Word Count: 7,160

Positive Spillover: The Result of Attitude Change

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Author Note

This research was supported by a grant from the Helmholtz Society as part of the Helmholtz Alliance ENERGY-TRANS and by grant 03SFK4Q0 from the German Federal Ministry of Education and Research (BMBF) as part of the Kopernikus project ENavi. We thank Jane Zagorski for her language support on earlier versions of this manuscript and the editor and four anonymous reviewers for their helpful comments.

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3

Abstract

Behavioral spillover is the phenomenon when a behavior change is accompanied by subsequent changes in other behaviors related to the same goal (e.g., environmental protection). We propose to understand behavioral spillover as the result of attitude change. According to the Campbell Paradigm (see Kaiser, Byrka, & Hartig, 2010), pro-environmental behaviors are an expression of a person's environmental attitude. The higher the person's level of environmental attitude, the more behavioral costs the person will endure to perform pro-environmental behaviors. Thus, if the person's attitude changes, what is commonly called behavioral spillover will occur: For all pro-environmental behaviors, the person's likelihood of engaging in any one of them will increase. We illustrate this argument by presenting a secondary analysis of data showing that an attitude change results in the frequencies of various pro-environmental behaviors increasing by 3.5% on average. Our proposed model of spillover enforces the idea that those who wish to promote sustainable pro-environmental behavior must inspire changes in people's environmental attitudes instead of attempting to change specific behaviors.

Keywords: spillover, attitude-behavior consistency, attitude change, Campbell Paradigm, conservation behavior

1. Introduction

For environmental protection to have a lasting impact, individual behavior must be changed comprehensively because the impact of targeting only isolated behaviors will not be sufficient (see, e.g., Kibbe, Arnold, & Kaiser, 2017; Otto, Kaiser, & Arnold, 2014; Thøgersen & Crompton, 2009). The phenomenon of spillover—where with an increase of engagement in one behavior the probability of engaging in several other related behaviors changes as well—is therefore attracting a lot of attention among researchers who are interested in pro-environmental behavior modification (Lanzini & Thøgersen, 2014; Thøgersen, 1999; Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014; Whitmarsh & O'Neill, 2010). If a thorough understanding of the mechanisms behind behavioral spillover can be achieved, it might be possible to deploy them for interventions that target more than only a single behavior but rather many behaviors at the same time.

A large body of literature has reported a somewhat inconsistent picture of the occurrence of spillover in pro-environmental behavior (for extensive overviews see, e.g., Maki, Carrico, Raimi, Truelove, Araujo, & Yeung, 2019; Nilsson, Bergquist, & Schultz, 2017; Truelove et al., 2014). Many studies have identified a desirable level of positive spillover where not only one targeted but several other behaviors changed in the same direction. For example, a change in recycling behavior was accompanied by the avoidance of excess packaging (Thøgersen, 1999), recycling behavior changed also along with energy- and water-saving behaviors, composting, and reusing bags (Berger, 1997), and a correlation was found between fuel-efficient driving styles and intentions to reduce meat consumption (Van der Werff, Steg, & Keizer, 2013). But negative spillover has also been reported where an increase in one pro-environmental behavior led to a decrease in another: For example, an increase in the purchasing of organic products was associated with less recycling (Thøgersen & Ölander, 2003), and after participating in a green power program, some households were

found to increase their energy use (Jacobsen, Kotchen, & Vandenbergh, 2012). Finally, other studies have not found any evidence of spillover: For example, an increase in the use of one's own bags for shopping (after a charge for single-use bags was introduced) was not associated with other pro-environmental behaviors such as avoiding excess packaging, refraining from car use, saving water, or washing clothes at lower temperatures (Poortinga, Whitmarsh, & Suffolk, 2013).

Spillover is commonly understood as the change of not only one (targeted) behavior but of other associated behaviors as well. In detail, the explanations how behavioral spillover comes about differ. Some see spillover resulting from the change of one behavior that causes other behaviors to change (see, e.g., Lanzini & Thøgersen, 2014; Nilsson et al., 2017; Poortinga et al., 2013; Thøgersen, 2004; Thøgersen & Crompton, 2009). Other explanations of spillover do not regard the causal effect as being rooted in the initial behavior necessarily but in what caused the initial behavior, for example an intervention or an attitude change (see, e.g., Dolan & Galizzi, 2015; Thøgersen, 1999; Truelove et al., 2014). Empirical evidence supports the notion that a person's predisposition—referred to as general environmental values (cf. Thøgersen, 1999), the underlying motive of the behaviors (cf. Dolan & Galizzi, 2015) or a person's environmental identity (cf. Truelove et al., 2014)—is critical for behavioral spillover to occur.

We suggest a model for understanding spillover phenomena that likewise draws on the common goal of behaviors and that regards spillover as the result of an increase (decrease) in the importance of the underlying goal of behaviors—using the example of environmental attitude as the motivational basis of pro-environmental behavior (see Kaiser & Wilson, 2004).

Attitudes are intrapersonal, latent variables that constitute a person's esteem for an object or goal (e.g., a football team, a political party, or environmental protection; see, e.g.,

Eagly & Chaiken, 1993; Kaiser & Byrka, 2015). Attitudes become apparent in manifest expressions of appreciation for the object or its implied goal. Such manifestations can include affective reactions (e.g., facial expressions of joy after one's favorite football team scored a goal), cognitive evaluations (e.g., verbal expression of a supportive argument for one's favorite party), or overt behavior (e.g., signing up for a green energy plan; see Kaiser, Byrka, & Hartig, 2010; Kaiser & Wilson, 2019; Rosenberg & Hovland, 1960). Our model of spillover draws on the Campbell Paradigm and regards the phenomenon of spillover (i.e., a generalized behavior effect) as the result of attitude change. In this conceptualization of spillover, it is not the change in one behavior that causes other behaviors to change, but a change in attitude underlies all involved behaviors—thus, positive spillover is understood as the behavioral expression of a change in attitude.

In the following, we first present the most prominent explanations that have been suggested to account for different spillover phenomena. Then we introduce our model in which we describe spillover as attitude change in more detail. Subsequently, we present empirical proof that attitude change produces behavioral spillover.

1.1 In Search of the Mechanisms Behind Behavioral Spillover

Several authors have provided comprehensive reviews and even a meta-analysis on behavioral spillover effects and suggested frameworks to understand and explain different types of spillover (see Dolan & Galizzi, 2015; Maki et al., 2019; Nilsson et al., 2017; Truelove et al., 2014). Therein, a number of moderators and psychological processes have been suggested to account for spillover processes to happen. Based on these elaborate approaches to understand spillover, two distinguishable – even though not exclusive – lines of understanding and implicit definitions of spillover can be found. The first line defines spillover effects in environmental issues as the influence of one behavior on the probability of

another behavior (e.g., Nilsson, Bergquist, & Schultz, 2017), which can be seen as a sequential process. Proponents of the other line of understanding do not see behavior performance as the cause for spillover, but as an effect of an intervention on behaviors not specifically targeted by an intervention (e.g., Dolan & Galizzi, 2015; Truelove et al., 2014). Thus, this understanding implies an underlying third construct (e.g., knowledge or personal characteristics) that is affected by an intervention and itself affects not just the target behavior but other behaviors as well. Even though these two lines of understanding differ in the way they define spillover, explanations might be similar to account for spillover effects.

The most typical explanation for the former understanding of spillover (i.e., sequential behavior-to-behavior spillover) are consistency theories (see, e.g., Thøgersen, 1999). In consistency theories (Bem, 1967; Thøgersen, 2004), a process of self-perception is thought to mediate spillover, for instance, because the person experiences discomfort when they behave pro-environmentally in one situation but not in another (Festinger, 1957), or the self-perception of being a pro-environmental person affects a person's attitude toward the behavior (see, e.g., Lanzini & Thøgersen, 2014). Inferring one's environmental attitude from the self-perceived own pro-environmental behavior is thought to either increase the attitude's salience (see Thøgersen & Crompton, 2009) or will even increase the person's attitude toward that behavior (see, e.g., Holland, Verplanken, & Van Knippenberg, 2002) or a broader goal (e.g., environmental protection; see e.g., Spence, Leygue, Bedwell, & O'Malley, 2014). This, in turn, is thought to increase the inclination to behave pro-environmentally in the future.

The later understanding of spillover (i.e., an underlying construct or a 'third variable' that affects more than just the targeted behavior) is explained by learning theories or person characteristics. Learning theories explain positive spillover through the acquisition of new skills or knowledge about pro-environmental behavior (see, e.g., Lanzini & Thøgersen, 2014; see also Nilsson et al., 2017). Knowing more about why and how to protect the environment

through one's behavior is thought to lead to more pro-environmental behavior in the future (see, e.g., De Young, 2000; Maiteny, 2002). This view is supported by findings that show a positive relation between environmental knowledge and pro-environmental behavior at least on a general level (Díaz-Siefer, Neaman, Salgado, Celis-Diez, & Otto, 2015). However, this seems to work predominantly for people who are already engaged in environmental behaviors (see, e.g., Thøgersen, Haugaard, & Olesen, 2010)—and thus value the goal of environmental protection. Thus, if learning is a mechanism leading to behavioral spillover, it might be conditional nonetheless—that is, it might depend on a person's appreciation of environmental protection (see, e.g., Taube, Ranney, Henn, & Kaiser, 2020).

Spillover is regarded as dependent on person characteristics as well. Some potential psychological moderators or mediators are universalism, preference for consistency, and environmental self-identity (see Lanzini & Thøgersen, 2014; Nilsson et al., 2017; Truelove et al., 2014). High universalism speaks of a great concern for all living things (Schwartz, 1994). Preference for consistency (Cialdini, Trost, & Newsom, 1995) implies a goal that is consistent or inconsistent with a person's actions. Finally, environmental self-identity is defined as seeing oneself as the type of person who acts pro-environmentally (see, e.g., Van der Werff et al., 2013) and is thus a concept that comprises environmental protection as a personal goal. In a longitudinal study, environmental self-identity at baseline (not its change due to the intervention) predicted behavioral spillover (Elf, Gatersleben, & Christie, 2019). The person's esteem for environmental protection thus seems to be a requirement or at least a facilitator of spillover (see also Brügger & Höchli, 2019).

After all, both lines of understanding explain spillover by mechanisms and constructs 'between' (e.g., consistency or self-perception) or behind (e.g., learning, attitude, or self-identity) the manifest influence of one behavior on another. Our aim is not to explain these specific processes in further detail, but to present a common understanding for these

144 explanations. From the summary of these spillover explanations we furthermore conclude that
145 two assumptions are necessary for positive spillover to occur: (a) Pro-environmental
146 behaviors are related, and (b) the individual values environmental protection as a personal
147 goal. Both assumptions represent core elements of our proposed model of spillover.

148 Whereas most of the previous explanations of spillover regard an initially performed
149 pro-environmental behavior as the cause of some psychological processes (e.g., self-
150 perception, reflecting on one's environmental goals, learning) that mediate subsequent change
151 in engaging in more environmentally relevant behaviors, we suggest to focus on common
152 behavioral determinants to understand spillover. When not only one but several pro-
153 environmental behaviors change as a result of an intervention of some kind, we assume that
154 this is due to their common characteristics from an individual's perspective (i.e., the
155 interdependence of the behaviors). Whereas empirical evidence for the abovementioned
156 psychologically mediated effects is weak (see, e.g., Nilsson et al., 2017; Thøgersen, 1999;
157 Truelove, Yeung, Carrico, Gillis, & Raimi, 2016), the assumption of the interdependence of
158 pro-environmental behaviors has repeatedly been supported by empirical data (e.g., Berger,
159 1997; Thøgersen, 1999; Thøgersen & Ölander, 2003). The common characteristic of pro-
160 environmental behaviors is quite obviously that they are supportive of environmental
161 protection. A person who cares for the environment will not only try to save energy, for
162 example, but will probably also refrain from car use, eat less meat, or even donate to
163 environmental organizations. If the person's attitude changes (e.g., increases), this change
164 should become apparent in the respective behavior (e.g., more environmental behavior).
165 Hence, we propose that a different way of describing behavioral spillover can be to
166 understand it as a change in environmental attitude.

167 **1.2 Attitude as the Common Variable Underlying Pro-Environmental Behaviors**

168 Even though the degree of similarity between various pro-environmental behaviors is

subject to debate (see, e.g., Stern, 2000; Thøgersen, 2004), it must be the case that behaviors affected by spillover have to be related. Otherwise, it would not be plausible for them to change jointly. Empirically, large sets of pro-environmental behaviors—even from different domains—have been shown to fall into one transitively ordered (i.e., ordered by their increasing difficulty) class of related behaviors based on the extent of individual propensity to protect the environment (e.g., Kaiser & Wilson, 2004). Due to this interdependence between pro-environmental behaviors and their transitive ordering by difficulty, such an item set (e.g., the General Ecological Behavior scale; Kaiser & Wilson, 2004) serves to estimate a person's environmental attitude. In this measurement approach known as the Campbell Paradigm, an attitude is defined as the propensity to act according to a valued goal (see Kaiser et al., 2010). The level of attitude thus becomes apparent in the face of behavioral costs: The more pronounced a person's environmental attitude, the more costs he or she is willing to bear to implement pro-environmental behavior. The behaviors through which environmental attitude is expressed fall into a pattern of cost order that pertains to all people in a given sociocultural context (see Kaiser et al., 2010; Kaiser, Merten, & Wetzel, 2018; Kaiser & Wilson, 2004, 2019).

Mathematically, the relation between a person's attitude and the costs of a behavior can be described with a Rasch model. A person's probability of performing a behavior can be expressed as the natural logarithm of the ratio of the probability (p_{ki}) that person k will engage in a specific behavior i relative to the counter-probability that person k will not engage in behavior i ($1 - p_{ki}$; see Equation 1). Thus, the probability that a behavior will be performed is a function of the arithmetic difference between k's attitude level (θ_k) and the composite of the costs (δ_i) involved in engaging in the specific behavior i.

$$\ln\left(\frac{p_{ki}}{1-p_{ki}}\right) = \theta_k - \delta_i \quad (1)$$

The metric of both the behavioral costs (i.e., the difficulty) and the level of environmental attitude is in logits, and, thus, attitude level and the difficulty of a behavior can be compared directly: If the attitude level of a person *k* and the difficulty of a behavior *i* are equal, the probability that the person will perform the behavior is .50. Thus, a person *k* with an attitude level greater than the difficulty of a behavior *i* is more likely than not to perform the behavior, and vice versa.

According to the Campbell Paradigm, there can be two reasons behind pro-environmental behavior change. Either the level of environmental attitude (θ_k) increased, and thus, more behavioral costs can be overcome—as a consequence of which more and even costlier environmental behavior is performed. Or else the behavior in question became less costly—and therefore, even people with a somewhat less pronounced environmental attitude are likely to bear the behavioral costs (δ_i). In the latter case, it is unlikely that other pro-environmental behaviors will change as well (unless their behavioral costs are also affected by the cost reduction). If, however, the former case is true, and the environmental attitude has increased, all pro-environmental behaviors should then become more likely. This, of course, does not mean that *any* behavior is likely to be performed; we elaborate on this point in the next section.

1.3 Spillover as Attitude Change

If over time, a person is showing more pro-environmental behaviors than before, two explanations seem possible. a) Either the behaviors affected by change have become easier. This could be due to, for example, reduced financial costs or the wider availability of sustainable products, structural improvements, or reduced social costs because of a stronger social norm for a behavior that has become more respected (see e.g., Otto, Kibbe, Henn,

Hentschke, & Kaiser, 2018). Also a change in legal regulations could make a pro-environmental behavior easier, such as for example a carbon tax changing price and supply structures in favor of pro-environmental options (see, e.g., Hammar & Sjöström, 2011). b) Or the behavior changes are due to a person having become more determined to act pro-environmentally—in other words, the person's environmental attitude has become more pronounced and thus the likelihood of all pro-environmental behaviors increased for that person.

We assume that it is rather unlikely that all pro-environmental behaviors uniformly become easier on the basis of changes in factors external to the person. Instead, a change in the person's determination to act in favor of the environment (i.e., their environmental attitude) appears as a plausible basis for a change of several pro-environmental behaviors. Our proposed model of spillover as a change in attitude is grounded in the relationship of environmental attitude and the probability of any pro-environmental behavior that will increase as the attitude level increases. However, not all behaviors are equally likely to actually be performed subsequent to an attitude increase. As we and others argue, it is important to consider the difficulty of the behavior (see, e.g., Arnold & Kaiser, 2018; Thøgersen & Crompton, 2009; Truelove et al., 2014).

Attitude changes will most likely affect behaviors with difficulty levels that are similar to the person's attitude level. For instance, it is more likely that a person with an initially rather average level of environmental attitude, after becoming more committed to environmental protection, will show behaviors that are somewhat more than average in their demands or cost (e.g., subscribe to a green electricity tariff) rather than very demanding or costly behavior (e.g., volunteering for an environmental organization). Because environmental attitude is normally distributed in the population (see, e.g., Byrka, Kaiser, & Olko, 2017; Kaiser, Otto, & Schuler, 2015; Otto & Kaiser, 2014), behavioral spillover is most likely to be

240 detected in the middle range and least likely at the extremes (i.e., the very easy and the very
241 difficult behaviors).

242 **1.4 Research Goals**

243 With this research, we propose to view spillover as a change in attitude, and we aim to
244 empirically support this view by providing a secondary analysis of data from two surveys
245 conducted in 2001 and 2010, in which a general increase in environmental attitude can be
246 observed and has been reported elsewhere (Otto & Kaiser, 2014).

247 Our research goals are to show that attitude change becomes apparent in an increased
248 performance probability of nearly all pro-environmental behaviors (except for behaviors with
249 very high frequencies in which a further increase is technically more or less impossible) and
250 that spillover can thus be understood as the result of a change in attitude. Furthermore, we aim
251 to demonstrate that our model allows to derive predictions about the extent of spillover,
252 dependent on behavioral difficulty. Accordingly, we expect to find that spillover is less
253 pronounced at the extremes of the behavioral difficulty distribution.

254 **2. Method**

255 **2.1 Sample**

256 We reanalyzed data from two studies that were conducted in the state of Saxony-
257 Anhalt (Germany) in 2001 (n = 779) and 2010 (n = 2,317). Both samples were randomly
258 drawn from resident registers of communities in Saxony-Anhalt (see Otto & Kaiser, 2014, for
259 details). The 2001 participants were sampled from four communities as one of two samples
260 used in a study by Kaiser, Schultz, and Scheuthle (2007). Of the 5,000 people selected, 787
261 returned completed questionnaires (response rate: 15.7%). Of these 787 respondents, eight did
262 not state their birth year and were thus excluded from the analyses. The 2010 sample was also

randomly selected from four communities (different from those in 2001) located in Saxony-Anhalt as a baseline measure for an intervention study. Of the 9,000 people selected, 2,221 returned questionnaires (response rate: 24.7%); 156 additional questionnaires came from employees of local companies and administrative bodies suggested by the funding agency. Of the 2,377 respondents, 60 did not state their birth year and were excluded.

Because the sample sizes in 2001 and 2010 were greatly unequal, the 2001 sample was stratified and matched to a subsample from 2010 that reproduced the same cohorts as the 2001 sample. This stratification procedure derives from a cross-sequential strategy that explores peer groups across two assessment times (for a methodological explanation of the cross-sequential strategy see, e.g., Schaie, 1965). By doing so, we were able to overcome possible biases due to different birth-year distributions in the two samples that could result in participants being exposed to different historical influences. The stratification procedure from which we used one subsample (n = 757) is described in detail in Otto and Kaiser (2014) and resulted in comparable groups with regard to birth-year. This way, even though the data were not longitudinal, the samples represented cohorts that had lived through similar historical experiences. Note also that for dichotomous Rasch-type analyses to yield item estimations that are stable within 0.5 logits with a 99% confidence, a sample size of approximately 150 was sufficient (Linacre, 1994).

2.2 Measures

Environmental attitude. We measured environmental attitude with the General Ecological Behavior Scale (GEB; Kaiser & Wilson, 2004; Kaiser et al., 2010), a Rasch-model-based measure that is composed of behavioral statements that describe environmentally relevant behavior. The original measure comprises 50 items of which 32 items have a 5-point frequency response format, and 18 items have a dichotomous yes/no

response format. Responses to the previous set of items were dichotomized for a Rasch analysis by collapsing the response categories *never*, *seldom*, and *occasionally* into 0 (unreliable pro-environmental engagement) and the response categories *often* and *very often/always* into 1 (reliable pro-environmental engagement). In the 2010 study, 31 items from the 45-item GEB version overlapped with the items used in the 2001 study and were used for our analyses (see Figure 1 for the items).[1] Twelve items were related to environmentally harmful behaviors and were reverse-coded before analysis. The item "I read about environmental issues" was affirmed much more frequently in the latter sample and showed differential item functioning (i.e., it was a much easier behavior in 2010 compared with 2001) and was excluded from analyses. Whereas in 2001, 7.6% stated they would read about environmental issues, in 2010, a proportion of 44.3% reported doing so. The remaining 30 items were used to demonstrate behavioral spillover as a result of attitude change. The Rasch model fit the data, both when the samples were pooled (the overall reliability of person scores was $rel = .64$) and when they were calibrated separately ($rel_{2001} = .66$ and $rel_{2010} = .61$). Environmental attitude was approximately normally distributed in both samples. Person estimates were satisfactory, and only 4.0% of the sample showed misfit.

Spillover. We measured spillover as the incremental frequencies of pro-environmental behaviors from 2001 to 2010. As described above, the responses to the behavioral self-report items were dichotomized and were accordingly regarded as either present or absent. The relative number of individuals in the sample reporting a specific behavior represented the frequency of the given behavior in the sample.

Model-predicted spillover. Model-predicted spillover was derived from the

[1] Note that the scale-freeness of Rasch-model-based measures allows the use of any item that is an indicator of the underlying characteristic, or, stated another way, that falls into the same class of behaviors. Thus, the measure does not depend on a specific set of items (see Bond & Fox, 2007). For more details, see Otto and Kaiser (2014).

behavioral difficulties that were estimated in the 2001 sample, prospectively determining the change in each behavioral frequency for 2010 given the reported attitude change (according to Otto & Kaiser, 2014). Because Equation 1 can also be expressed as

$$p(x_{ki} = 1 \mid \theta_k, \delta_i) = \frac{\exp(\theta_k - \delta_i)}{1 + \exp(\theta_k - \delta_i)} \quad (2)$$

by inserting the item difficulty estimates from the initial measurement in 2001 and the increase in environmental attitude level and standard deviation from the 2010 measurement into the model equation (see Equation 2), we were able to predict the frequencies of the same behaviors in 2010 when the average attitude level had increased, given that the behavioral costs remained stable over time.

3. Results

The difference in attitude between 2001 and 2010 results in nearly all pro-environmental behaviors being more frequent in 2010 compared with 2001. In Figure 1, the bars indicate the absolute increases in the relative frequencies of the behaviors from 2001 to 2010. The bars can be interpreted as the percentage of the sample that additionally adapted the respective behavior in 2010 on top of the percentage of people who already showed the behavior in 2001. For example, an additional 12.3% avoided using a car to reach the starting point of a hike in 2010 on top of the 51.9% who already avoided using a car for this in 2001.

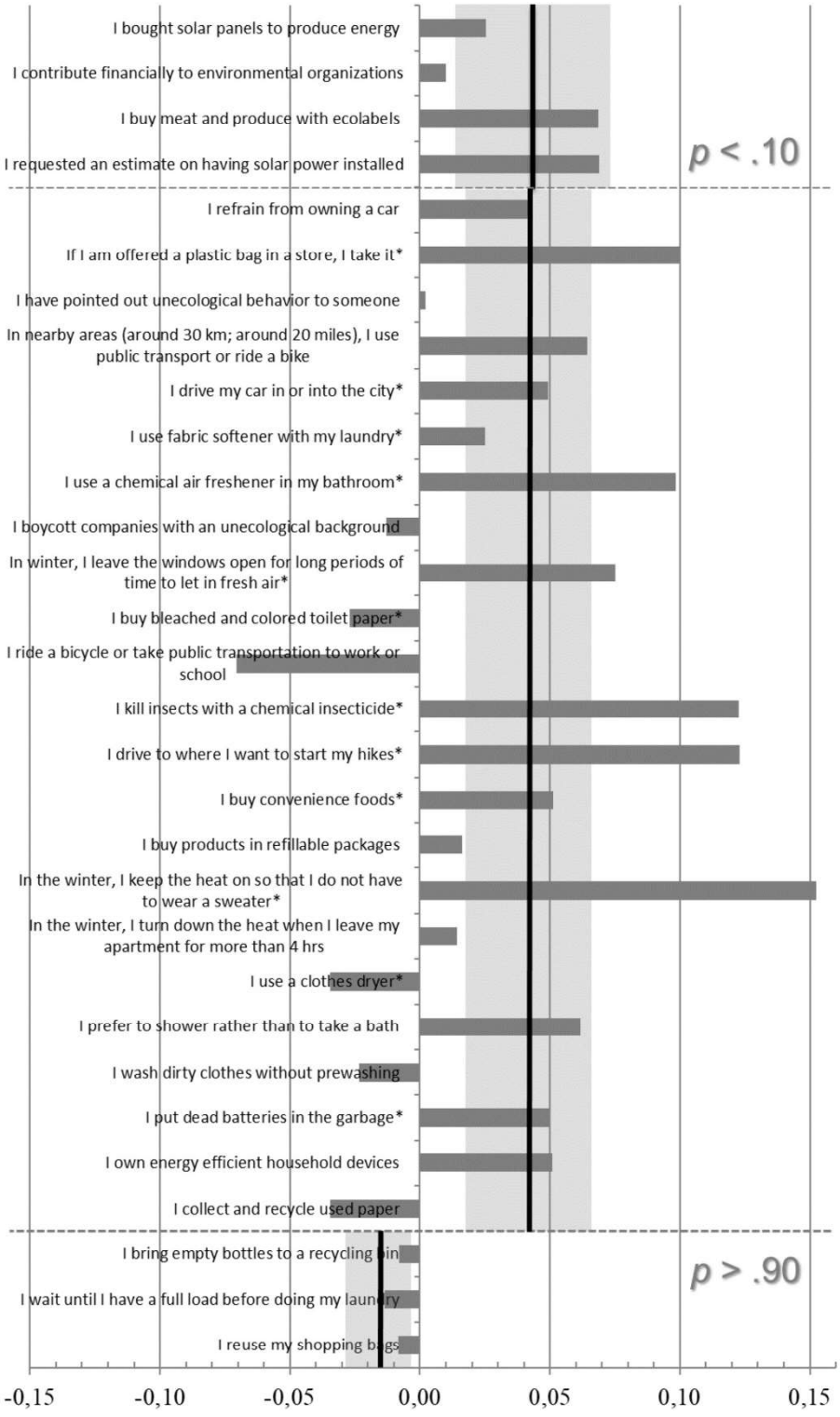

Figure 1. Changes in the relative frequencies of behaviors from 2001 to 2010. Items are ordered by difficulty along the y-axis, based on 2001 data. Asterisks indicate reverse-coded items. Bars directed to the right indicate an increase in relative frequency. Vertical solid lines indicate the mean change in the absolute behavioral frequency for easy (more than 90% of the

sample report it), medium, and difficult (less than 10% of the sample report it) items. Shaded areas are 95% confidence intervals.

Overall, pro-environmental behaviors were on average 3.5% more likely in 2010 than in 2001. Easy behaviors such as reusing shopping bags (the lowest item on the y-axis, see Figure 1) were nearly saturated (98% of the 2001 sample reported this behavior) so no increase could be detected in 2010. Separating the items into three categories, easy behaviors (performed by 90% of the sample or more), difficult behaviors (performed by 10% of the sample or less), and behaviors in the medium difficulty range (performed by more than 10% but less than 90% of the sample), the data supported the hypothesis that in the lower difficulty range, there was no substantial increase in behavior frequency. In fact, there was a small decrease of -1.6% (SD = 1.3) in easy behaviors whereas in the medium range, the likelihood of behaviors increased by 4.2% (SD = 5.7) and among the difficult behaviors by 4.3% (SD = 3.0). Differences in behavior changes between item categories did not reach conventional levels of significance, $F(2, 27) = 2.25$, $p = .13$, $\eta^2_p = .14$, which can be partly attributed to a lack of power given the small sample size. Nevertheless, post hoc tests using the Games-Howell procedure (which is appropriate for unequal sample sizes and variances; see Field, 2013) revealed significant differences in relative frequencies between easy behaviors and behaviors with medium difficulty, $M(\Delta) = -0.06$, 95% CI [-0.09, -0.02], $p = .001$, and between easy and difficult behaviors, $M(\Delta) = -0.06$, 95% CI [-0.12, -0.001], $p = .05$.

Correspondingly, the environmental attitude levels in 2001 and 2010 were significantly different, $t(1512) = 5.15$, $p < .001$, with $M = 0.10$ (SD = 0.86) in the 2001 sample and $M = 0.32$ (SD = 0.80) in the 2010 sample (see also Otto & Kaiser, 2014). The very

increase is mirrored in a test for uniform differential item functioning, a test of whether the average "person ability" (in our case, people's environmental attitude) increased systematically (see Tennant & Pallant, 2007; Wu, Adams, Wilson, & Haldane, 2007). This time, the mean environmental attitude was 0.21 logits higher in 2010 than in 2001, which closely resembles the direct comparison of the mean environmental attitude estimates of the two groups. The 95% confidence interval of this increase (i.e., 0.17-0.25) did not entail 0.00, and thus represents a significant increase in people's environmental attitude.

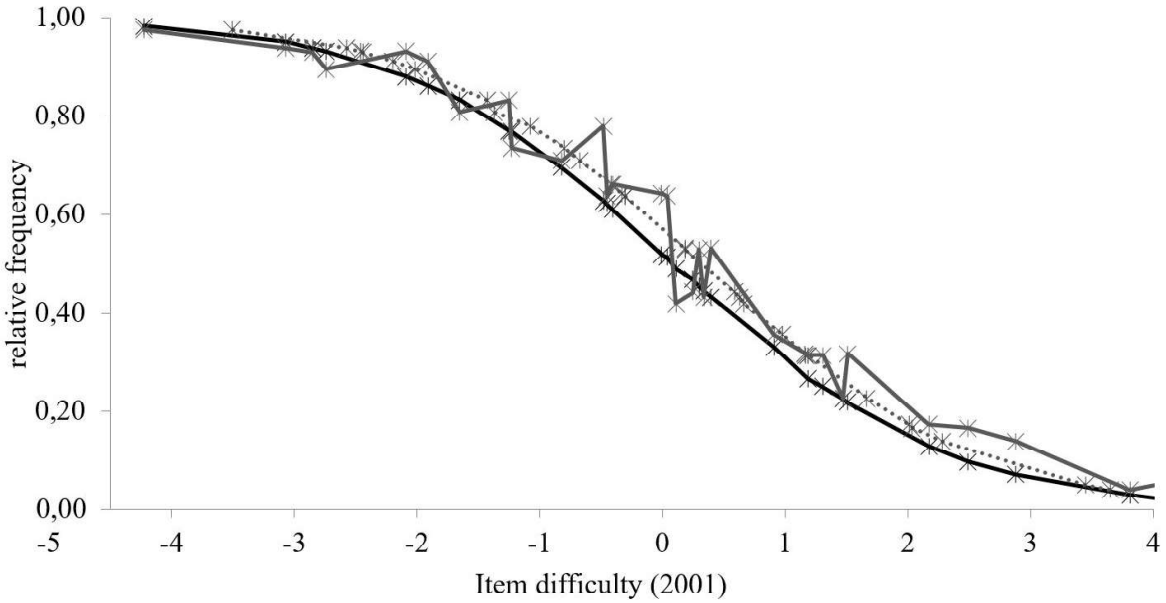

Figure 2. Spillover effect in relation to item difficulties. Relative frequencies are depicted in relation to item difficulties in 2001 (solid black line), predicted for 2010 given the item difficulties from 2001 and the known increase in environmental attitude in 2010 (dashed grey line), and the empirical increase in the frequency of the behavior in 2010, also in relation to 2001 item difficulties (solid grey line). The spillover effect is the area between the two solid lines (i.e., the change in the relative frequencies of a behavior between 2001 and 2010).

Knowing the item difficulties from the initial measurement in 2001 and the increase in attitude by 2010, we were able to make model-based predictions about the extent to which the

frequency of behaviors would increase on the basis of their difficulty, that is, in which behaviors spillover could be expected as a result from attitude change. Figure 2 illustrates the frequencies of the behaviors in 2001, the predicted behavioral frequencies for each behavior in 2010 given the attitude change that was known for that time period, and the empirical frequencies of behaviors measured in 2010. All behaviors are ordered by their initial difficulty in 2001 along the x-axis. As our model predicted more pronounced behavior changes in the middle range of behavioral difficulty, the predicted curve (dashed grey line) diverges further from the initial behavioral frequencies in the middle range of the curves compared with the extremes. The area between the solid black line (behavioral frequencies in 2001) and the solid grey line (empirical frequencies in 2010) in Figure 2 depicts the spillover effect of 3.5% (i.e., the joint increase in several behaviors from 2001 to 2010).

4. Discussion

We proposed a novel perspective on behavioral spillover in which a) we see spillover as a change in a latent attribute of the person (i.e., his or her environmental attitude), and in which b) we regard the difficulty of behaviors as crucial for spillover to become apparent. Environmental attitude is a determinant of multiple pro-environmental behaviors—in fact, of the whole class of pro-environmental behaviors (see, e.g. Kaiser et al., 2010, 2018). Therefore, a change in environmental attitude affects multiple pro-environmental behaviors and thus produces behavioral spillover—that is, several related behaviors change jointly. In a reanalysis of data from 2001 and 2010, we could demonstrate in two similar samples that a difference in environmental attitude became apparent in behavioral spillover that occurred across the whole class of pro-environmental behaviors such that overall, pro-environmental behaviors were by 3.5% more frequent in 2010.

With this model, we offer a parsimonious understanding of behavioral spillover

phenomena across several distinct and elaborate explanations. This includes explanations that see spillover as caused by an initial behavior (e.g., Nilsson, Bergquist, & Schultz, 2017) as well as those, which explain spillover through the effect of an intervention on an underlying construct or a 'third variable' that affects more than just the targeted behavior (e.g., Dolan & Galizzi, 2015; Truelove et al., 2014). If not only a targeted pro-environmental behavior, but several other pro-environmental behaviors change as the result of an intervention (delivered on purpose or represented by accidental changes over time), it might be for the reason that the intervention was successful in altering the person's motivational basis for pro-environmental behavior, for example, their environmental attitude. A change in person-bound determinants of behavior (such as environmental attitude) can account for the case that a person would implement other, not directly targeted changes, and—perhaps more important—maintain them. This does not exclude the possibility that spillover might be caused by the performance of an initial behavior, as suggested in several explanations (see, e.g., Nilsson et al., 2017; Truelove et al., 2014). However, empirical support for mediated effects of the initial behavior is mixed (e.g., Thøgersen, 1999; Poortinga et al., 2013; see also Truelove et al., 2014) and personal disposition has repeatedly been considered a crucial factor (e.g., Elf et al., 2019; Thøgersen & Ölander, 2003). Thus, we believe focusing on the change of an underlying, 'third' variable such as attitude instead of behavior change as initializing further behavior change might be fruitful for understanding spillover phenomena.

We found that spillover occurred in all behavioral difficulty ranges, albeit the very easy behaviors tend to be saturated such that an increase in relative frequency was effectively not possible. We do not see evidence that other common goals of the behaviors (e.g., saving money) should be considered as responsible for the pattern of behavior change because behavior change could be detected irrespective of specific item content (see Figure 1). In the very difficult range of behaviors, however, we found more spillover in the 2010 sample than

predicted. The lack of a longitudinal design does not allow to disentangle whether the 2010 sample was unexpectedly over-representing people in the rather high range of attitude level, or whether single behaviors in that category have become slightly easier due to external factors (e.g., the item 'I buy meat and produce with ecolables' could have become easier due to an increasing availability of ecolabelled food throughout the observed time period). Because the high-difficulty category is very small (i.e., consisting of only four items), chances of overestimating category-wise increases of relative behavior frequencies are quite high. Nonetheless, at present, we cannot regard our hypothesis from the model-based prediction about less spillover at the extremes of the difficulty range as confirmed—at least not for the difficult extreme. The proposed model includes, however, a novel approach to the role of difficulty for behavioral spillover: If spillover was the result of a change in attitude, very precise predictions are possible about the probability of spillover to behaviors with regard to their difficulty level. According to the logic of the Campbell Paradigm, behavioral spillover in that case is most likely in behaviors whose difficulty does not exceed what can be compensated by a person's (increased) level of environmental attitude. This view offers interesting new research ideas that take into account individual levels of environmental attitude and difficulties of behaviors to predict potential spillover to a higher or lesser extent.

4.1 A General Increase in Environmental Attitude Resulted in Behavioral Spillover

We reported spillover as attitude change not within a person but with two independent samples, whereas most research investigates spillover in the environmental behavior domain as a within-person phenomenon (see, e.g., Lauren, Fielding, Smith, & Louis, 2016; Lanzini & Thøgersen, 2014; Whitmarsh & O'Neill, 2010). With our cross-sectional design, we cannot rule out the possibility that the observed mean difference in people's environmental attitude levels in 2001 and 2010 is actually caused by imperfect sampling procedures and does not reflect a real change in people's attitudes. Whereas only longitudinal data can address this

problem, for the sake of our demonstration it is sufficient that people's environmental attitude levels in 2001 and 2010 significantly differ as they do.

Being stratified and stemming from the same population, our samples are comparable (see also Otto &Kaiser, 2014). Furthermore, the measurement instrument for environmental attitude is invariant: it measures the same attribute in both groups (i.e., environmental attitude), it uses the same metric (i.e., the same measurement units, in our case: logits), and it applies the same origin (i.e., the same zero point; see Van de Vijver & Leung, 1997). Therefore, the difference in environmental attitude between both groups can be interpreted as a change in environmental attitude in society that manifests in a generalized behavior effect (i.e., behavioral spillover) in 2010.

The extent of attitude change reported from 2001 to 2010 (see also Otto & Kaiser, 2014) is coherent with other research that shows the increasing of environmental attitude in the German population at a slow but steady rate (see Bauske, Kaiser, & Kibbe, 2020; Federal Ministry for the Environment [BMU] of Germany, 2017). Thus, the attitude change—albeit not observed within-person—is plausible, on the one hand, and reflects an attitude difference either way, on the other hand, since the same measurement instrument was used, even if it did not reflect a *process* of change. Therefore, the presented data serve to demonstrate that an increased environmental attitude would become apparent in a behavioral spillover phenomenon. Understandably, the empirical behavior change pattern is not as smooth as the ideal model-based prediction: Despite the overall increase of behavioral frequency there is variability between single items, with very few even being reported less in 2010 compared to 2001. Single items are prone to random fluctuation and measurement error (Hoyle, Harris, & Judd, 2008), therefore, it is not surprising that the frequency of single behavior items is fluctuant. Thus, relying on a multi-item measure gives a somewhat more reliable account of the effect. For the same reason, it might be sometimes difficult to find spillover effects when

only single behaviors are taken into consideration.

Whereas much of spillover research investigates specific interventions and their effect on subsequent behaviors (see, e.g., Carrico, Raimi, Truelove, & Eby, 2018; Lanzini & Thøgersen, 2014; Poortinga et al., 2013), there are other studies that investigated spillover without an intervention but in relation to person characteristics or previous behavior (see, e.g., Lauren et al., 2016; Thøgersen & Ölander, 2003). Our design also does not entail a specific intervention but is based on the observation of attitude and behavior change over time. In the course of nine years, it is reasonable to assume that even comparably stable characteristics like attitudes can change. The reported attitude change (or: difference in attitude in similar samples of a population) could be speculated to be the result of a 'naturally occurring' intervention that happened over the time of the study and that increased people's propensity to protect the environment—for example, by a higher prevalence of environmental topics in the media and the public for which our outlier item (i.e. the massive increase in reported acquisition of information about environmental issues) is an indicator (see also Otto & Kaiser, 2014). It was not our aim to explain how attitude change would come about but to suggest that spillover phenomena could be understood as the result of an attitude change. This view might help to integrate different explanatory attempts to understand what happens when spillover phenomena occur. More knowledge is needed about how to deliberately change people's environmental attitude—firstly, to find stronger empirical evidence for spillover as the result of attitude change, and then secondly, for the effective promotion of sustainable lifestyles.

4.2 Behavioral Difficulty and Environmental Attitude Levels as Crucial Factors for Spillover to Occur

As claimed by the Campbell paradigm, pro-environmental behavior is determined by two factors: the individual level of environmental attitude and the difficulty of the to-be-

494 explained behavior (Kaiser et al., 2010). Correspondingly, we regard both, the level of
495 environmental attitude and the difficulties of the pro-environmental behaviors, as important
496 for understanding spillover. Behavioral difficulty has repeatedly been proposed to be an
497 explanatory factor for whether spillover effects will occur or not (Lanzini & Thøgersen, 2014;
498 Truelove et al., 2014; Truelove et al., 2016). The proposed model allows to specify the role
499 that behavioral difficulty plays in the emergence of spillover. Difficulty affects the extent of
500 spillover in that it determines the proportion of people who are likely to adopt a behavior as a
501 consequence of an increase in attitude. An attitude shift of a certain magnitude in the
502 population leads to an adoption of behaviors in the upper medium range of difficulty because
503 this is the range where the majority of individual attitude shifts take place. The same relative
504 shift in individuals with a strong attitude, however, should affect the frequency of difficult
505 behaviors to a lesser degree in absolute terms because fewer people in total have a strong
506 attitude. The fact that we did find a higher than expected extent of behavior change in very
507 difficult behaviors has been addressed above and requires more investigation, ideally in a
508 longitudinal design to exclude sample differences as a cause.

509 We did not find evidence that the behavior changes were limited to subdomains (e.g.,
510 electricity saving, mobility). Our theoretical reasoning and our empirical evidence imply
511 that—if pro-environmental attitude was the reason for behavior change—all kinds of pro-
512 environmental behaviors should be affected by spillover (i.e., increase in frequency)
513 irrespective of their subdomains or other semantic connections. On the other hand, this means
514 that if an intervention tackled, for example, energy saving behavior by reducing behavioral
515 costs (i.e., by subsidizing energy-efficient household appliances), spillover would most likely
516 be expected to be restricted to energy-saving behaviors whose behavioral costs were affected
517 by the intervention and not generalize to other pro-environmental behaviors.

518 Understanding spillover as attitude change allows to reason about the occurrence of

519 spillover in a different way. Since even proponents of mediation models of spillover effects
520 regard interventions as more promising for eliciting spillover if they appeal to environmental
521 concerns (see, e.g., Steinhorst, Klöckner, & Matthies, 2015; Thøgersen & Noblet, 2012), we
522 propose to describe spillover in terms of these intrapersonal processes. In the following, we
523 briefly present possible explanations for negative or no spillover effects that follow from
524 understanding spillover as attitude change.

525 When positive spillover does not happen, according to our model two explanations
526 suggest themselves. The absence of spillover (i.e., one behavior changes but all other
527 behaviors remain unchanged) speaks of a specific cost-reduction effect: For example, the
528 behavior 'recycling electronic waste' could be facilitated by an intervention that makes this
529 specific behavior easier through reducing behavioral costs (e.g., by offering collection service
530 for electronic waste much closer to the household; see, e.g., Otto, Kibbe, Henn, Hentschke, &
531 Kaiser, 2018). Such an intervention most likely leaves the person's attitude and other
532 behaviors unaffected. According to our model, the absence of spillover could be an indicator
533 of the failure to address a person's inclination to protect the environment with the
534 intervention.

535 Negative spillover, in turn, might be an indicator that the intervention addressed a
536 different motive. For example, imagine that a monetary incentive is offered for engaging in a
537 specific pro-environmental activity (e.g., choosing a vegetarian meal instead of a meat-based
538 meal)—why should the person be motivated to engage in pro-environmental behavior
539 thereafter? The behavior would be guided by a motive that is unrelated to environmental
540 protection (i.e., saving money).

541 If environmental protection is not a person's aim and behavior change instead results
542 from specific behavioral cost reduction or from addressing an environment-unrelated motive,

lifestyles will most likely not change toward higher levels of sustainability. Thus, regarding positive spillover as resulting from attitude change offers a promising pathway to yield a generalized behavior effect in people by which all kinds of pro-environmental behaviors increase. Our study, however, does not provide insights into how to evoke such an attitude change. Fostering high levels of environmental attitude, so far, seems to be a long term endeavor which we should already start in childhood (see, e.g., Otto, Evans, Moon, & Kaiser, 2019; Neaman, Otto, & Vinokur, 2018) and promote throughout the course of life (Otto & Kaiser, 2014).

4.3 Conclusion

We presented a novel model of spillover in the environmental behavior domain which suggests that the joint change of pro-environmental behaviors can be understood as an indicator of attitude change. This definition does not require that behavior change is necessarily a consequence of a specific (initial) behavior change but focuses on the behavioral determinants. This model simply provides a common understanding for some of the different and detailed explanations of the mixed evidence of occurrence and direction of spillover (see, e.g., Truelove et al., 2014). If spillover occurs it might be the consequence of a change in a person's esteem for environmental protection (i.e., environmental attitude) and thus an indicator that a preceding intervention was successful in changing this attitude. If no spillover eventuates it might be for the reason that the environmental attitude did *not* change but instead specific behavior facilitation was provided or other motives were addressed by a preceding intervention. Regarding spillover as attitude change, we were able to predict the pattern of behavior change dependent on behavioral difficulty. We empirically demonstrated that an increase in environmental attitude would result in a predictable generalized behavior effect. In search of the mechanisms behind spillover effects, we aimed to contribute a perspective focusing on behavioral determinants of the behaviors affected by spillover. Understanding

spillover as resulting from attitude change means that interventions aiming to promote more sustainable lifestyles (i.e., the joint change of several environmentally relevant behaviors) should go beyond promoting specific behaviors but focus on fostering people's environmental attitude.

Ethics Statement

Approval by an ethics committee was not required as per the ethics guidelines of the German Psychological Associations (DGPs) and German national regulations. Consent of each participant was given by virtue of survey completion. Anonymity of participants was guaranteed.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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