that were the primary focus of the research without being able to take into account what other treatments were combined with it. In contrast, in the theoretical analysis making use of linear regression with multiple continuous predictors, the confounded nature of the treatments can be accounted for, and thus the results present a more complete picture of the effects of the treatments on conservation behavior.

4.1.2. Best-Fitting Theory

In terms of determining which theory is the best model to explain the variance in the effect size data, the R-square for the theories can be directly compared. McKenzie-Mohr [92,93] and Hornik [91] accounted for 74% and 67% of the explainable variance, respectively. However, neither of these researchers advanced a conceptual model of conservation behavior; rather, they both looked at the research and suggested a typology of treatments. In contrast, Hines [82] and Stern [83] both advanced more conceptual models. These models explained over 40% of the explainable variance in the data set.

Typologies and conceptual models each have different uses and strengths. A typology is useful for knowing how to change conservation behavior. A typology can serve as a laundry list of options; it would be useful in the brainstorming phase of trying to figure out how to encourage other people to engage in conservation behaviors. In contrast, a model is an explanation of why people engage in conservation behavior. Understanding the "why" provides some insight into the "how," but the "why" alone does not result in any new behavior initiation.

4.2. Theoretical Considerations

4.2.1. Selection of Theories

We deliberately chose these six theories because we felt they were representative of the theories advanced in the conservation psychology literature. One could argue that our test of these theories was not a fair test because we deliberately chose the theories that best matched the treatments. As with all meta-analyses, a weakness is that the meta-analysis is only as good as the literature from which it is derived. It is likely that there are dozens of other treatments that could promote conservation behavior, but if they have not been tested and do not appear in the literature, then there is no way to meta-analyze them. Similarly, there are other theories that we could have examined in this analysis, but if there is not a set of studies to support them, then there is no way to do those analyses.

Are there other theories that perhaps better describe the predictors of conservation behavior than the ones that we selected? Of course there are. In this section, we present seven additional theories and explain why we did not use them in the analyses.

Bamberg and Moser [89] sought to update the Hines meta-analysis, and they found 46 studies (57 samples) that provided correlational data between the nine key variables in their proposed model. As we noted above (in Section 1.2.2), the heart of their model is the TPB. As precursors to the TPB, they proposed four additional variables: problem awareness, internal attributions, social norms, and feelings of guilt. We evaluated TPB using our data set, but we felt that their model was too sophisticated for our method. There are 7 mediator variables between the exogenous variable (problem awareness) and the outcome variable (behavior) and 22 significant correlations between the variables. Our data set is not equipped to evaluate such a complex model.

One very important theory of environmental behavior is Stern's [84,85] values-beliefs-norms theory. In a nutshell, Stern proposed that values lead to beliefs, beliefs lead to norms, and norms lead to behavior. We attempted to synthesize the ten treatments onto the value-beliefs-norms theory, but we found that five of the treatments did not map on at all (make it easy, prompts, instructions, feedback, and rewards), and we found no treatments utilized values. Given such a mis-match between the treatments and the theory components, we did not proceed further with the analysis.

Stern [3,85] has also proposed a causal model of environmentally relevant behavior. This model has seven "levels of causality," and Stern notes that if contextual influences are weak then personal norms and beliefs will be stronger determinants of behavior. In terms of the causal model, if level seven is strong, then the lower levels do not strongly influence behavior, but if level seven is weak, then the lower levels play a much stronger role. We sought to test this model, but it turned out that the seven levels of causality coded the same way as Stern's ESB model, and so the results are exactly the same as those of the ESB model. This model does offer many testable hypotheses and is perhaps the most sophisticated development of the relationship between contextual factors and social-psychological variables.

Steg and Vlek [90] offered a simple framework of the factors that influence environmental behavior. Their framework included three components: motivational factors, contextual factors, and habit. We synthesized this framework with the ten treatments, but since we found no treatments that mapped on to habit, the framework only has two categories. The R-squared for this analysis was 1%, so we have elected not to discuss it further.

Vining and Ebreo [105] formed a meta-theoretical framework for considering the theories of conservation behavior. They summarized the theoretical approaches to addressing conservation problems, and they found five broad approaches: (1) learning theory, (2) motivation, moral, and value theories, (3) attitude, beliefs, and intentions theories, (4) emotion and affect theories, and (5) other theories (of which the most relevant to us here is social influence and diffusion).

Clayton and Brook [106] also sought to provide an overview and introduction to the field of conservation psychology to both psychologists who are not familiar with environmentalism and environmentalists who are not familiar with psychology. They reviewed the literature and advanced a social psychological model of conservation behavior with three factors: situational context, existing schemas (or past experiences), and personal motives.

Harre [107] wrote a book that comprehensively discusses the different strategies to promote conservation behaviors. The four approaches or theories that she discusses are emotions, modeling and social norms, identity and roles, and morality. Her book is designed to inspire activists, and it is a compelling collection of research-based suggestions that could help promote conservation.

The theories advanced by Vining and Ebreo [105], Clayton and Brook [106], and Harre [107] all seem to draw on useful research that has been done on conservation behavior specifically and behavior change in general. However, the set of conservation psychology experiments does not map on to any of these theories particularly well. For example, both Vining and Harre mention the importance of emotions in fostering conservation behavior. Yet no experiments that we know of have included any kind of treatment that manipulates people's emotions. Clayton and Brook include the component of existing schemas, which they define as one's past experiences and resulting stored knowledge. Although some of the research on cognitive dissonance comes from this approach and many studies provide information to participants, actually manipulating past experiences and significantly altering stored knowledge is not really possible within the bounds of a typical psychology experiment. Harre includes the component of identity and roles, and again, we know of no treatments that attempted to manipulate these types of variables.

4.2.2. Why Is There a Mismatch between Our Experiments and Our Theories?

In the preceding section, we noted seven theories that could not be synthesized with the experimental literature. This observation leads us to two questions that are different sides of the same coin. Why are our theories much broader than our experimental foundation? And why haven't our experiments tested all of the components in our theories? We have three possible explanations for these questions.

One possible explanation is that it is just very difficult to manipulate some of the theoretical components. Concepts like morality, values, emotions, and past experiences are typically created and reinforced by a large number of daily messages. Creating a psychology experiment that appreciably changes them for any length of time such that they actually influence behavior is a daunting task. Helping someone change a life-long habit of behaving wastefully is a mission that a typical psychology experiment is simply unequipped to do. It may be wishful thinking to reprogram decades of habit in the length of time and degree of involvement that we have with our participants.

A second possible explanation is that behavior is just too complex to be understood using the experimental framework. A sophisticated psychology experiment might have about three independent variables, and indeed, a three-way interaction is about all researchers can meaningfully interpret and discuss. But behavior is not a function of three variables, or even six or nine; behavior is a function of probably dozens of variables interacting together. Using a tools analogy, the hammer of experiments might not be sophisticated enough to drive the nail of behavior.

Perhaps this is why the era of the conservation psychology experiment seems to have passed us by, and the era of research based on multiple regression, hierarchical regression, and path analysis seems to be upon us. In the 1980s and 1990s, the dominant methodology of conservation behavior was the experiment, but in the 2000s, correlational studies are much more prevalent than experiments. We do not have comprehensive evidence of this trend, but we offer this anecdotal evidence. We keep a database of all the conservation psychology research that we collect. In this database, 180 experiments were published between 1980 and 2000, but only 39 experiments have been published since 2000. In contrast, 125 correlational studies were published between 1980 and 2000, and an additional 130 have been published since 2000. We make no claim that we have captured and categorized every relevant study, but this anecdotal evidence does show a trend that researchers have preferred to use correlational methodologies more so than experimental methodologies in the last decade.

A third possible answer is that the field has moved away from seeing behavior as an event that can be controlled and isolated. The history of psychology shows us marching through different phases of intellectual thought; for example, moving from behaviorism's very precise prediction of behavior based on rewards and punishment to the cognitive revolution's more general predictions that behavior is based on a host of internal factors. Perhaps the field of conservation psychology is going through a similar transition. We have learned that it takes more than pamphlets, reminders, and free bus tickets to get people to engage in really meaningful, significant behaviors, and so we have started to explore the much deeper concepts like morality, identity, and personal values.

4.2.3. The Fuzziness of Psychology Theories

Each of the theories discussed here presents psychological constructs as though they are separate and unique. Each component of a model is presented as a non-overlapping construct. Of course, the real world is much more complex than that. Many psychological constructs do not fall neatly into one and only one component, and any component in one theory often influences other components. Each component of these models probably overlaps at least to a small extent with each other component of the models. Because of this overlap, we can say that the models are fuzzy: the definitions of and the boundaries between these components are not clear-cut.

As an example of this, consider the meta-theory of Vining and Ebreo [105] that advanced five broad constructs. Unfortunately, these five broad approaches are not as clear-cut and categorical as one would hope. We provide three examples of this fuzziness, but these examples are not the only ones that exist. First, in the motivation, moral, and value theories group, Vining and Ebreo include self-regulation theories, and then they note that the theories explain how people regulate their own behaviors by changes in their cognitions, emotions, or perceptions. It could be reasonably argued that cognitions are related to learning theory, emotions are related to emotion theories, and perceptions are related to

attitudes and beliefs theories, so actually it is very difficult to pigeon hole self-regulation theories into just one of the five broad approaches. Second, when discussing Schwartz's [108] value theory, Vining and Ebreo observe that values affect attitudes [109,110], so again there is substantial crossover between the values theories and the attitudes theories. Third, when discussing the learning theories and operant conditioning, Vining and Ebreo note that rewards and incentives actually play a role in the motivation of the behavior, so it is hard to separate out the learning processes from the motivational processes. Even though the five broad approaches have some fuzzy overlap, we feel that this is a useful meta-theory of conservation behavior.

All of this fuzziness among concepts that at first glance appear categorical and discrete is important to acknowledge. Rarely are the forces that govern our behavior neatly cut and dried; every psychology theory is necessarily a simplification of some very complex processes. All of this fuzziness is probably an accurate description of how factors interplay to drive behavior. The novel method that we have used here to analyze the data is a first step to being able analyze and understand some of this fuzziness.

4.3. Methodological Limitations

The main limitation that this research faces is the subjectivity of the coding. There are two places where subjectivity could have entered our analyses. First, mapping the treatments on to the components of the theories was subjective. We have included a table that shows our mappings, and these codings are based on our reading of both the experimental and theoretical literatures. But it is fair to assume that other researchers may see these concepts as related in different ways than we have. We elected to use the none or one criterion for mapping the treatments on to the theoretical components for parsimonious reasons, but there may be more sophisticated and valid alternatives.

Second, our method for forming the predictor variables was subjective. We assumed that meaningful predictor variables could be formed by summing the codings of the treatments to create coding ratings for the components of the theories. This method allowed us to have some indication of degree or strength of the components of the theories. However, there are probably other ways to do this, too, and which method is best is an open question. One alternative system would be to use an all-or-none system, such that instead of adding up the coding ratings, they were simply categorized as fitting the component or not.

We know of no previous research that has attempted to analyze the literature using the method we have employed here. Although our attempts may be judged as crude, it does point to a critically important fact: we have hundreds of good primary studies, but we are still very short at developing ways to meaningfully combine these studies to form powerful generalized theories.

4.4. Future Directions

Osbaldiston and Schott [7] meta-analyzed the experiments on conservation psychology, and their results provide some insight into how to encourage people to engage in conservation behaviors. However, there is more to saving the planet than employing the ten treatments that have been most often tested in the literature. Conservation psychology probably hinges on much deeper psychological questions than, for example, "Are rewards effective?" and "Can attitudes be changed?" Next, we explore four suggestions for future research in the field.

4.4.1. Synthesize the Studies That Have Already Been Done

As noted earlier, the era of the conservation psychology experiment seems to have passed. While much of this research was published in the 1980s and 1990s, not nearly as much is still forthcoming. In contrast, the era of the correlational study is upon us. There are literally hundreds of these studies that have been done in the last 20 years, and with the widespread application of statistical procedures like path analysis and structural equation modeling, these types of studies are likely to continue to appear in the literature. But these types of studies on an individual basis are not of much value. The future of conservation research must explore ways to combine these hundreds of studies into theories that are valid and insightful.

Hines [82] was the first research report to attempt a meta-analysis of the literature, and it was published in 1987. The next comprehensive attempt was Bamberg and Moser [89], and it was published in 2007. There is plenty of research that is publicly available to synthesize. To address the concern that conservation behaviors are too diverse to meaningfully combine, researchers may elect to focus on just one behavior at a time.

There are special meta-analysis statistical software packages that are commercially available. However, most meta-analytical calculations can be done with Excel, SPSS, or any other non-specialty statistical package. There are excellent brief books that detail the steps of meta-analysis [111,112] to help researchers get started.

4.4.2. Plan Experiments That Test Theories

Although we have noted that the field seems to be scaling back the numbers of experiments that are done, experiments have not lost their value. In the previous decades, experiments seemed to be driven by what ideas researchers had about what would cause a change in behavior. Although that was a good starting place, researchers should deliberately test constructs in the conservation psychology theories.

For example, Stern's ESB model [83] posits that attitudes, contextual forces, personal capabilities, and habit are the four major types of variables that influence conservation behavior. The first three of these variables are relatively easy to manipulate as the independent variable in an experiment. Stern notes that personal capabilities include behavior specific knowledge and skills, so an experiment could assign one group to receive this type of information (for example, training about how to adjust driving behaviors for maximum fuel economy) and a control group to not receive it. This would be a very basic test of one of the hypotheses that flows from this model. The experiments could be more sophisticated; they could use factorial designs to test for interactions between multiple variables. Researchers should select a theory and then devise a set of experiments to comprehensively test that theory on the same conservation behavior. Utilizing a set of experiments that tests a theory would help minimize some of the piecemeal nature of the literature.

4.4.3. Measure Behavior Better

One of the great drawbacks of the currently existing correlational research is the measurement of conservation behavior. As noted earlier, the vast majority of these studies do not use an objective measurement of behavior but rather rely on self-reports. Further, the variation in how these self-reports

are done is large; it runs the gamut from a single question that attempts to summarize all conservation behaviors to multiple questions that address subtle differences in the behaviors. As researchers, if we are not going to objectively measure actual behaviors, then in the future, an accurate and consistent method of measuring behavior is needed. We have three suggestions for how to improve the measurement of behavior. First, questions that ask about extent or frequency of performing behaviors are too subjective. Researchers do not have any information about what comparison or criteria participants are using. If questions can be re-framed to be dichotomous and specific, then the responses will be more accurate. Replace "How frequently do you recycle?" with a question like, "Do you always recycle plastic bottles?" The response to this question will still be subjective, but it will not be as subjective as the question it replaced.

Second, there is a variety of built-in objective measurements of behaviors that neither participants nor researchers need to monitor closely, but they provide accurate information. For example, electricity and fuel bills accurately reflect how much energy a household has used. Credit card statements monitor consumer purchases, and car odometer readings keep track of mileage. There is usually an easily accessible record of practically all on-line purchases. Taking advantage of these recordings can help reduce some of the subjectivity of measuring environmental behaviors.

Third, it is possible to utilize quasi-experimental designs in correlational research. For example, a correlational study on the factors effecting commuting mode choice could be administered at a public transportation terminal and at a commuter parking lot. The researchers would know if the participants completing the survey traveled to work by public transportation or by private car. Similar comparisons could be made for people shopping at organic farmers' markets *vs.* traditional grocery stores, people observed buying high efficiency lightbulbs *vs.* conventional lightbulbs, or people observed driving fuel efficient cars *vs.* inefficient cars.

4.4.4. Maximize Environmental Impact

This point has nothing to do with methodological or theoretical considerations of future research. It has to do with actually making an impact on our environment. To date, much of the experimental research has studied behaviors that are convenient to observe. But turning off lights and recycling office paper are not going to ameliorate the environmental challenges that we face.

We have already mentioned Dietz's [8] research that compared 17 household behaviors and determined which behaviors will have the most impact on US carbon emissions. That research indicates that much more work needs to be done on American transportation choices. Researchers who truly want to have an impact on the environment should start there.

Most of the experiments in the literature focus on individuals in their homes or everyday lives. Work settings are under-represented in the literature, and there is room to make significant environmental impact in the work setting. A very basic research question is "Do our theories of conservation behavior carry over to the work setting?" For example, do the variables in TPB operate in the same way for workers as they do for householders? A good thing about the work environment is that usually conservation behaviors are also financially beneficial. Researchers can use the financial incentives as the selling point for finding businesses that will be agreeable to serving as research settings.

In sum, there is a lot to be optimistic about the conservation psychology research that has been done to date. Although it is far from complete, the research does indicate some valuable approaches to addressing environmental problems. Most notably, the role of the situation or context is a much stronger variable than we previously had thought. And the theories that have been developed are on the right track; they explain relatively large amounts of the variance in the behavioral data. Environmental problems are complex, but that does not mean that we should shy away from addressing them. Psychology is uniquely positioned to develop some of the best methods for addressing these problems.

Conflict of Interest

The author declares no conflict of interest.

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