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Ryan W. Buell  
Shwetha Mariadassou  
Yanchong Zheng

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Ryan W. Buell

Harvard Business School

Shwetha Mariadassou

Stanford University

Yanchong Zheng

Massachusetts Institute of Technology

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# Relative Performance Transparency: Effects on Sustainable Choices

Ryan W. Buell

Harvard Business School, Harvard University, Boston, MA 02163, rbuell@hbs.edu

Shwetha Mariadassou

Stanford Graduate School of Business, Stanford University, Stanford, CA 94305, shwetham@stanford.edu

Yanchong Zheng

Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA 02142, yanchong@mit.edu

We study how transparency into the levels and changes of relative sustainability performance affects consumer choices. Our work considers two forms of transparency: *process transparency*, in which customers receive information about the company’s sustainability performance relative to other companies, and *customer transparency*, in which customers receive information about their own sustainability performance relative to other customers. Through three studies with 7,308 participants, we observe that revealing the *levels* of relative performance is more motivating for customers in the *process transparency* domain, whereas revealing relative *changes* in performance is more motivating for customers in the *customer transparency* domain. We employ structural equation modeling to identify the underlying mechanisms for these results. We show that levels information is more reflective of objective performance comparison, thus strengthening motivation in the domain of process transparency. In contrast, changes information helps to mitigate self-serving attribution biases in the customer transparency domain, thus playing a more significant role in affecting motivation.

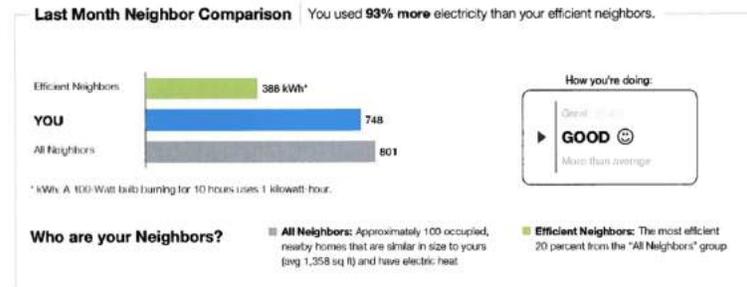
*Keywords*: Relative performance transparency, process transparency, customer transparency, levels, changes, reflectiveness, self-serving attribution biases, sustainability, consumer choice

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## 1. Introduction

Environmental responsibility is one of the world’s most pressing issues. Both private and public organizations are devoting increased attention and effort to operate more sustainably and to encourage consumers to do the same. For example, Starbucks recently pledged to eliminate plastic straws across 28,000 stores globally by 2020, as part of their \$10M commitment to develop a fully recyclable and compostable global cup solution (Starbucks Newsroom 2018). Opower, now part of Oracle Utilities, encourages customers to reduce energy consumption by providing households with analysis of their energy usage compared to that of their neighbors (Smith, Rodger 2018). Governments encourage consumers to be conscious about their carbon footprints by incentivizing fuel-efficient vehicles through tax credits and carpool lane stickers. Despite these efforts, changing consumer behaviors, either to purchase a more sustainable product or to consume resources in a more sustainable manner, remains a key challenge. However, it is indispensable for truly achieving sustainability. Our research goal is to examine how organizations can more effectively leverage transparency to motivate sustainable behavior.

Figure 1 Customer Transparency Example: Household Home Energy Report

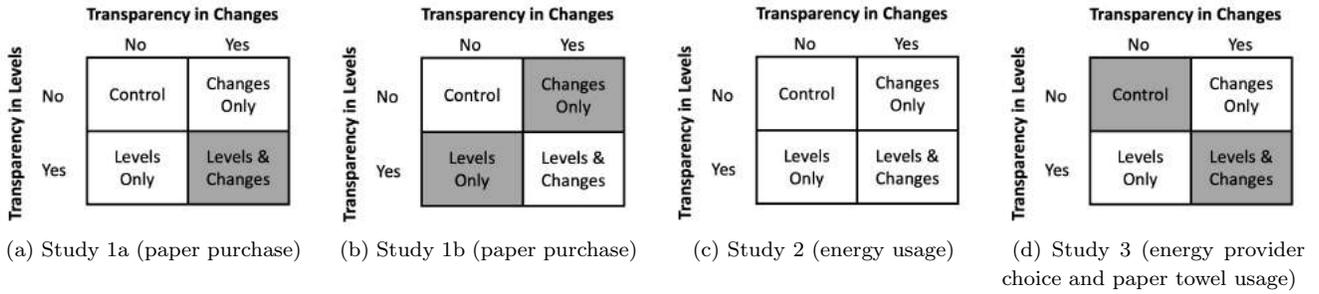


Organizations are increasingly using transparency to influence customer behavior (Kalkanici et al. 2012, Delmas and Lessem 2014, Hainmueller et al. 2015). We distinguish between two domains of transparency: (i) *process transparency*, in which the relative sustainability of a company's processes is revealed to the customer; and (ii) *customer transparency*, in which the relative sustainability of the customer's own behavior is revealed to the customer-self. For example, Domtar, a North American paper and pulp producer, engages in process transparency by revealing on their website that 75% of the energy they use in their mills comes from renewable biomass, compared to the industry average of 67% (Domtar 2018). In contrast, utility companies like National Grid in Massachusetts engage in customer transparency by sending out home energy reports to households (Figure 1). These home energy reports compare a household's energy usage to their neighbors' usage. A commonality in both examples is the use of relative performance transparency, in which the focal company or customer's sustainability performance is compared to a benchmark, such as the industry average or other (similar) customers. Relative performance transparency in the domains of process and customer transparency is the focus of our research.

In particular, we investigate two ways in which relative performance can be conveyed: *levels* information that reveals current performance at a given point in time; and *changes* information that reveals differences in performance over a time period. As an example of providing relative performance transparency with levels information, consider the home energy report in Figure 1. Here, the focal household is shown how much energy they have used compared to their neighbors in the current month. Alternatively, the report could show the focal household how much more or less energy they have used between the prior and the current month, compared to their neighbors' change in energy consumption over the same time period. Our key research questions in this paper are: (i) Which kind of information, levels or changes, is more influential in motivating sustainable choices in the domain of process transparency? (ii) How might our answer to (i) change in the domain of customer transparency? (iii) What underlying mechanisms can explain our answers to (i) and (ii)?

To address these questions, we conducted a series of studies that involved 7,308 participants on the Amazon Mechanical Turk platform (Buhrmester et al. 2011, Mason and Suri 2012). Participants were

Figure 2 Overview of Treatment Design



Note. In each study, only those conditions in the white cells were implemented. In the Control condition, no relative performance information was shown to the participants.

asked to indicate their likelihood to engage in sustainable behavior given the information shown in the studies. We consider environmental performance of the company or the customer in our studies. The key manipulation across treatment conditions was the kind of relative performance information – levels or changes – shown to the participants. Specifically, each study implemented a subset of four possible conditions from a 2 (transparency in levels: yes or no) × 2 (transparency in changes: yes or no) design: *control*, *levels only*, *changes only*, and both *levels and changes*. Figure 2 summarizes the conditions implemented in each study (indicated as white cells). To strengthen the generalizability of our conclusions, we also examine different contexts of customer choices. These include paper purchase (Studies 1a, 1b) and choosing an energy provider (Study 3) for the domain of process transparency; and energy usage (Study 2) and paper towel usage (Study 3) for the domain of customer transparency.

1.1. Contributions

Our key results and contributions are twofold. First, to the best of our knowledge, we are the first to demonstrate that providing relative performance transparency with *levels* versus *changes* information has drastically different impacts on motivating sustainable behavior, across two different domains of transparency – process and customer transparency. A growing body of research has been studying the impacts of either process transparency or customer transparency on individuals’ perception and behavior. For example, transparency into a company’s operations has been shown to improve customers’ trust in the company and their perceptions of its service value (Buell and Norton 2011, Buell et al. 2017, Zheng et al. 2016), often increasing a customer’s likelihood to purchase. In addition, studies have shown that relative performance feedback (particularly when public) is effective in altering the behavior of the focal actor (Delmas and Lessem 2014, Song et al. 2017). In the extant literature, researchers have predominantly focused on *levels* information, i.e., disclosing current performance or processes. Some limited research has examined the effect of transparency with respect to disclosing *changes* information. For example, Bowman (2006) finds that in the realm of charity donations, revealing changes in overhead ratios can be useful. However, we are the first to experimentally compare the efficacy of

presenting levels versus changes information across process and customer transparency. We thus advance this literature by determining the most effective way of disclosure for different domains of transparency to better motivate sustainable choices.

In particular, we observe that in the domain of process transparency – when a company’s sustainability performance is compared to the industry average – transparency that reveals performance *levels* has a more significant impact on customer motivation than transparency that reveals performance *changes*. In sharp contrast, in the domain of customer transparency – when a customer’s sustainability performance is compared to other customers – transparency that reveals performance *changes* more significantly impacts customer motivation. These results offer valuable insights regarding how organizations can best design their information transparency in different settings. For example, contrary to the current practice of presenting a household’s usage levels, home energy reports can better motivate conservation if they are redesigned to highlight the household’s usage *change* over time as compared to their neighbors’ change.

Second, leveraging structural equation modeling, we identify potential mechanisms underlying the above observations. Specifically, customers in general perceive *levels* information to be more reflective of the objective performance comparison between the focal party and the benchmark than *changes* information. As a result, when the comparison involves two parties external to the customer as in the process transparency domain, revealing *levels* has a stronger impact on customer choices. However, when the comparison involves the customer self as in the customer transparency domain, customers are subject to a self-serving attribution bias wherein they attribute poor performance levels to situational factors (e.g., task difficulty or luck) rather than dispositional ones (e.g., skills or effort). Therefore, they are less likely to internalize responsibility for the performance difference and are, in turn, less motivated to change. In this case, revealing *changes* instead helps to mitigate this bias because changes information by definition has already controlled for each customer’s unique initial point. As such, customers are more likely to attribute differences in performance changes to dispositional factors, and hence, become more motivated to change for better performance.

## 1.2. Related literature on transparency

We briefly discuss here related literatures that examine process and customer transparency.

**1.2.1. Process transparency** Transparency into a company’s operations has been shown to improve customers’ perceptions and valuations of a company; it can also result in increased demand for the company’s products (Buell and Norton 2011, Hainmueller et al. 2015, Zheng et al. 2016, Buell et al. 2017, Kraft et al. 2018). Revealing the effort involved in delivering the final product can result in increased gratitude, which translates into increased willingness to pay and overall satisfaction (Morales 2005). Revealing the time and effort involved in the production process can serve as a heuristic for

product quality (Chinander and Schweitzer 2003, Kruger et al. 2004). Other research has shown that even voluntary disclosures of poor performance can promote trust and subsequently lead to increased brand loyalty and market share (Chaudhuri and Holbrook 2001, Mohan et al. 2016). In our research, we consider process transparency that specifically highlights the company’s performance in environmental sustainability.

Within this realm, researchers have explored how the type of information and the manner in which information is presented influence behavior (O’Rourke and Ringer 2016). Studies have illustrated the impact of eco-labels as an effective type of transparency in changing consumer perception and behavior. Examples include dolphin-safe labels that increase market share of canned tuna (Teisl et al. 2002), fair-trade coffee labels that result in higher satisfaction with taste, increased demand, or lower price elasticity (Loureiro and Lotade 2005, Sörqvist et al. 2013, Hainmueller et al. 2015), and eco-labelled lamps that enhance task performance (Sörqvist et al. 2015). Kalkanci et al. (2012) find that voluntary disclosure of greenhouse gas emissions can increase market share if competitors do not disclose information. Muthulingam et al. (2013) show that the order in which energy-saving recommendations are presented to small and medium firms significantly affects the resulting adoption rate of such recommendations. Our research builds on this body of work by investigating a new dimension of process transparency: whether revealing *levels* or *changes* can better motivate sustainable choices and why.

**1.2.2. Customer transparency** The second domain of transparency we study considers revealing to customers their own performance relative to the performance of their peers. The practice of revealing information about peer behavior to encourage socially desirable actions rests on the basis that people tend to conform to the behavior of the majority (Burchell et al. 2013). This approach has been applied in a number of different settings, including charitable giving (Frey and Meier 2004), alcohol consumption (Mattern and Neighbors 2004), energy conservation (Goldstein et al. 2008), voting (Gerber and Rogers 2009), and retirement savings (Beshears et al. 2015). Beyond simply providing peer information, a social comparison approach – in which customers are shown their own performance relative to the peers – is also shown to be effective in influencing behavior. Specifically within the environmental sustainability context, this approach has been applied in energy consumption (Schultz et al. 2007, Nolan et al. 2008, Allcott 2011, Ayres et al. 2013), food waste (Nomura et al. 2011), and water conservation efforts (Ferraro and Price 2013).

An important point of research in this area is how social comparison information may trigger different motivations of the customers and result in different behaviors (Delmas and Lessem 2014). In some instances, presenting peer information can shift behavior away from the desired outcome. As evidenced by the “boomerang effect,” people whose performance is initially better than the average may actually adjust their behavior toward the average (Schultz et al. 2007, Ayres et al. 2013). This effect can be mitigated if information about desirable behavior is also being conveyed (e.g., presenting a happy

face for good performance). In a field experiment conducted with 84,000 households, Ayres et al. (2013) show that households who started with a higher level of pre-treatment usage reduced their usage more substantially (in percentage terms) if they were periodically sent home energy reports that included neighbor comparisons. Roels and Su (2013) develop a model to analyze what type of neighbor comparison information a social planner should present to households to maximize conservation, given individuals' preferences as being ahead-seeking or behind-averse. We add to this literature by studying and contrasting the efficacy of presenting *levels* versus *changes* information to motivate more sustainable consumption. Furthermore, we identify an additional behavioral factor – self-serving attribution biases – which plays a significant role in affecting what kind of information is more effective to motivate conservation in the domain of customer transparency.

**1.2.3. Research hypotheses** Based on the extant literature on transparency, we predict that transparency is more beneficial than harmful in motivating sustainable choices. In addition, due to the lack of prior works that contrast the efficacy of levels versus changes information, we make a null hypothesis of no difference between these two kinds of information. Our research hypotheses are thus summarized as follows.

*HYPOTHESIS 1. Compared to no transparency, both process and customer transparency result in a higher likelihood that the customer would engage in more sustainable behavior.*

*HYPOTHESIS 2. For both process and customer transparency, revealing levels and revealing changes have the same effects on customers' likelihood of engaging in more sustainable behavior.*

In what follows, we discuss the detailed design, analysis, and results of each study. Participants must satisfy the following conditions to be accepted to our studies (Buhrmester et al. 2011): (i) they must be over 18 years old and residing in the United States; (ii) they must have a 95% or higher approval rate and have successfully completed at least 500 tasks on Amazon Mechanical Turk. In our analysis, we only retain data from participants who correctly answered predefined attention check questions in the study (Goodman et al. 2013). We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study (Simmons et al. 2012).

## **2. Study 1: Process Transparency and Purchase Intention**

In this study, we consider a scenario in which a paper company discloses its performance in carbon dioxide (CO<sub>2</sub>) emissions during its production process and examine how such process transparency affects customers' intention to purchase the company's paper.

## 2.1. Study 1a: Revealing levels or changes in relative performance

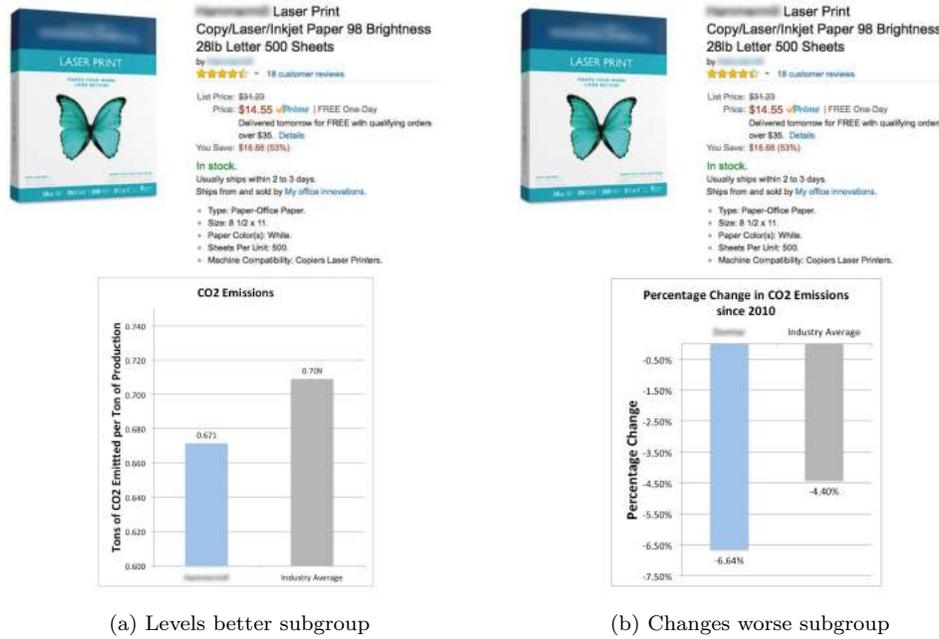
**2.1.1. Design and procedure.** Participants assumed the role of a potential buyer and were asked to answer questions related to a hypothetical scenario of purchasing printing paper, an inexpensive product with low brand loyalty. We employed a 2 (transparency: *levels* or *changes*)  $\times$  2 (relative performance: better or worse than the industry average) + 1 (control: no transparency) design. Participants in all conditions saw the image and specifications of one of two brands of printing paper. The *control* group was not shown any CO<sub>2</sub> emissions information but only the image and specifications of the product. The two treatment groups, *levels only* and *changes only*, were additionally shown a bar chart that illustrated either the company’s current level of CO<sub>2</sub> emissions compared to the current industry average (*levels only* group), or the change in the company’s CO<sub>2</sub> emissions since 2010 compared to the average change in the industry (*changes only* group; see Figure 3). Within the *levels only* group, approximately half of the participants were in the *levels better* subgroup. The chart showed that the company’s CO<sub>2</sub> emissions were at a level of 0.671 tons of CO<sub>2</sub> emitted per ton of production, lower than the industry average of 0.709. The other half were in the *levels worse* subgroup and observed a chart showing the company’s CO<sub>2</sub> emissions at a level of 0.739. Similarly, within the *changes only* group, half of the participants were in the *changes better* subgroup and observed that the company reduced CO<sub>2</sub> emissions since 2010 by 6.64%, larger than the average industry reduction of 4.40%. Conversely, the *changes worse* subgroup observed that the company reduced CO<sub>2</sub> emissions by 2.93%. The values used in the study were chosen based on sustainability reports from the American Forest & Paper Association to ensure credibility (American Forest & Paper Association 2014). We randomly used one of two brands across participants in every condition in a counterbalanced manner to control for potential effects of the brand name on participants’ choices. We designed the bar charts to have similar-sized bars and included gridlines and tick marks to aid with interpretability (Cleveland 1984, Isenberg et al. 2011). Appendix O.1 summarizes all performance values used in our studies.

**2.1.2. Dependent measures.** Participants indicated their purchase intention by responding to the question: “How likely are you to purchase this product?” (7-point scale; 1 = very unlikely to 7 = very likely). We asked additional questions on company perceptions and individual motives to explore possible mechanisms (See Appendix O.2).

**2.1.3. Participants.** 400 participants completed Study 1a for \$1.00, which took on average 4 minutes. Among them, 396 participants correctly answered the attention check question. We only used data from these participants for our analysis ( $N = 396$ , 60.6% male,  $M_{\text{age}} = 35.0$ ).

**2.1.4. Results.** We do not observe any significant differences across brands; hence, we pool the data from both brands for our analysis. We first use Wilcoxon rank sum tests to compare the participants’ purchase intention between the *control* group (mean ( $M$ ) = 3.385, standard deviation ( $SD$ ))

Figure 3 Example Images in Study 1a



(a) Levels better subgroup

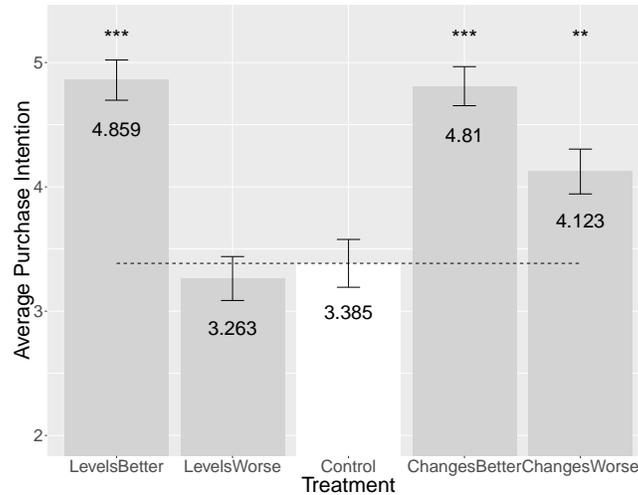
(b) Changes worse subgroup

*Note.* For transparency with *levels* information, the industry average stayed constant at 0.709 tons while the company took one of two values, either better (0.671) or worse (0.739) than the average. For transparency with *changes* information, the industry average stayed constant at -4.40% while the company took one of two values, either better (-6.64%) or worse (-2.93%) than the average.

= 1.700) and each of the treatment conditions (Figure 4). We observe that showing relative performance information almost always results in significantly higher purchase intention than not providing transparency. Unsurprisingly, when the brand fares better than the industry, we observe the highest values of purchase intention. The participants' purchase intention in the *levels better* group ( $M = 4.859$ ,  $SD = 1.430$ ,  $W = 1,558$ ,  $p < 0.001$ ) and in the *changes better* group ( $M = 4.810$ ,  $SD = 1.397$ ,  $W = 1,643$ ,  $p < 0.001$ ) are both significantly higher than in the *control* group. When the brand fares worse than the industry in *changes*, purchase intention is still significantly higher than in the *control* group ( $M = 4.123$ ,  $SD = 1.623$ ,  $W = 2,395.5$ ,  $p = 0.007$ ). Finally, there is no significant difference in purchase intention between the *control* group and the *levels worse* group ( $M = 3.263$ ,  $SD = 1.581$ ,  $W = 3,238$ ,  $p = 0.676$ ). Consistent with Hypothesis 1, these results provide evidence that compared to no transparency, providing process transparency that reveals a company's relative sustainability performance can attract customers to purchase more sustainable products. In fact, we find that transparency of unfavorable performance may not necessarily undermine purchase intention, as has been previously documented by Kalkanici et al. (2012).

To further confirm the above results, we estimate a regression model with purchase intention as the dependent variable and indicator variables for revealing *levels* or revealing *changes* as the key independent variables. The baseline in the regression is the *control* group. We reverse code purchase intention for participants who saw the company fare worse than the industry average. As such, the

**Figure 4 Study 1a: Comparison of Purchase Intention by Treatment Condition**



*Note.* The number on each bar presents the average purchase intention in the corresponding group. The error bars show the standard errors. Significance levels are based on Wilcoxon rank sum tests that compare each treatment group to the control group. \*\*\*:  $p < 0.001$ , \*\*:  $p < 0.01$ .

**Table 1 Study 1a Regression Results: Effect of Process Transparency on Purchase Intention**

Variables	Purchase intention	
	(1)	(2)
<i>Levels only</i>	1.41*** (0.22)	1.46*** (0.22)
<i>Changes only</i>	0.96*** (0.22)	0.99*** (0.22)
Age	–	-0.01 (0.01)
Male	–	-0.33* (0.16)
Education	–	0.04 (0.05)
Income	–	0.03 (0.06)

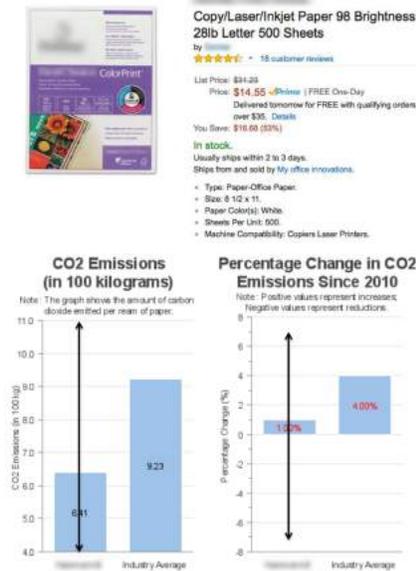
*Note.* Standard errors are in parentheses. “–” means the corresponding variable is not included in the regression. \*\*\*:  $p < 0.001$ , \*:  $p < 0.05$ ,  $p$  values are derived from two-sided  $t$  tests.

dependent variable captures motivation to purchase from the company (when the company fares well) or motivation to *not* purchase from the company (when the company fares poorly). We control for the participants’ age, gender, education, and income level in the regression. These demographic factors do not significantly impact the effect of transparency on purchase intention. We observe that revealing *levels* ( $\beta = 1.46$ ,  $p < 0.001$ ) has a stronger impact on purchase intention than revealing *changes* ( $\beta = 0.99$ ,  $p < 0.001$ ; Table 1).

## 2.2. Study 1b: Revealing levels and changes in relative performance

**2.2.1. Design and procedure.** In this study, we examine whether *levels* or *changes* information plays a more important role in affecting customers’ choices, when both are presented together. To do so, we implemented the *control* group and the *levels and changes* treatment group (Figure 2b). Similar

Figure 5 Example Image in Study 1b



*Note.* Both bar charts were shown to all participants in the *levels and changes* group. The performance values for the focal company varied along the range indicated by the double-arrow lines. The industry average took one of two values: 573kg or 923kg in *levels*,  $-4.00\%$  or  $+4.00\%$  in *changes*. The positions of the *levels* and *changes* bar charts (left or right) were randomized across participants.

to Study 1a, participants in both groups were shown the image and specifications of one of two brands of paper. 5% of the participants were assigned to the *control* group and only observed the product image and specifications. The remaining 95% of the participants were to the *levels and changes* group. They additionally observed two bar charts side-by-side that presented both the company's current CO2 emissions level and the change in its CO2 emissions since 2010, relative to the respective industry average (Figure 5). We assigned a large number of participants to the treatment group because we varied the focal company's performance values on a continuous scale. This way we can investigate whether the effects of revealing levels versus changes information on customers' choices depend on the magnitude of the differences between the company's performance and the industry average.

The industry average emissions were either low (573 kg) or high (923 kg), both reflecting the amount of CO2 emitted to produce one ream of paper. These values were adapted from CO2 emissions reported by two paper brands in 2010 and 2012, as well as reports from the American Forest & Paper Association (American Forest & Paper Association 2014). The company's emissions level was randomized across participants on a continuous scale between 400kg and 1,099kg. This range was chosen such that the low and high industry average levels were at the first and third quartiles of the range. The change values were designed similarly. Across participants, the company's change in emissions was randomized on a continuous scale, with a positive (negative) value indicating an increase (reduction) in emissions since 2010. We set the largest reduction at  $-7.00\%$ , derived from the change in emissions reported by one paper brand between 2010 and 2012. We set the largest increase at  $+7.00\%$  to be symmetric to the

**Table 2 Summary Statistics: Difference in Average Purchase Intention from Control**

		Company <i>change</i> vs. industry average						
		[-11, -7.33)	[-7.33, -3.67)	[-3.67, 0)	[0, 3.67)	[3.67, 7.33)	[7.33, 11)	Average
Company <i>level</i> vs. industry average	[3.49, 5.24)	0.172 (4.536%)	0.626 <sup>†</sup> (16.507%)	0.642* (16.933%)	0.834*** (22.002%)	-0.261 (-6.898%)	0.765* (20.171%)	0.600** (15.828%)
	[1.74, 3.49)	0.615 <sup>†</sup> (16.232%)	0.889** (23.453%)	0.876** (23.102%)	0.635* (16.471%)	0.797 <sup>†</sup> (21.033%)	1.002** (26.437%)	0.789*** (20.802%)
	[0, 1.74)	0.100 (2.638%)	0.313 (8.244%)	0.317 (8.352%)	0.598** (15.774%)	0.621* (16.377%)	0.959*** (25.300%)	0.508** (13.389%)
	[-1.76, 0)	-0.031 (-0.815%)	-0.458 <sup>†</sup> (-12.070%)	-0.235 (-6.208%)	-0.291 (-7.674%)	-0.177 (-4.676%)	-0.170 (-4.490%)	-0.231 (-6.105%)
	[-3.51, -1.76)	-0.446 (-11.767%)	-0.232 (-6.122%)	-0.251 (-6.627%)	-0.561* (-14.809%)	-0.382 (-10.072%)	-0.400 (-10.541%)	-0.381* (-10.062%)
	[-5.26, -3.51)	-0.891** (-23.501%)	-0.759* (-20.012%)	-0.569* (-15.001%)	-0.340 (-8.967%)	-0.618 <sup>†</sup> (-16.315%)	-0.404 (-10.652%)	-0.570** (-15.027%)
	Average	-0.049 (-1.292%)	-0.021 (-0.546%)	0.093 (2.448%)	0.179 (4.718%)	0.037 (0.973%)	0.387* (10.207%)	0.116 (3.066%)

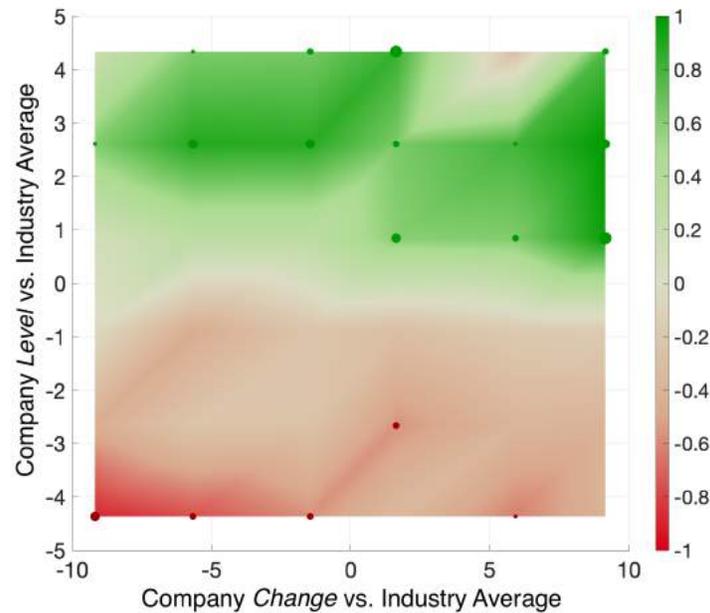
*Note.* Positive (negative) values of performance difference between the company and the industry average indicate that the company performs better (worse) than the industry in the associated dimension (*levels* or *changes*). Effect size is in parentheses.

\*\*\*:  $p < 0.001$ , \*\*:  $p < 0.01$ , \*:  $p < 0.05$ , <sup>†</sup>:  $p < 0.10$ ,  $p$  values are derived from Wilcoxon rank sum tests.

largest reduction around zero. We chose the industry average change to be either  $-4.00\%$  or  $+4.00\%$ , at approximately the first and third quartiles of the range for the company’s change values. Participants were asked questions similar to those in Study 1a.

**2.2.2. Participants.** 2,000 participants completed this study for \$0.50, which took on average 3 minutes. Among them, 1,919 participants correctly answered the attention check questions. We only used data from these participants for our analysis ( $N = 1,919$ , 54.8% male,  $M_{\text{age}} = 35.0$ ).

**2.2.3. Results.** Results in Study 1b reinforce the impact of process transparency on customers’ purchase intention as observed in Study 1a, supporting Hypothesis 1. We segment the treatment group into 36 subgroups based on equidistant splits of the performance difference between the focal company and the industry average along levels and changes (6 subgroups in each dimension). We then compare the participants’ purchase intention in each of these 36 subgroups to that in the *control* group. Table 2 presents for each subgroup the difference in average purchase intention between the subgroup and the *control* group, the corresponding significance level (based on a Wilcoxon rank sum test), and the effect size as a percentage difference from the average purchase intention in the *control* group. The rows correspond to how the company’s CO2 emissions *level* compares to the industry average level. The columns correspond to how the company’s *change* in CO2 emissions compares to the industry average change. Positive (negative) values mean that the company is doing better (worse) than the industry average in the associated dimension. Figure 6 illustrates these results, with green reflecting higher purchase intention and red reflecting lower purchase intention compared to the *control* group. The vertical (horizontal) axis maps to the rows (columns) in Table 2. The dots indicate the subgroups in which purchase intention is significantly different from that in the *control* group.

**Figure 6** Heat Map: Average Change in Purchase Intention Relative to Control by Company Performance

*Note.* This heat map visualizes Table 2. The green (red) color indicates higher (lower) purchase intention than in the *control* group. Dots indicate where the difference in purchase intention is statistically significant, with a larger dot meaning a stronger significance level.

We highlight two observations from Table 2 and Figure 6. First, when the focal company outperforms the industry average in *levels* (top half of Figure 6), the participants' purchase intention is significantly higher with process transparency than without (the *control* group) in 13 out of 18 subgroups. This result holds even for a number of subgroups in which the company performs worse than the industry average in *changes*. Second, when the company underperforms relative to the industry average in *levels* (bottom half of Figure 6), we observe limited significant effects of process transparency on the participants' purchase intention (significant differences in only 5 out of 18 subgroups). The significant differences mainly occur when the company is performing at the worst levels and is also underperforming in *changes*. In these cases, revealing poor performance yields significantly lower purchase intention. Similarly, as seen in the last column of Table 2, when we average over all *change* values, we observe a significant increase (decrease) in purchase intention if the company performs better (worse) than the industry in *levels*. Conversely, the last row of Table 2 shows little significant change in purchase intention relative to *control* when we average over all *level* values.

Taking together our observations from Studies 1a and 1b, we reject Hypothesis 2 in the process transparency domain. Our data demonstrates that for process transparency, disclosing relative performance with *levels* information has a stronger effect on customers' choices than disclosing *changes* information, as summarized in the following result.

RESULT 1. *In the domain of process transparency – where performance comparison is between a focal company and its industry competitors – revealing relative performance in levels plays a more dominant role in affecting customers’ choices than revealing relative performance in changes.*

### 3. Study 2: Customer Transparency and Conservation

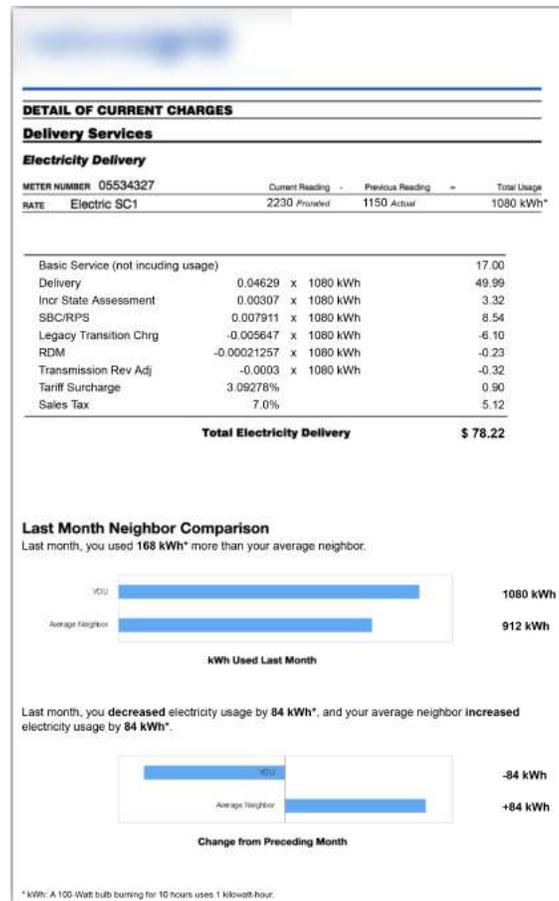
In Study 2, we consider a scenario in which a household observes its energy usage relative to its average neighbor and examine how such customer transparency influences the household’s likelihood to reduce energy consumption in the future.

#### 3.1. Design and procedure

Participants were shown a household’s hypothetical electricity bill and asked to answer questions related to this household’s energy usage in the future. We implemented all four groups – *control*, *levels only*, *changes only*, and *levels and changes* – in this study (Figure 2c). Participants were randomly assigned to one of these four groups. All groups were shown an electricity bill with the household’s usage level in the current month. We randomly varied this usage level across participants among six equidistant values on a discrete scale between 660 kilowatt-hours (kWh) and 1,164 kWh. This range of possible usage levels was chosen based on the average monthly electricity usage by residential customers in the United States (U.S. Energy Information Administration 2016).<sup>1</sup> The *control* group only observed the electricity bill, while the three treatment groups additionally observed bar charts showing usage comparisons between the focal household and its average neighbor. The *levels only* group was shown a bar chart that compared the household’s usage *level* to that of the average neighbor. The average neighbor’s usage level was set at 912 kWh, the midpoint of the possible range for the household. The *changes only* group was shown a bar chart that compared the household’s usage *change* from the prior month to that of the average neighbor. The average neighbor’s usage change from the prior month was either +84 kWh (an increase in usage) or –84 kWh (a decrease in usage). The household’s usage change was randomly varied across participants among six equidistant values on a discrete scale between –126 kWh and +126 kWh. These two values were chosen to ensure that no household would be outside the minimum or maximum average monthly usage across all U.S. states. Participants in the *levels and changes* group were shown both bar charts, with the position of the level or change chart (top or bottom) randomized across participants (Figure 7). In total, we examined 108 possible combinations of relative performance in usage levels and changes for the focal household and the average neighbor.

<sup>1</sup>Specifically, 1,164 kWh is 90% of the maximum average monthly electricity usage across all states. We did not use the maximum itself so that it would be realistic to consider the case where a household has used more than this value in the previous month. We chose 660 kWh as the lowest usage level so that the midpoint of this range (912 kWh) corresponds to the average monthly electricity usage across all states.

Figure 7 Example Image in Study 2



*Note.* This is an example image shown to the *levels and changes* group. The positions of the *level* and *change* charts (top or bottom) were randomized across participants. The *control* group saw only the top half of this bill, excluding the bar charts at the bottom.

### 3.2. Dependent measures

We asked participants to indicate the likelihood that the focal household would reduce its energy consumption in the future as follows: “How likely would most people be to reduce energy consumption in the next month if they were to receive this bill (assuming similar climate)?” (7-point scale; 1 = very unlikely, 7 = very likely). We phrased the question in the third person following previous research that attempts to elicit participants’ true attitudes when such attitudes may be perceived as socially undesirable. It has been shown that asking participants to speculate about others’ socially undesirable responses can capture a more accurate measure of their own (Cohen-Charash et al. 2013). Indeed, we conducted a pilot study with 240 participants (50.1% male,  $M_{age} = 38.1$ ) and confirmed that asking our question in the third person rather than the first person yielded responses that were less inflated in the socially desirable direction. In particular, the stated likelihood to reduce usage in the future was lower in the third person scenario ( $M = 4.043$ ,  $SD = 1.551$ ) than in the first person scenario ( $M = 4.389$ ,  $SD = 1.689$ ,  $W = 7,314$ ,  $p = 0.095$ ). To explore possible behavioral mechanisms, we also asked participants additional questions on company perception and individual motives (Appendix O.3).

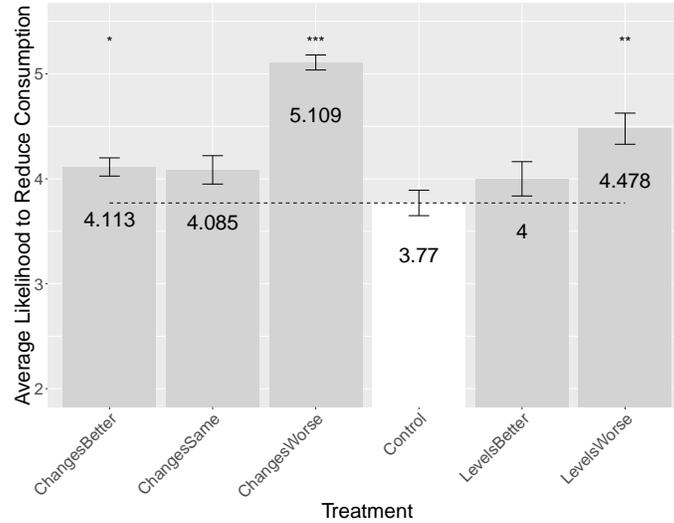
### 3.3. Participants

3,780 participants completed this study for \$0.50, which took on average 4 minutes. For our analysis, we only retained data from 3,457 participants who correctly answered the attention check questions and for whom the images loaded correctly ( $N = 3,457$ , 43.9% male,  $M_{\text{age}} = 35.1$ ).

### 3.4. Results

We parallel our analyses of Study 2 to those of Studies 1a and 1b. First, we compare the likelihood to reduce future energy consumption stated by the participants among the following three groups: *control*, *levels only*, and *changes only*; within *levels only* and *changes only*, we further divide the data into conditions in which a household performs better or worse than the average neighbor. The average likelihood to reduce future consumption in the *control* group is 3.770 ( $SD = 1.654$ ). Results from Wilcoxon rank sum tests show that, compared to the *control* group, the likelihood to reduce consumption is significantly higher in three treatment groups: the *changes worse* group ( $M = 5.109$ ,  $SD = 1.266$ ,  $W = 15,986$ ,  $p < 0.001$ ), *levels worse* group ( $M = 4.478$ ,  $SD = 1.408$ ,  $W = 6,406$ ,  $p = 0.001$ ), and *changes better* group ( $M = 4.113$ ,  $SD = 1.548$ ,  $W = 26,428$ ,  $p = 0.029$ ), in decreasing order of likelihood to reduce. The increased likelihoods in the *changes worse* and *levels worse* groups are in line with results in the social comparison literature that revealing performance that is worse than others would motivate people to improve their own performance (Kuhnen and Tymula 2012). For the *changes same* and *levels better* group, the likelihood to reduce consumption is not significantly different from *control*, albeit being directionally higher. To summarize, we find support for Hypothesis 1 regarding customer transparency. Revealing a customer's own sustainability performance relative to other customers results in a stronger motivation to behave in a sustainable manner (for example, to reduce future energy consumption).

We next perform a regression analysis similar to that in Study 1a. The dependent variable is the likelihood to reduce future consumption stated by the participants. The key independent variables are an indicator for *levels* (equals 1 if levels information was shown), an indicator for *changes* (equals 1 if changes information was shown), and the interaction between the two. The *control* group is the baseline. We also control for the usage level presented in the bill, as well as the participants' age, gender, education, and income. Table 3 summarizes the regression results. We observe that the coefficient of revealing *changes* ( $\beta = 0.75$ ,  $p < 0.001$ ) is larger and more significant than the coefficient of revealing *levels* ( $\beta = 0.47$ ,  $p = 0.002$ ). In addition, the coefficient of the interaction term ( $\beta = -0.52$ ,  $p = 0.002$ ) is significantly negative and almost exactly cancels that of revealing *levels*. This observation is confirmed by Wilcoxon rank sum tests that compare the likelihood to reduce consumption in the *levels and changes* group ( $M = 4.459$ ,  $SD = 1.439$ ) to that in the *levels only* or *changes only* group. In particular, the likelihood to reduce is significantly higher in the *levels and changes* group than in the *levels only* group ( $W = 230,420$ ,  $p = 0.041$ ). In contrast, there is no significant difference between the *levels and changes* group and the *changes only* group ( $W = 860,260$ ,  $p = 0.223$ ). These regression results provide evidence

**Figure 8 Study 2: Comparison of Likelihood to Reduce Consumption by Treatment Condition**

*Note.* The number on each bar presents the average likelihood to reduce future consumption in the corresponding group. The error bars show the standard errors. Significance levels are based on Wilcoxon rank sum tests that compare each treatment group to the control group. \*\*\*:  $p < 0.001$ , \*\*:  $p < 0.01$ , \*:  $p < 0.05$ .

**Table 3 Study 2 Regression Results: Effect of Customer Transparency on Likelihood to Reduce Consumption**

Variables	Likelihood to reduce consumption	
	(1)	(2)
<i>Levels</i>	0.46** (0.15)	0.47** (0.15)
<i>Changes</i>	0.74*** (0.12)	0.75*** (0.12)
<i>Levels</i> × <i>Changes</i>	-0.52** (0.16)	-0.52** (0.16)
Household usage	0.00*** (0.00)	0.00*** (0.00)
Age	-	-0.01*** (0.00)
Male	-	-0.12* (0.05)
Education	-	0.03* (0.01)
Income	-	-0.05** (0.01)

*Note.* Standard errors are in parentheses. “-” means the corresponding variable is not included in the regression. \*\*\*:  $p < 0.001$ , \*\*:  $p < 0.01$ , \*:  $p < 0.05$ ,  $p$  values are derived from two-sided  $t$  tests.

that in the customer transparency domain, revealing *changes* has a stronger impact in motivating sustainable choices than revealing *levels*.

Finally, as in Study 1b, we compare the *levels* and *changes* group to the *control* group to examine the potential varying effects of revealing levels or revealing changes on motivating conservation, when both kinds of information are presented. We segment this treatment group into 54 subgroups based on the difference in levels or changes between the focal household and the average neighbor. We compare the likelihood to reduce future consumption between each of these subgroups and the *control* group. Table

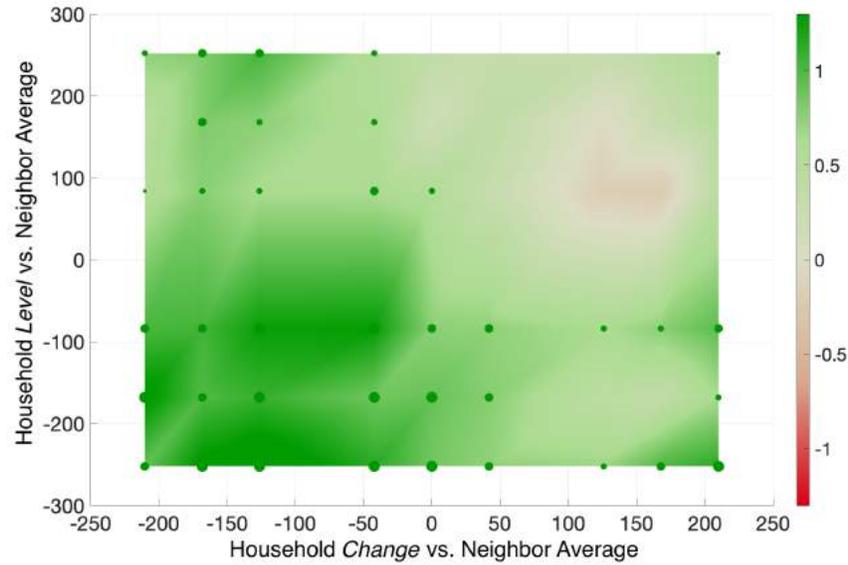
**Table 4 Summary Statistics: Difference in Average Likelihood to Reduce Consumption from Control**

		Household <i>change</i> vs. neighbor average									
		-210	-168	-126	-42	0	42	126	168	210	Average
Household level vs. neighbor average	252	0.745* (19.764%)	0.801** (21.256%)	1.024** (27.163%)	0.547* (14.520%)	0.349 (9.266%)	0.317 (8.406%)	0.299 (7.929%)	0.436 (11.560%)	0.644† (17.075%)	0.533*** (14.131%)
	168	0.487 (12.920%)	0.801** (21.256%)	0.761* (20.191%)	0.568* (15.077%)	0.184 (4.894%)	0.389 (10.310%)	-0.020 (-0.532%)	0.262 (6.955%)	0.503 (13.333%)	0.426** (11.310%)
	84	0.544† (14.436%)	0.773* (20.498%)	0.636* (16.875%)	0.630** (16.709%)	0.524* (13.901%)	0.305 (8.079%)	-0.187 (-4.953%)	-0.227 (-6.026%)	0.423 (11.233%)	0.419** (11.107%)
	-84	1.018** (26.998%)	1.036** (27.490%)	1.262*** (33.480%)	1.277*** (33.867%)	0.764** (20.276%)	0.746** (19.776%)	0.624* (16.548%)	0.761* (20.191%)	0.949** (25.164%)	0.936*** (24.835%)
	-168	1.355*** (35.940%)	0.988** (26.194%)	1.087*** (28.835%)	0.866*** (22.979%)	0.897*** (23.783%)	0.784** (20.790%)	0.406 (10.780%)	0.351 (9.314%)	0.642* (17.021%)	0.823*** (21.833%)
	-252	0.920** (24.392%)	1.348*** (35.745%)	1.472*** (39.054%)	1.142*** (30.284%)	0.857*** (22.727%)	0.746** (19.790%)	0.699* (18.533%)	0.988** (26.194%)	1.139*** (30.213%)	1.010*** (26.790%)
	Average	0.834*** (22.122%)	0.954*** (25.307%)	1.042*** (27.642%)	0.840*** (22.293%)	0.587*** (15.582%)	0.543*** (14.397%)	0.328† (8.694%)	0.422* (11.190%)	0.720*** (19.085%)	0.689*** (18.273%)

*Note.* Positive (negative) values of performance difference between the household and the neighbor average indicate that the household performs better (worse) than the average neighbor in the associated dimension (*levels* or *changes*). Effect size is in parentheses. \*\*\*:  $p < 0.001$ , \*\*:  $p < 0.01$ , \*:  $p < 0.05$ , †:  $p < 0.10$ ,  $p$  values are derived from Wilcoxon rank sum tests.

4 presents for each subgroup the difference in average likelihood between the subgroup and the *control* group, the significance level (based on Wilcoxon rank sum tests), and the effect size as a percentage difference from the *control* group. The rows correspond to 6 possible differences in consumption *levels* between the household and the average neighbor, and the columns correspond to 9 possible differences in consumption *changes* from the prior month between the household and the average neighbor. Positive (negative) values mean that the household performs better (worse) than the average neighbor. We visualize Table 4 with a heat map (Figure 9). The green (red) color means the likelihood to reduce consumption is higher (lower) in the treatment subgroup than in the *control* group. The horizontal (vertical) axis corresponds to the columns (rows) in Table 4. The dots in Figure 9 indicate the subgroups in which the likelihood to reduce consumption significantly differs from that in the *control* group.

We highlight three observations from Figure 9. First, when the focal household performs worse than the average neighbor in *changes* (left half of Figure 9), the likelihood to reduce consumption is significantly higher with customer transparency than without (the *control* group) in 23 out of 24 subgroups. This result holds for all but one subgroup in which the household performs better than the average neighbor in *levels*. Second, when the household outperforms the average neighbor in *changes* (right half of Figure 9), we observe fewer significant effects of customer transparency on the likelihood to reduce consumption. Significant differences occur in 10 out of 24 subgroups in which the household underperforms in *levels*. Third, in none of the subgroups do we observe that customer transparency yields a decrease in the likelihood to reduce consumption. These observations corroborate that for customer transparency, disclosing relative performance with *changes* information has a stronger effect on customers’ choices than disclosing *levels* information. We therefore reject Hypothesis 2 in the customer transparency domain. We obtain the following result based on Study 2:

**Figure 9 Heat Map: Average Change in Likelihood to Reduce Consumption Relative to Control by Household Performance**

*Note.* This heat map visualizes Table 4. The green (red) color indicates higher (lower) likelihood to reduce consumption than in the *control* group. Dots indicate where the difference in likelihood is statistically significant, with a larger dot meaning a stronger significance level.

**RESULT 2.** *In the domain of customer transparency – where performance comparison is between a focal customer and his or her peers – revealing relative performance in changes plays a more dominant role in affecting customers’ choices than revealing relative performance in levels.*

#### 4. Study 3: Behavioral Mechanisms

Our results in Studies 1 and 2 demonstrate an interesting contrast. In the domain of process transparency – when a focal company’s performance is compared to that of the industry (other competitors) – revealing performance *levels* has a more dominant effect on customers’ choices than revealing performance *changes*. Conversely, in the domain of customer transparency – when a focal customer’s own performance is compared to that of other customers – revealing performance *changes* has a more dominant effect on customers’ choices than revealing performance *levels*. In Study 3, we investigate two possible behavioral mechanisms for this contrasting pattern: the degree to which the information presented reflects objective performance difference (termed hereafter as “reflectiveness”) and self-serving attribution biases. In addition, we verify the robustness of our results by implementing process transparency in choosing an energy provider and customer transparency in paper towel consumption.

##### 4.1. Reflectiveness versus self-serving attribution biases

We first propose that in the domain of process transparency – where performance comparison involves two parties external to customers – revealing performance *levels* has a stronger effect on customers’ choices than revealing performance *changes* because levels information is more reflective of the objective performance difference between the focal party and the benchmark. Consider an example where a

company generates 700 kg of CO<sub>2</sub> per ream of paper produced, while the industry average emissions are 900 kg per ream of paper produced. A direct comparison of these two numbers will lead customers to rightly conclude that the focal company is performing better (i.e., generates fewer CO<sub>2</sub> emissions) than the industry average. Now consider instead another example where the company has reduced its CO<sub>2</sub> emissions by 7% since 2010, while the industry on average has reduced emissions by 4%. The larger reduction for the company does not necessarily mean that the company performs objectively better than its competitors, since the company could have started with emissions that were much higher than the industry average in absolute terms. This ambiguity in the interpretation of *changes* information makes it hard for customers to reach a conclusion about the company's objective performance. Hence, customers are likely to be less responsive to changes information than to levels information in the domain of process transparency. This mechanism is related to research suggesting that consumers' judgments about the significance of numerical differences depend on the ease of mental computations. Numerical differences that are easier to compute are judged to be more pronounced than computationally difficult differences (Thomas and Morwitz 2009). Revealing *changes* introduces ambiguity and therefore difficulty in comparing the focal company to the industry. Conversely, revealing *levels* allows for a simpler comparison, making the difference more pronounced. We summarize the above discussion in the following hypothesis.

*HYPOTHESIS 3. In the domain of process transparency – where performance comparison involves two parties external to the customers – revealing performance levels has a stronger effect on motivating sustainable choices than revealing performance changes because levels information is more reflective of the differences in the underlying objective performance.*

We next postulate that in the domain of customer transparency – where performance comparison involves the customers themselves – revealing performance *changes* has a stronger effect on customers' choices than revealing performance *levels* because changes information helps to mitigate self-serving attribution biases of the customers. With self-serving attribution biases, individuals are more inclined to attributing their successes to dispositional factors (e.g., their own skills and efforts) while attributing their failures to situational factors (e.g., task difficulty and luck; Miller and Ross 1975, Stephan et al. 1978, Mezulis et al. 2004). Consider an example of a household being shown that they have used more energy than the average neighbor. Being influenced by self-serving attribution biases, the household is more likely to find “excuses” with respect to situational factors (e.g., they have more people residing in the house or they have an older house with limited insulation) to “justify” their relatively poor performance. However, if the household is shown that their increase in energy usage from the prior month is larger than the increase by the average neighbor, then it becomes more difficult to attribute the performance difference to situational factors. This is because the change values are based on the

starting point of each party, and hence, have implicitly controlled for situational heterogeneity. As such, self-serving attribution biases would be attenuated, and the household would more likely attribute their performance to dispositional factors. When individuals take ownership of their performance, they will, in turn, have a stronger motivation to improve it. Importantly, the above mechanism only applies in the domain of customer transparency but not in the domain of process transparency. This is because under process transparency, the customer-self is not involved in the comparison, and thus, self-serving attribution biases are not relevant. We summarize our discussion in the following hypothesis.

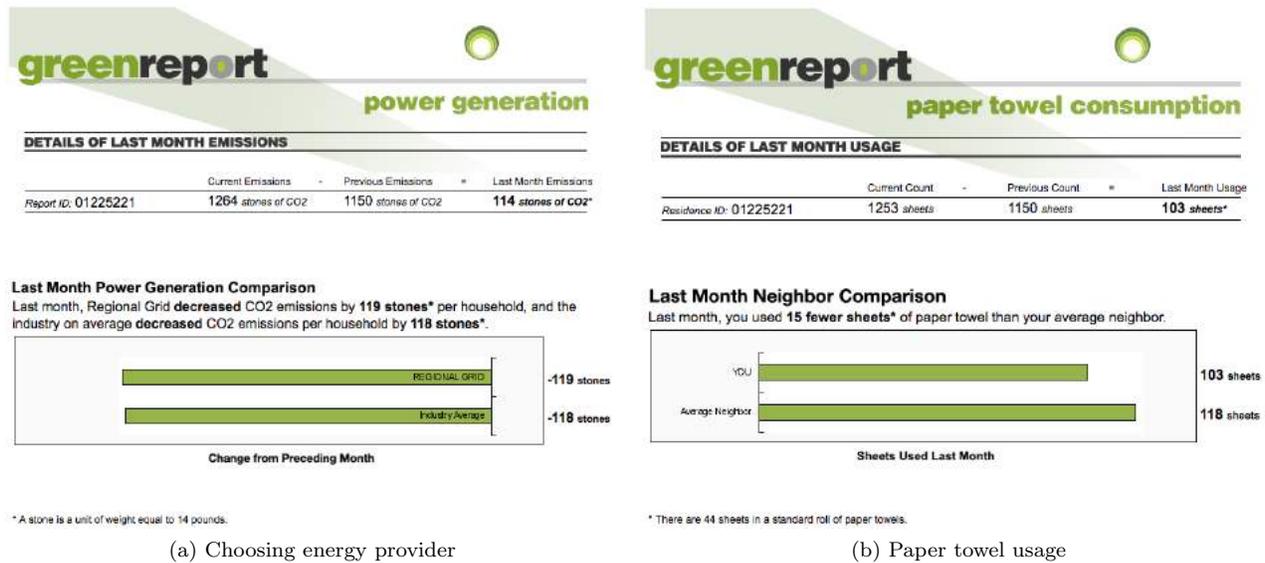
**HYPOTHESIS 4.** *In the domain of customer transparency – where performance comparison involves the customer-self – revealing performance changes has a stronger effect on motivating sustainable choices than revealing performance levels because changes information mitigates self-serving attribution biases of the customers.*

#### **4.2. Design and procedure**

We employed a 2 (transparency: *levels only* or *changes only*)  $\times$  2 (context: *choosing an energy provider* or *paper towel usage*) design in Study 3. To verify the robustness of our earlier results, we switch the contexts to examine process transparency in the energy context and customer transparency in the paper context. In the context of choosing an energy provider, participants were shown information about an energy company’s CO2 emissions during power generation relative to the industry average. They were then asked to answer questions about the likelihood of a customer choosing this company as his or her electricity provider. In the context of paper towel usage, participants were shown information about a household’s paper towel usage relative to its average neighbor. They were then asked to answer questions about this household’s paper towel consumption in the future. We described the scenarios and asked the questions in the third person in both contexts.

Within each context, participants were randomly assigned to one of two treatment groups, *levels only* or *changes only*. In the *levels only* group, participants observed the following performance information (Figure 10): (i) for the energy context, the energy company’s CO2 emissions level per household served in the current month, relative to the industry average; (ii) for the paper context, the number of sheets of paper towels used by the household in the current month, relative to the usage by the average neighbor. In the *changes only* group, participants observed similar information but with current emissions or usage being replaced by reduction in emissions or usage from the prior month. We focus on reduction in emissions or usage because we are more interested in studying customers’ choices when the state of the world is improving (i.e., when companies and customers are achieving better environmental performance). In all scenarios, participants always observed the focal company’s CO2 emissions (in the energy context) or the focal household’s paper towel usage (in the paper context) in the current month. The benchmark level and change values (industry or neighbor average) were fixed at 118. The level and

Figure 10 Example Images in Study 3



Note. For either context and both *levels* and *changes*, the performance values were designed such that the industry (neighbor) average stayed constant while the company (household) value varied along a range within 17 units plus or minus the industry (neighbor) average.

change values for the focal company or household were randomized across participants on a continuous scale between 101 and 135, with the change values taking a negative sign to represent reduction. We chose these values based on relevant data published in industry reports or by environmental groups. To maintain the same value range being used between the energy and paper contexts while ensuring the plausibility of the values, we used a less common unit of weight – stones, equivalent to 14 pounds – to measure the amount of CO2 emissions. We explicitly explained this unit in the information presented to the participants.

### 4.3. Dependent measures

Participants in the energy context indicated the likelihood of choosing the focal company as a provider by responding to the question: “Upon receiving this report, how likely is it that the customer would choose to use this company as an electricity provider?” (7-point scale; 1 = very unlikely to 7 = very likely). Participants in the paper context indicated the likelihood to reduce paper towel consumption by responding to the question: “Upon receiving this report, how likely is it that the members of this household would choose to reduce paper towel consumption?” (7-point scale; 1 = very unlikely to 7 = very likely). To elicit the hypothesized mechanisms, we asked the following questions. First, to determine whether *levels* or *changes* information was more reflective of the focal party’s relative performance, we asked participants: “How well is the company [are the members of this household] performing from an environmental perspective compared to the industry [their neighbors]?” (7-point scale; 1 = very badly to 7 = very well). Second, we measured the degree to which participants attributed the focal

party's performance to situational versus dispositional factors. Following the literature (Stephan et al. 1978, Mezulis et al. 2004), we considered situational factors of task difficulty and luck and dispositional factors of skill and effort. In the paper context, we asked participants how much they agree or disagree with the following four statements: "This household's paper towel usage is affected by the household's skill in saving paper," "This household's paper towel usage is affected by the household's effort to save paper," "This household's paper towel usage is affected by the difficulties in saving paper," and "This household's paper towel usage is affected by luck" (7-point scale; 1 = strongly disagree to 7 = strongly agree). The statements in the energy context were designed similarly. We randomized the order of all questions, including the order of the above four statements.

#### 4.4. Participants

1,600 participants completed Study 3 for \$0.50, which took on average 3 minutes. For our analysis, we only retained data from 1,536 participants who correctly answered the attention check question and for whom the images loaded properly ( $N = 1,536$ , 51.4% male,  $M_{\text{age}} = 37.8$ ).

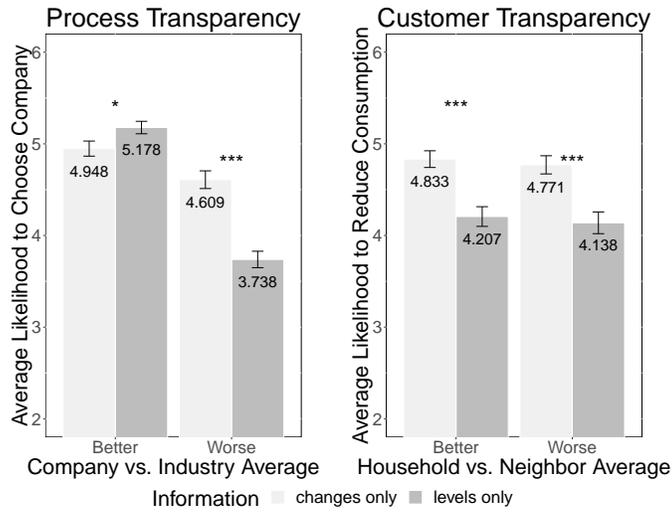
#### 4.5. Results

Figure 11 demonstrates that the treatment differences observed in Study 3 are consistent with those in Studies 1 and 2. First, in the domain of process transparency and the context of choosing an energy provider (left chart in Figure 11), revealing *levels* has a more significant effect on customers' choices than revealing *changes*. Specifically, when the company performs better than the industry, the probability of the company being chosen is significantly higher in the *levels only* group than in the *changes only* group ( $M = 5.178$  vs. 4.948,  $W = 17,349$ ,  $p = 0.045$ ). Conversely, when the company performs worse than the industry, choice probability in the *levels only* group is significantly lower than that in the *changes only* group ( $M = 3.738$  vs. 4.609,  $W = 20,782$ ,  $p < 0.001$ ). Second, in the domain of customer transparency and the context of household paper towel usage (right chart in Figure 11), revealing *changes* results in a significantly higher likelihood to reduce consumption than revealing *levels*, regardless of whether the household performs better or worse than the average neighbor ( $M = 4.833$  vs. 4.207,  $W = 23,312$ ,  $p < 0.001$ ;  $M = 4.771$  vs. 4.138,  $W = 20,587$ ,  $p < 0.001$ ).<sup>2</sup>

We next employ structural equation models to conduct a path analysis and examine the behavioral mechanisms for the observed contrasting pattern. Path analysis uses a series of linear models to decompose the direct and indirect effects of measured variables on a key dependent measure (Alwin and Hauser 1975). In our analysis, the key dependent measure is the likelihood to choose the company (in

<sup>2</sup>Figure 11 does not include the few data points where the focal party has the same performance as the benchmark. We report summary statistics of these omitted data here. For process transparency and the energy context, 14 participants observed the company and the industry having the same *levels* value ( $M = 4.857$ ,  $SD = 1.231$ ), and 8 participants observed the two parties having the same *changes* value ( $M = 5.000$ ,  $SD = 1.195$ ). For customer transparency and the paper context, 11 participants observed the household and the average neighbor having the same *levels* value ( $M = 4.364$ ,  $SD = 1.804$ ), and 5 participants observed the two parties having the same *changes* value ( $M = 3.200$ ,  $SD = 1.095$ ).

Figure 11 Study 3: Comparison of Participants' Responses by Treatment Condition

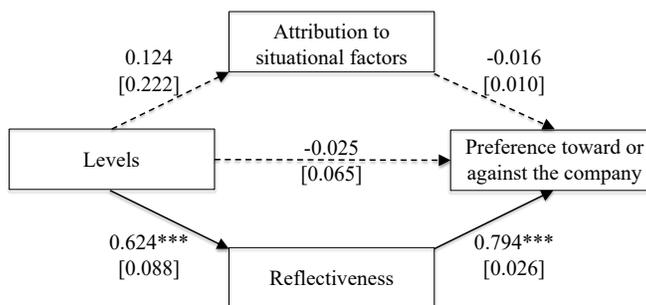


Note. The dark (light) gray bars correspond to the *levels only* (*changes only*) group. We further divide each treatment group into two subgroups based on whether the focal party performs better or worse than the benchmark. The number on each bar presents the average response in the corresponding subgroup. The error bars show the standard errors. Significance levels are based on Wilcoxon rank sum tests that compare participants' responses in the *levels only* group to those in the *changes only* group, conditioned on the focal party performing better or worse than the benchmark. \*\*\*:  $p < 0.001$ , \*:  $p < 0.05$ .

the energy context) or the likelihood to reduce paper towel consumption (in the paper context). The two key independent variables capturing the possible mechanisms are reflectiveness and self-serving attribution biases. For reflectiveness, we take the participants' response to the question about how well the focal party is performing relative to the benchmark. In cases where the focal party performs worse than the benchmark (in either levels or changes), we reverse code the responses, i.e., coding 1 = very well to 7 = very badly. This way, a larger value of reflectiveness always represents a stronger perception of differing performance. For self-serving attribution biases, we first sum up the participants' scores of attributing the focal party's performance to situational factors (i.e., difficulty and luck), and separately, sum up their scores of attributing the performance to dispositional factors (i.e., skill and effort). We then subtract the latter sum from the former to obtain a measure of the strength of the biases (Stephan et al. 1978). The larger the value, the stronger biases the participants exhibit.

We first analyze the possible mechanisms under process transparency and the energy context, wherein the company reveals information about its CO2 emissions while generating power for a household. Recall from Figure 11 that observing the company performing better (worse) than the industry average naturally leads to a higher (lower) likelihood of the company being chosen by the customer. Therefore, we reverse code the participants' responses to the choice question in cases of worse performance, so that a larger value of the dependent variable means a stronger preference by the customer of either choosing or not choosing the company. Our structural equation models involve the joint estimation of the following three linear models:

$$\text{Reflective}_i = \text{Intercept} + \beta_0 I_{\text{levels}} + \epsilon_i,$$

**Figure 12 Study 3 Path Analysis: Process Transparency**

*Note.* The *changes only* group is the baseline. Standard errors are in brackets. Solid lines indicate statistically significant paths in the models, and dashed lines indicate nonsignificant ones. The model exhibits a good fit, with a high comparative fit index (CFI=0.986) and a low root mean squared error of approximation (RMSEA=0.112,  $p = 0.032$ ). \*\*\*:  $p < 0.001$ ,  $p$  values are derived from two-sided  $t$  tests.

$$\text{Attribution bias}_i = \text{Intercept} + \beta_1 I_{\text{levels}} + \delta_i,$$

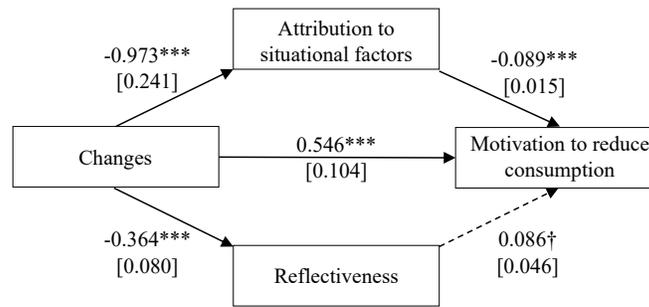
$$\text{Likelihood to choose or not choose}_i = \text{Intercept} + \beta_2 \text{Reflective}_i + \beta_3 \text{Attribution bias}_i + \beta_4 I_{\text{levels}} + \varepsilon_i.$$

The subscript  $i$  is the participant index. In all models, the *changes only* group is the baseline. The variable  $I_{\text{levels}}$  is an indicator variable for the *levels only* group. The estimation results are presented in Figure 12. We highlight two observations. First, compared to *changes* information, *levels* information is significantly more reflective of the company's relative performance ( $\beta_0 = 0.624$ ,  $p < 0.001$ ). This stronger reflectiveness in turn significantly influences the customers' preferences toward or against the company ( $\beta_2 = 0.794$ ,  $p < 0.001$ ). In sharp contrast, revealing either levels or changes information results in similar attribution biases, which have no significant effect on the customers' preferences. This lack of difference or effect is expected. Since process transparency concerns comparison that does not involve the customers themselves, the customers would not have a desire to engage in self-serving attribution reasoning. To summarize, we find evidence in support of Hypothesis 3.<sup>3</sup>

We next analyze the potential mechanisms for customer transparency in the paper context, wherein the customers observe information about a household's paper towel consumption. We estimate a similar set of structural equation models as above with the following difference: We treat the *levels only* group as the baseline and include an indicator variable for the *changes only* group. Figure 13 presents the estimation results. We highlight two observations. First, as before, *changes* information – as compared to *levels* information – is less reflective of the focal party's relative performance ( $\beta_0 = -0.364$ ,  $p < 0.001$ ). However, in the customer transparency domain, reflectiveness has a much weaker effect on the customers' likelihood to reduce consumption than in the process transparency domain ( $\beta_2 = 0.086$ ,

<sup>3</sup>As a robustness analysis, we divide the data for the energy context into two subsets based on whether the focal company has a better or worse performance than the industry average and reestimate our structural equation models for each subset separately. We observe the same results as discussed here. See Appendix O.5 for more details.

Figure 13 Study 3 Path Analysis: Customer Transparency



*Note.* The *levels only* group is the baseline. Standard errors are in brackets. Solid lines indicate statistically significant paths in the models, and dashed lines indicate nonsignificant ones. The model exhibits a good fit, with a high comparative fit index (CFI=0.946) and a low root mean squared error of approximation (RMSEA=0.087,  $p = 0.110$ ). \*\*\*:  $p < 0.001$ , †:  $p < 0.10$ ,  $p$  values are derived from two-sided  $t$  tests.

$p = 0.060$ ). Second, revealing *changes* (as opposed to revealing *levels*) significantly reduces customers' attributions to situational factors ( $\beta_1 = -0.973$ ,  $p < 0.001$ ). Since attributions to situational factors demotivate customers from reducing consumption ( $\beta_3 = -0.089$ ,  $p < 0.001$ ), the combined effect is that revealing *changes* significantly increases the customers' likelihood to reduce consumption. Therefore, we find support for Hypothesis 4.

We note two observations that could benefit from future research. First, there remains a significant direct effect of revealing *changes* on the likelihood to reduce consumption after incorporating our two mechanisms (Figure 13). This result suggests that additional mechanisms exist to explain why *changes* information better motivates sustainable behavior in the domain of customer transparency. Second, self-serving attribution biases predict that individuals are more likely to attribute successes to dispositional factors rather than situational ones. However, in our data when the focal household performs better than the average neighbor, participants in the *levels only* group still attribute the performance more to situational factors (and revealing *changes* mitigates such biases). This result suggests that even top performers feel a lack of agency for their better performance in *levels*, which can hurt their motivation to continue performing well. Our results thus emphasize the importance of revealing *changes* in the customer transparency domain, regardless of the customers' relative performance.

## 5. Discussion and Conclusions

To our knowledge, we are the first to study the differential effects of conveying relative performance with *levels* versus *changes* information on customers' sustainable choices in two different domains of transparency: process transparency in which the sustainability performance of a company's production processes is disclosed relative to industry competitors, and customer transparency in which the customer's own sustainability performance is disclosed relative to other customers. Our results are derived from studies that involve 7,308 participants. The large sample size offers a high degree of confidence in the robustness of our conclusions.

In particular, we demonstrate that in the process transparency domain – where performance comparison involves two parties external to the customers – revealing relative performance with *levels* information plays a more dominant role in motivating sustainable choices than revealing *changes*. In this domain, customers consider *levels* information as a stronger indicator of the company’s relative performance compared to the industry. As a result, *levels* information has a more significant effect on the customers’ preferences toward or against the company (when the company performs better or worse than the industry, respectively). Our results also imply that with process transparency, customers are primarily concerned with the ultimate performance of a company, rather than its trajectory over time.

In the customer transparency domain – where performance comparison involves the customers themselves, we observe the opposite pattern. That is, revealing relative performance with *changes* information plays a more dominant role in motivating sustainable behavior than revealing *levels*. We identify an important behavioral reason underlying this result. Specifically, when observing *levels* information, customers exhibit a self-serving attribution bias whereby they attribute their performance to situational factors such as task difficulty and luck rather than dispositional factors such as their skills and effort. As a result, they do not take ownership of their performance and are less motivated to reduce consumption. *Changes* information, having controlled for situational heterogeneity across customers, helps to mitigate such attribution biases. Therefore, customers are more responsive to the performance difference implied by *changes* information and are more motivated to conserve. Our results suggest that current designs of home energy reports (such as those created by Opower for utility companies) are underutilizing the benefits of transparency because they primarily focus on presenting a household’s usage *levels* relative to its neighbors. We advocate that these reports can better motivate conservation if they instead highlight the household’s usage *change* over time as compared to their neighbors’ change.

Our results can be extended beyond sustainability to a variety of applications, from real estate companies that report standardized test scores of school districts, to charities that disclose how they spend donations, to governments encouraging their employees to reduce spending. Future research can also be expanded to consider institutional customers in addition to individual customers. For example, a manufacturing company can leverage relative performance transparency to influence its various factories to adopt more environmentally responsible practices in their production processes. Governments can motivate more sustainable procurement when the suppliers’ sustainability performance is being disclosed and contrasted. This paper illustrates that relative performance transparency can be an instrumental tool to enhancing sustainable choices in practice, and we uncover new insights regarding how best to convey such transparency to maximize its benefits (e.g., revealing *levels* for process transparency and revealing *changes* for customer transparency). We hope that our research will stimulate future work that continues to investigate the impact of transparency in driving behavioral changes, including in field settings.

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# Online Appendix to “Relative Performance Transparency: Effects on Sustainable Choices”

## O.1. Performance Values Used in Our Studies

**Table O.1 Sustainability Performance Values Used in Our Studies**

Study	Transparency type	Performance of focal company/customer	Benchmark values
Study 1a	Levels	0.671 or 0.739	0.709
Study 1a	Changes	-6.64% or -2.93%	-4.40%
Study 1b	Levels	Continuous on [4.00, 10.99]	5.73 or 9.23
Study 1b	Changes	Continuous on [-7.00%, +7.00%]	-4.00% or 4.00%
Study 2	Levels	6 equi-distanced values on [660, 1164]	912
Study 2	Changes	6 equi-distanced values on [-126, 126]	-84 or 84
Study 3	Levels	Continuous on [101, 135]	118
Study 3	Changes	Continuous on [-135, -101]	-118

Notes. This table reports the numeric values used in each study. The benchmark values refer to the performance of the industry average or the average neighbor.

## O.2. Measures in Studies 1a and 1b

All questions were asked using a 7-point scale unless otherwise noted.

1. How likely are you to purchase this product? (Very Unlikely - Very Likely)
2. Up to what price (in USD) would you pay for this product?<sup>4</sup>
3. What is your perceived quality of this product? (Very Poor - Very Good)
4. How fair do you think the price of \$14.55 is for this product? (Very Unfair - Very Fair)<sup>5</sup>
5. How likely are you to recommend this product to a friend or colleague? (Very Unlikely - Very Likely)<sup>5</sup>
6. How likely are you to consider other brands of paper? (Very Unlikely - Very Likely)<sup>5</sup>
7. My feelings towards this company can best be described as: (Very Dissatisfied - Very Satisfied)
8. Compared to competitors, this company has a(n) \_\_\_ reputation. (One of the Worst - Average - One of the Best)
9. My overall trust in the company is: (Very Low - Very High)
10. To what extent do you agree with the following statements (Strongly Disagree - Strongly Agree)
  - This company appears more trustworthy than others from which I've purchased. <sup>5</sup>
  - This company feels morally obligated to be environmentally responsible. <sup>5</sup>
11. To what extent do you agree with the following statements (Strongly Disagree - Strongly Agree)
  - I would feel good if I bought this product. <sup>6</sup>
  - I would discuss this purchase with others if I bought this product. <sup>5</sup>
  - I would enhance my reputation if I bought this product. <sup>7</sup>
  - The issue of carbon dioxide emissions is important to me. <sup>5</sup>
  - Carbon dioxide emissions directly impact my life. <sup>5</sup>
  - The issue of carbon dioxide emissions directly impacts my purchase decisions. <sup>5</sup>
  - Please select “Somewhat Agree” for this row only. <sup>8</sup>

<sup>4</sup>Participants could choose a value along a scale between \$5 and \$25.

<sup>5</sup>Only asked in Study 1a.

<sup>6</sup>Rephrased in Study 1b: If I were to buy this product, I would feel good \_\_\_ about myself. (Very Bad - Very Good)

<sup>7</sup>Rephrased in Study 1b: If I were to buy this product, my reputation would \_\_\_. (Significantly Worsen - Significantly Improve)

<sup>8</sup>Attention check.

- What product did you see in this survey (T-shirts, Laundry Detergent, Paper) <sup>8, 9</sup>

**Table O.2 Study 1a Summary Statistics**

Variable	Control			ChangesBetter			ChangesWorse			LevelsBetter			LevelsWorse		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1 Purchase Intention	78	3.38	1.70	79	4.81	1.40	81	4.12	1.62	78	4.86	1.43	80	3.26	1.58
2 WTP	78	10.87	4.48	79	11.71	4.53	81	11.58	4.42	78	12.53	4.07	80	10.22	4.31
3 Quality	78	5.47	1.03	79	5.53	1.14	81	5.11	1.38	78	5.83	0.96	80	4.89	1.38
4 Fairness of Price	78	4.08	1.76	79	4.47	1.54	81	4.41	1.77	78	4.54	1.53	80	4.11	1.75
5 Recommend	78	3.32	1.54	79	3.96	1.56	81	3.73	1.62	78	4.22	1.37	80	2.92	1.45
6 Other Brands	78	5.51	1.33	79	5.33	1.18	81	5.42	1.21	78	5.05	1.26	80	5.65	1.39
7 Satisfaction	78	4.38	1.12	79	4.97	1.15	81	4.19	1.22	78	5.17	1.12	80	3.56	1.34
8 Reputation	78	4.51	0.92	79	5.10	1.08	81	4.37	1.29	78	5.38	1.05	80	3.69	1.16
9 Trust	78	4.49	0.99	79	4.90	1.17	81	4.32	1.24	78	5.12	1.08	80	3.51	1.25
10a Trustworthiness	78	4.03	1.21	79	4.80	1.29	81	4.04	1.27	78	4.82	1.22	80	3.29	1.41
10b Moral Obligation	78	4.24	1.20	79	4.95	1.50	81	4.10	1.58	78	5.36	1.26	80	2.80	1.43
11 Familiarity	78	2.62	1.65	79	2.61	1.86	81	2.86	1.84	78	2.79	1.83	80	2.83	1.82
12a Feel Good	78	4.03	1.43	79	4.62	1.56	81	4.04	1.62	78	5.15	1.28	80	3.04	1.50
12b Discuss	78	2.96	1.61	79	3.82	1.79	81	3.26	1.59	78	3.69	1.72	80	2.98	1.61
12c My Reputation	78	2.68	1.32	79	2.97	1.52	81	3.04	1.50	78	3.38	1.48	80	2.41	1.38
12d CO2E.To.Me	78	4.55	1.74	79	4.72	1.80	81	4.63	1.73	78	5.09	1.63	80	4.83	1.83
12e CO2E.My.Life	78	4.32	1.71	79	4.63	1.82	81	4.69	1.56	78	4.81	1.62	80	4.64	1.84
12f CO2E.Purchases	78	3.38	1.58	79	3.94	1.84	81	4.12	1.71	78	4.27	1.73	80	4.09	1.87

**Table O.3 Study 1b Summary Statistics**

Variable	Control			Transparent		
	N	Mean	SD	N	Mean	SD
1 Purchase Intention	110	3.79	1.60	1809	3.91	1.72
2 WTP	110	11.11	3.97	1809	10.89	4.51
3 Quality	110	5.41	0.98	1809	5.19	1.22
7 Satisfaction	110	4.67	0.99	1809	4.41	1.33
8 Reputation	110	4.75	1.04	1809	4.57	1.33
9 Trust	110	4.65	1.10	1809	4.33	1.27
10b Moral Obligation	110	4.03	0.83	1809	4.34	1.71
12a Feel About Self	110	4.39	0.77	1809	4.30	1.26
12c My Reputation	110	4.06	0.43	1809	4.08	0.70

### O.3. Measures in Study 2

1. How likely would most people be to reduce energy consumption in the next month if they received this bill (assuming similar climate)? (Very Unlikely - Very Likely)
2. Most people if they received this bill would feel bad about not reducing their energy consumption if they had the chance. (Strongly Disagree - Strongly Agree)
3. Most people if they received this bill would feel good if they were to reduce their energy consumption. (Strongly Disagree - Strongly Agree)

<sup>9</sup>Only asked in Study 1b

4. Saving money would be an important factor in most people's decision to reduce energy consumption if they received this bill. (Strongly Disagree - Strongly Agree)
5. By reducing their energy consumption, most people if they received this bill would think they make a good impression. (Strongly Disagree - Strongly Agree)
6. By reducing their energy consumption, most people if they received this bill would think they satisfy the expectations of others. (Strongly Disagree - Strongly Agree)
7. By reducing their energy consumption, most people if they received this bill would think they are valued by others. (Strongly Disagree - Strongly Agree)
8. Please select "Somewhat Agree" for this row only.<sup>8</sup>
9. The overall trust by most people if they received this bill towards this company would be: (Very Low - Very High)
10. Most people if they received this bill would find this company \_\_\_ trustworthy than other utilities companies. (Significantly Less - Significantly More)
11. Most people if they received this bill would believe that the credibility of the information on this bill is: (Very Low - Very High)

**Table O.4 Study 2 Summary Statistics**

Variable	Control			LevelsOnly			ChangesOnly			Levels&Changes		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1 Reduce	187	3.77	1.65	182	4.24	1.51	761	4.52	1.52	2327	4.46	1.44
2 Feel Bad	187	3.70	1.50	182	4.00	1.49	761	4.14	1.54	2327	4.17	1.46
3 Feel Good	187	5.05	1.19	182	5.39	0.95	761	5.44	1.09	2327	5.41	1.05
4 Saving Money	187	5.12	1.50	182	5.52	1.26	761	5.60	1.28	2327	5.66	1.16
5 Good Impression	187	4.55	1.23	182	4.91	1.14	761	4.92	1.23	2327	4.93	1.23
6 Satisfy Expectations	187	4.42	1.25	182	4.57	1.11	761	4.76	1.26	2327	4.70	1.23
7 Valued by Others	187	4.10	1.24	182	4.34	1.15	761	4.41	1.24	2327	4.36	1.29
9 Trust	187	4.52	1.15	182	4.63	1.08	761	4.67	1.10	2327	4.69	1.12
10 Trustworthy	187	4.19	1.04	182	4.34	0.95	761	4.41	1.01	2327	4.46	1.04
11 Credibility	187	4.88	1.19	182	4.98	1.13	761	4.93	1.22	2327	5.01	1.20

## O.4. Measures in Study 3

1. Upon receiving this report, how likely is it that the customer would choose to use this company as an electricity provider? (Very Unlikely - Very Likely)<sup>10</sup>
2. How well is the company performing from an environmental perspective compared to the industry? (Very Badly - Very Well)<sup>10</sup>
3. To what extent would the customer agree with these statements (Strongly Disagree - Strongly Agree)<sup>10</sup>
  - This company's CO2 emissions are affected by the company's skill in reducing emissions.
  - This company's CO2 emissions are affected by the company's effort to reduce emissions.
  - This company's CO2 emissions are affected by the difficulties in reducing emissions.
  - This company's CO2 emissions are affected by luck.
4. Upon receiving this report, how likely is it that members of this household would choose to reduce paper towel consumption? (Very Unlikely - Very Likely)<sup>11</sup>

<sup>10</sup>Only asked to those in the *process transparency* condition.

<sup>11</sup>Only asked to those in the *customer transparency* condition.

5. How well are the members of this household performing from an environmental perspective compared to their neighbors ?  
(Very Badly - Very Well)<sup>11</sup>
6. To what extent would the members of this household agree with these statements (Strongly Disagree - Strongly Agree)<sup>11</sup>
  - This household’s paper towel usage is affected by the household’s skill in saving paper.
  - This household’s paper towel usage is affected by the household’s effort to save paper.
  - This household’s paper towel usage is affected by the difficulties in saving paper.
  - This household’s paper towel usage is affected by luck.
7. What were you asked about in this survey? (Laundry Detergent, Power, Paper Towels)
8. Did the graphics in this survey load properly for you? (Yes, No)

**Table O.5 Study 3 Summary Statistics: Process Transparency**

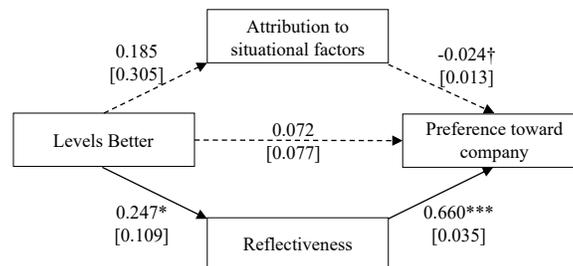
Variable	LevelsBetter			LevelsSame			LevelsWorse			ChangesBetter			ChangesSame			ChangesWorse		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1 Choose	202	5.18	0.97	14	4.86	1.23	191	3.74	1.24	193	4.95	1.14	8	5.00	1.20	156	4.61	1.21
2 Comparison	202	5.04	0.93	14	4.29	1.27	191	3.36	1.11	193	4.80	1.22	8	4.75	0.71	156	4.56	1.19
3a Skill	202	5.16	1.20	14	5.36	1.60	191	4.83	1.32	193	5.30	0.94	8	5.00	1.60	156	5.15	1.08
3b Effort	202	5.36	1.23	14	5.29	1.49	191	5.06	1.45	193	5.48	1.05	8	5.38	1.92	156	5.46	1.10
3c Difficulties	202	4.51	1.32	14	4.50	1.40	191	4.38	1.31	193	4.66	1.31	8	4.62	1.30	156	4.54	1.26
3d Luck	202	2.93	1.45	14	2.50	1.02	191	2.42	1.25	193	2.84	1.40	8	2.50	1.69	156	2.89	1.49

**Table O.6 Study 3 Summary Statistics: Customer Transparency**

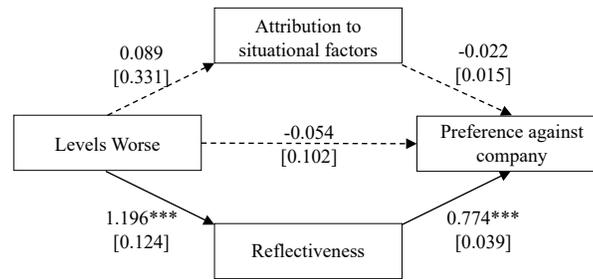
Variable	LevelsBetter			LevelsSame			LevelsWorse			ChangesBetter			ChangesSame			ChangesWorse		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
4 Reduce	203	4.21	1.53	11	4.36	1.80	188	4.14	1.63	186	4.83	1.24	5	3.20	1.10	179	4.77	1.33
5 Comparison	203	4.72	0.94	11	4.55	1.29	188	3.66	0.99	186	4.60	1.20	5	5.00	1.00	179	4.30	1.12
6a Skill	203	4.29	1.53	11	4.45	1.57	188	4.32	1.56	186	4.75	1.30	5	5.00	1.22	179	4.64	1.33
6b Effort	203	4.65	1.46	11	5.27	1.10	188	4.73	1.60	186	5.31	1.25	5	6.00	0.71	179	5.16	1.31
6c Difficulties	203	3.71	1.45	11	3.73	1.56	188	3.94	1.50	186	3.93	1.33	5	4.00	2.55	179	3.91	1.48
6d Luck	203	3.36	1.78	11	3.18	1.72	188	2.74	1.64	186	2.99	1.51	5	3.40	1.52	179	2.83	1.53

## O.5. Study 3 Robustness Analysis: Additional Structural Equation Models

**Figure O.1 Study 3 Path Analysis: Process Transparency (Better)**



*Note.* The *changes better* group is the baseline. Standard errors are in brackets. Solid lines indicate statistically significant fit paths in the models, and dashed lines indicate nonsignificant ones. The model exhibits a good fit, with a high comparative fit index (CFI=0.932) and a low root mean squared error of approximation (RMSEA=0.222,  $p < 0.001$ ). \*\*\*:  $p < 0.001$ , \*:  $p < 0.05$ , †:  $p < 0.10$ ,  $p$  values are derived from two-sided  $t$  tests.

**Figure O.2 Study 3 Path Analysis: Process Transparency (Worse)**

*Note.* The *changes worse* group is the baseline. Standard errors are in brackets. Solid lines indicate statistically significant paths in the models, and dashed lines indicate nonsignificant ones. The model has nearly perfect fit statistics, (CFI=1.000, RMSEA=0.000,  $p = 0.978$ ); this is close to a saturated model because there are not many parameters to estimate (StatModel 2017). \*\*\*:  $p < 0.001$ ,  $p$  values are derived from two-sided  $t$  tests.