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Affirming belief in scientific progress reduces environmentally friendly behaviour

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Abstract

Many people are reluctant to behave in environmentally friendly ways. One possible explanation might be that the motivation to behave in environmentally friendly ways is undermined by the way scientific progress is overstated in the popular media. Four experiments show that portraying science as rapidly progressing—and thus enabling society to control problems related to the natural environment and human health in the not-too-distant future—is detrimental to environmentally friendly behaviour because such a frame affirms perceptions of an orderly (vs chaotic) world. This in turn negatively affects the likelihood of engaging in environmentally friendly behaviour. Simultaneously, communication that questions (vs affirms) scientific progress leads to lower perceptions of order and consequential increases in environmentally friendly behaviour. These findings show that when the aim is to promote environmentally friendly attitudes and behaviour, it helps to not overstate scientific progress. Copyright © 2014 John Wiley & Sons, Ltd.

The climate is changing, but media coverage often seems to convey the message that science is one step ahead (e.g. Miller, Tegen, & Perlwitz, 2004; Rosenfeld et al., 2008). For instance, there have been media reports on scientists inventing huge mirrors that will reflect the rays of sunlight in order to evade the burning sun, on people that will live in floating cities in case of a drastic rise in sea level, and on solar-powered cars that will crowd the roads by the time that fossil fuels have run out. Research has indeed shown that the popular media often overstate the progress of science and its ability to spawn technological advances and provide solutions to pressing problems such as climate change and disease (i.e. a progress frame; e.g. Corbett & Durfee, 2004; Nisbet et al., 2002; Stewart, Dickerson, & Hotchkiss, 2009; Weaver, Lively, & Bimber, 2009). For example, diseases such as cancer and HIV are still very difficult to combat but are regularly portrayed as nearly 'solved' problems (Donovan, Carter, & Byrne, 2006). Because lay people's knowledge about science is often based on popular media coverage of science (e.g. Caulfield, 2004; Elliott & Rosenberg, 1987; McInerney, Bird, & Nucci, 2004; Zimmerman, Bisanz, Bisanz, Klein, & Klein, 2001), such a progress frame may affect their views on science as well as subsequent behaviours.

The current paper investigates whether overly optimistic reports on scientific progress might, ironically, contribute to the fact that people often fail to behave in environmentally friendly ways. Employing compensatory control theory (CCT; Kay, Gaucher, Napier, Callan, & Laurin, 2008) as our theoretical framework, we argue that a scientific progress

frame functions as an order-providing psychological mechanism (Rutjens, van Harreveld, & van der Pligt, 2013). Affirming the progress of science might enhance perceptions of order, which in turn decreases the motivation to engage in environmentally friendly actions. In the following, we will elaborate upon the theoretical foundations for this prediction.

COMPENSATORY CONTROL THEORY

Research has shown that people are highly motivated to perceive the world as meaningful, orderly, and structured (e.g. Heine, Proulx, & Vohs, 2006; Kay et al., 2008; Kruglanski & Webster, 1996; Landau, Greenberg, Solomon, Pyszczynski, & Martens, 2006; Landau et al., 2004; Whitson & Galinsky, 2008). When they perceive the world to be less orderly than desired, they aim to alleviate these feelings of disorder—which are generally thought to be stressful and anxiety inducing (e.g. Kay et al., 2008; Pennebaker & Stone, 2004). Understanding the different ways in which people try to maintain perceptions of the world as orderly and controlled forms the basic tenet of CCT (Kay et al., 2008). CCT argues that people have the fundamental motivation to perceive order in the world (Kay et al., 2008). The theory distinguishes two main routes to maintain such order perceptions: *personal* control and *external* control (see also Rothbaum, Weisz, & Snyder, 1982). In the case of personal control, it is the feeling that people are able to influence their environment that provides them with the

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notion of an orderly and navigable world. In the case of external control, it is the feeling that an external source (e.g. an intervening God or a powerful government) exerts influence over their environments and the world in general that provides similar perceptions of an orderly world that is under control. Personal control and external control thus function as two separate routes to perceiving the world as orderly and nonrandom.

Importantly, CCT posits that these different routes to orderly world perceptions function in a hydraulic fashion. In other words, a threat to one source of order (e.g. external control) enhances the motivation to affirm an alternative means (e.g. personal control) and thus prevent perceptions of disorder. Kay et al. (2008) used an analogy of a full glass that represents sufficient order perceptions to explain this hydraulic nature of external and personal control. To reach the preferred level of order, personal control and external control together should fill up the glass. Strongly affirming an external source of control (e.g. believing in a God that actively intervenes and exerts control over the world) will largely fill the glass, leaving only little need to exert personal control. In contrast, when belief in such an external source of control is there to a lesser extent, the glass will be far from full, which enhances the motivation to affirm personal control (Figure 1).

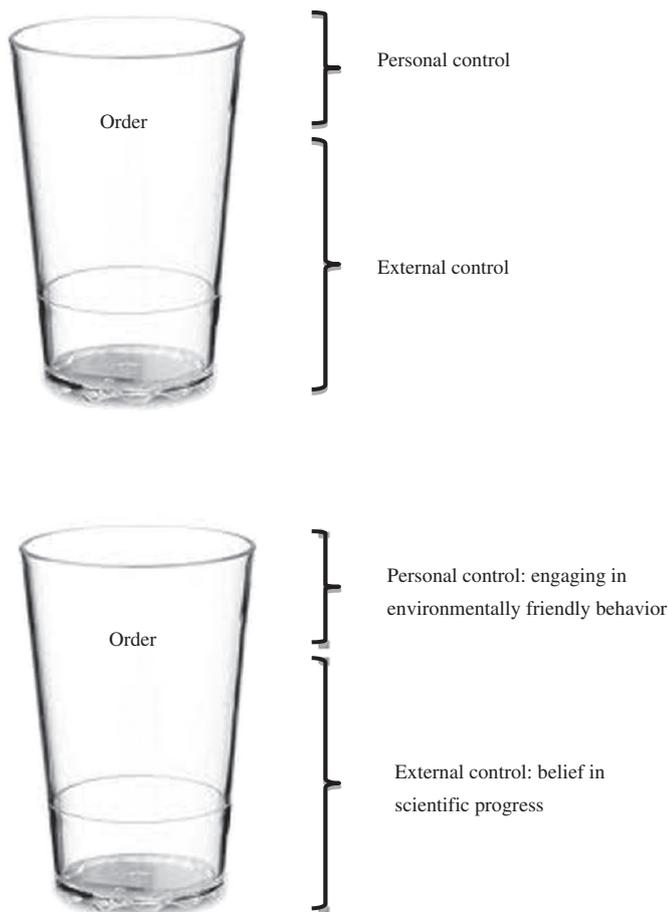


Figure 1. Environmental compensatory control. The upper figure represents an analogy of compensatory control theory (Kay et al., 2008); a full glass represents sufficient levels of perceived order. When one source of order fluctuates (e.g. decreases), the other does so too (e.g. increases). The lower figure represents our environmental version of compensatory control theory: when belief in scientific progress fluctuates (e.g. increases), the likelihood to engage in environmentally friendly behaviour will fluctuate accordingly (e.g. decreases)

Ample research has provided evidence for this hydraulic relation between personal and external control in satiating people's need to perceive order. Specifically, studies have shown that when the controlling abilities of a particular external source are limited (e.g. government instability), people seek to reaffirm order by exerting (sometimes illusory) personal control or affirming their belief in alternative external sources of control (e.g. God). In a similar vein, when people lack personal control, they bolster beliefs in an external source of control to restore order perceptions (e.g. Fritsche et al., 2013; Greenaway, Louis, & Hornsey, 2013; Kay et al., 2008; Kay, Shepherd, Blatz, Chua, & Galinsky, 2010; Shepherd, Kay, Landau, & Keefer, 2011). The majority of research sparked by CCT has shown that compensatory external control is generally found in the domains of religious and sociopolitical beliefs (Kay, Gaucher, McGregor, & Nash, 2010; Kay et al., 2008; Kay, Shepherd et al., 2010; Rutjens, van der Pligt, & van Harreveld, 2010). Of importance to the current paper, however, is that recent research has shown that *belief in scientific progress* can also function as compensation for low personal control (Rutjens, van Harreveld, & van der Pligt, 2010). This research found that experimentally lowering personal control increases the tendency to defend the notion of progress and generally increased faith in scientific and technological advances. In the succeeding section, we will elaborate on belief in scientific progress as an external source of control.

External Control: Scientific Progress

Scientific progress can be viewed as a testimony to humanity's increasing ability to exert control over the world, and bolstering belief in scientific progress as such can provide order (Rutjens, van Harreveld et al., 2010). A simple example would be the advances made in the medical and environmental sciences, which help to solve hitherto uncontrollable problems (e.g. natural disasters and diseases). By being able to solve these problems, science as an institution or human endeavour exerts control over the world, and thus, it could be argued that it functions as an external source of control that helps to maintain order perceptions. This suggests that the more one endorses science as an external source of control, the more one perceives order in the environment. The research by Rutjens, van Harreveld et al. (2010) showed that lowering personal control enhanced belief in scientific progress. It, however, did not provide evidence for the extent to which this belief actually helps to maintain order perceptions. Nor that it, as a hydraulic consequence, reduces the motivation to exert personal control. In other words, evidence for the functional value of belief in science has not yet been reported.

In the current research, we aim to provide such evidence and contend that the progress frame often used by media when communicating about science will affirm people's belief in science and thus enhance order perceptions. On the basis of the hydraulic nature of CCT (Kay, Shepherd et al., 2010), we expect that this consequently lowers people's need to engage in personal action. Related to this idea, recent research in the domain of religious compensatory control has found that when people are reminded of a controlling God, their motivation to actively pursue goals is undermined (Laurin, Kay, & Fitzsimons, 2012). In contrast,

when scientific progress is questioned and science thus does not provide a potent source of external control, feelings of order should come from elsewhere. One way to fill the glass (Figure 1) and restore order perceptions would be to exert personal control. In sum, we posit that the way the media portrays science has effects on the extent to which people feel the need to exert personal control. Importantly, we argue that—in the context of environmental challenges and natural threats—one way to regain a feeling of personal control is through environmentally friendly behaviour. Science communication might therefore have detrimental or beneficial effects on environmentally friendly behaviour, depending on whether scientific progress is affirmed or questioned.

Personal Control: Environmentally Friendly Behaviour

As pointed out before, besides endorsing external sources of order, another way to cope with the aversive experience of disorder is to affirm or even exaggerate a sense of personal control. When people experience personal control, they feel that they are able to predict and influence their environment. The events in their lives, no matter whether they are positive or negative, are perceived to be caused by their own actions. This instils the belief that they live in a sense-making world in which events do not just happen haphazardly (Kay et al., 2008).

We posit that one way to restore order is to reaffirm personal control by engaging in environmentally friendly behaviour, because—in the context of environmental challenges and natural threats—such behaviour boosts feelings of personal control through self-action. Engaging in environmentally friendly behaviour will provide people with the perception that they are able to influence outcomes in the world. As such, behaving in an environmentally friendly way may work as an order-providing psychological mechanism and thus help to alleviate feelings of disorder. There is some indirect evidence suggesting that such behaviour enhances perceptions of order; a recent study has shown that people tend to engage more in prosocial behaviour when the notion of an orderly world is threatened (Banfield, 2011). The idea is that people may engage in prosocial behaviour in an attempt to counteract threats to order that may occur in the world. We contend that environmentally friendly behaviour will similarly be more likely to occur when people perceive disorder in the world, for example when external sources of control (e.g. belief in scientific progress) are threatened.

In sum, on the basis of the basic tenet of CCT that personal and external feelings of control are substitutable (Kay, Shepherd, et al., 2010), we contend that a strong belief in scientific

progress (i.e. external control) and engaging in environmentally friendly behaviour (i.e. personal control) represent two substitutable sources of order. We hypothesize that portraying science as rapidly progressing may have disadvantageous side effects for environmentally friendly intentions and behaviour. Because desired levels of order are already met through the endorsement of an external source of order (i.e. science), exerting personal control (i.e. behaving in an environmentally friendly way) becomes less necessary. Returning to CCT's glass analogy, when belief in scientific progress is affirmed, the glass is largely filled by external control (Figure 1). This reduces the need to exert personal control. As such, communicating about science in a way that it seems infallible and rapidly progressing may cause inertia, whereas, in contrast, questioning scientific progress should lead to a relative increase in environmentally friendly intentions and behaviours. Because optimal levels of order are not provided by an external source of control, the motivation to exert personal control through behaving in an environmentally friendly way is enhanced.

OVERVIEW OF STUDIES

We conducted four studies to experimentally test our environmental compensatory control hypothesis (Figure 2). We started by examining whether reading a newspaper article that questions (vs affirms) belief in scientific progress increases feelings of disorder (Study 1). In Study 2, we investigated whether directly priming disorder (vs order) perceptions increases the need to exert personal control by making environmentally friendly choices. In Study 3, we sought to demonstrate that behaving in environmentally friendly ways indeed boosts feelings of personal control (i.e. can be seen as a way to exert control and as such enhance generalized feelings of control). In our fourth and final study, we replicated and extended Studies 1 and 2 by testing our main hypothesis that communication affirming scientific progress diminishes feelings of disorder and *therefore* reduced environmentally friendly attitudes, intentions, and behaviours, whereas communication questioning scientific progress enhances feelings of disorder and *therefore* heightens environmentally friendly attitudes, intentions, and behaviours.

STUDY 1

In this study, we tested whether participants whose belief in the progress of science was questioned by reading a counterfeit

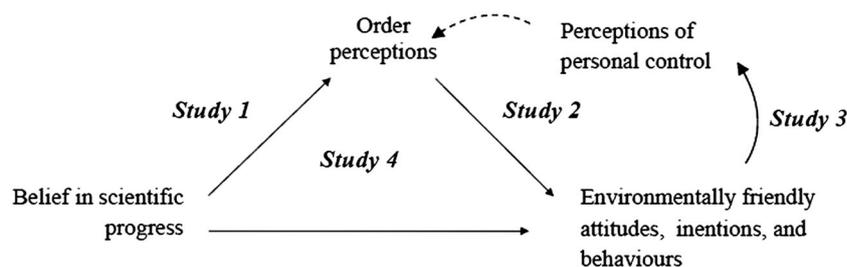


Figure 2. Overview of the current research

newspaper article were more likely to perceive disorder than participants whose belief in the progress of science was affirmed by reading a counterfeit newspaper article.

Participants and Design

One hundred and three university students ($M_{\text{age}} = 19.57$, $SD_{\text{age}} = 3.04$, 78.6% women) participated in the study in exchange for a monetary reward or partial course credit. The participants were randomly assigned to one of two conditions (newspaper article: affirmed vs questioned belief in scientific progress) of a between-subjects design. One participant only partially completed the questionnaire without answering the target measures and was therefore not included in the analyses.

Procedure

Participants were seated in individual cubicles and received a questionnaire booklet that ostensibly consisted of several unrelated questionnaires. They were asked to read all the instructions carefully and to ask for help if they had any questions. Participants first read a newspaper article about the progress of science, after which they completed a questionnaire on perceptions of disorder.

Belief in Scientific Progress Manipulation

We created two counterfeit newspaper articles to manipulate belief in scientific progress. These articles were identical in length (420 words). Moreover, the layout and writing style were modelled after articles of a popular news website, such that they appeared to be regular newspaper articles downloaded from the Internet. In the *affirmed belief in scientific progress* condition, we stressed that science progresses rapidly. The article described how diseases that used to have disastrous consequences, such as tuberculosis, are now more easily combated. Furthermore, it described how the treatments for potential deadly diseases such as HIV and cancer are improving and how science provides solutions for problems such as climate change by inventions such as electric cars and floating cities. In the *questioned belief in scientific progress* condition, we stressed that although scientific progress does occur, its pace is often insufficient to provide solutions to urgent problems. The article described how diseases that used to have disastrous consequences, such as tuberculosis, are now more easily combated, just like in the affirmed belief condition. However, the article stressed that although the treatments for potential deadly diseases such as HIV and cancer are improving, these diseases are still hard to combat. Moreover, it was posited that although science is starting to provide initial solutions for climate change issues, these solutions do not yet suffice. For example, electric cars still need energy and as such still contribute to climate change.

Dependent Measures

After reading one of the newspaper articles, the participants completed a questionnaire that included several items measuring perceptions of randomness and disorder, a manipulation check item, and several filler items. All items were measured

on a scale from 1 (*completely disagree*) to 7 (*completely agree*). To verify that our manipulation of a questioned versus affirmed belief in scientific progress was effective, we measured participants' belief in science with the following item: 'to what extent do you think science is capable of solving climate-related problems?' Participants' perceptions of disorder were measured by the following items: 'to a great extent my life is controlled by accidental happenings' and 'our lives are ruled by randomness' (Kay et al., 2008), $r = .56$, $p < .001$. After completing the questionnaires, participants were thanked for their participation and debriefed.

Results and Discussion

Results of a one-way ANOVA indicated that we successfully manipulated belief in scientific progress; participants who read the article that affirmed belief in scientific progress believed more strongly in the ability of science to solve climate-related problems ($M = 5.24$, $SD = 1.06$) than participants who read the article that questioned belief in scientific progress ($M = 4.85$, $SD = 0.89$), $F(1, 100) = 4.12$, $p = .045$, $\eta_p^2 = 0.04$.

Next, we averaged the scores on the two disorder items into an index and used this as the dependent variable in an ANOVA, which yielded a significant effect of condition, $F(1, 100) = 6.88$, $p = .010$, $\eta_p^2 = 0.06$. As expected, participants who read the newspaper article that affirmed belief in scientific progress experienced lower feelings of disorder ($M = 3.49$, $SD = 1.04$) than participants who read the newspaper article that questioned progress ($M = 4.01$, $SD = 0.96$). Study 1 thus shows that reading a newspaper article that affirms belief in scientific progress reduced feelings of disorder compared with reading a newspaper article that questions belief in scientific progress. The study thus provides initial evidence for the idea that employing a progress frame in science communication increases belief in scientific progress, which comprises an effective external source of control that reduces perceptions of disorder.

STUDY 2

In a second study, we investigated the relationship between disorder and environmentally friendly behaviour. Therefore, we built on the results of Study 1 and investigated whether directly activating feelings of disorder enhances environmentally friendly intentions, compared with directly activating feelings of order.

Participants and Design

One hundred and seven participants ($M_{\text{age}} = 19.86$, $SD_{\text{age}} = 2.17$, 73.8% women) participated in the study in exchange for a monetary reward or partial course credit. They were randomly assigned to one of two conditions (disorder vs order) of a between-subjects design. One participant inaccurately completed the priming task that was used to manipulate order and therefore could not be included in the analyses.

Procedure

Participants came into the lab for a series of unrelated experiments and completed the materials on a personal computer. Participants first completed a scrambled-sentence task (Srull & Wyer, 1979) that either primed the concept of disorder or order (Kay, Moscovitch, & Laurin, 2010). Participants unscrambled 16 word sets, each set consisting of five words of which four words had to be used to form a sentence. Eight word sets were related to disorder or to order (depending on condition). In the disorder condition, participants unscrambled word sets such as ‘the chaotically door meeting proceeds’ (‘the meeting proceeds chaotically’), whereas in the order condition, these were sets such as ‘the orderly door meeting proceeds’ (‘the meeting proceeds orderly’).

Next, participants read that a research institute affiliated with their university was interested in students’ opinions regarding environmental issues. This comprised the dependent measure that tapped into environmentally friendly attitudes (e.g. ‘we have to take the greenhouse effect seriously’) and behavioural intentions (e.g. ‘the next time it is cold inside I will turn up the thermostat rather than put on a sweater’; reverse coded) consisting of 12 items scored on 7-point scales ranging from 1 (*completely disagree*) to 7 (*completely agree*), $\alpha = .80$. Finally, participants were thanked and debriefed.

Results and Discussion

We averaged the scores on the attitudes and behavioural intention items into an index and used this as the dependent variable in an ANOVA. As expected, participants who unscrambled the disorder sentences displayed more positive environmental attitudes and intentions ($M = 5.35$, $SD = 0.76$) than participants who unscrambled the sentences concerning order ($M = 4.97$, $SD = 0.87$), $F(1, 104) = 5.78$, $p = .018$, $\eta_p^2 = 0.05$. Study 2 thus supports our hypothesis that activating feelings of disorder (vs order) enhances the likelihood of making environmentally friendly choices.

STUDY 3

Study 2 confirmed that people are more likely to make environmentally friendly choices when confronted with disorder compared with order. As elaborated upon in the introduction, we suggest that disorder perceptions increase environmentally friendly behaviour because engaging in such behaviour boosts feelings of personal control through self-action. In Study 3, we therefore investigated whether engaging in environmental behaviour can be understood as an order-providing mechanism, by directly testing whether making environmentally friendly choices boosts people’s generalized feelings of personal control.

Participants and Design

Fifty-eight university students ($M_{\text{age}} = 21.02$, $SD_{\text{age}} = 2.40$, 59.6% women) participated in the study in exchange for a monetary reward. They were randomly assigned to one of two conditions (order of tasks: environmentally friendly

behaviour first vs personal control first) of a between-subjects design. One participant failed to follow instructions and was excluded from the analyses.

Procedure

Participants came to the lab for a series of unrelated experiments and completed our questionnaire on a personal computer. We balanced the order of the following tasks: a task concerning environmentally friendly choices and a questionnaire measuring personal control. So, half of the participants first completed two tasks on environmentally friendly behaviour and then completed a questionnaire on generalized perceptions of control, whereas the other half first completed a questionnaire on perceptions of control and then completed two tasks on environmentally friendly behaviour. This enabled us to test our hypothesis that performing environmentally friendly behaviour enhances perceptions of personal control.

Environmental Behaviour Tasks

Participants read that a research institute interested in students’ opinions regarding environmental issues. Participants completed the same measures of environmentally friendly attitudes and intentions used in Study 2 ($\alpha = .75$). Participants then completed a task in which they imagined managing a manufacturing plant that pollutes the air via smokestacks (Sachdeva, Iliev, & Medin, 2009; also Tenbrunsel & Messick, 1999). In order to prevent the release of pollutants, they could run filters at monetary costs. Under pressure from environmental lobbyists, all manufacturing plants agreed with the lobbyists to run the filters at 60% of the time (at a cost of €1.2m). The participants were told that they could stick with this agreement but could also choose to run the filters for any 10% interval between 0% and 100%, with each incremental step costing €0.2m. The more often the filters would run, the better this would be for the environment, but also the higher the financial costs.

Personal Control Questionnaire

We measured generalized feelings of personal control with the items ‘are you the actor in, or the director of, your own life?’, ranging from 1 (*actor*) to 7 (*director*), and ‘to what extent do you feel that you can control what happens in your life?’, ranging from 1 (*not at all*) to 7 (*totally*), $r = .58$, $p < .001$ (Rutjens, van der Pligt, et al., 2010). The task measuring feelings of personal control was disguised as a separate study and also contained some filler items.

Results and Discussion

As expected, the results of an ANOVA showed that the order of tasks had a significant effect on participants’ reported feelings of personal control, $F(1, 55) = 4.15$, $p = .046$, $\eta_p^2 = 0.07$. Participants who first engaged in the environmental tasks experienced higher levels of personal control ($M = 5.23$, $SD = 1.03$) than participants who first completed the questionnaire regarding personal perceptions of control ($M = 4.62$, $SD = 1.22$). In other words, participants who engaged in environmentally friendly

behaviour experienced higher levels of general personal control than participants who did *not* have the chance to engage in environmentally friendly behaviour. This implies that behaving in an environmentally friendly way indeed boosts more general perceptions of personal control.

Finally, we checked whether the extent to which participants expressed their environmentally friendly attitudes and intentions and engaged in environmentally friendly behaviour differed between the two conditions. As expected, there were no differences of task order on expressing environmentally friendly attitudes and intentions, $F < 1$, nor in engaging in environmentally friendly behaviour, $F < 1$.

STUDY 4

So far, our studies show that reading a newspaper article questioning (vs affirming) belief in scientific progress increases perceptions of disorder (Study 1) and that activating disorder (vs order) increases the intention to engage in environmentally friendly behaviour. Increases the intention to engage in environmentally friendly behaviour (Study 2). Furthermore, we found that behaving in environmentally friendly ways boosts perceptions of personal control (Study 3). According to CCT, personal control is one route to maintaining order perceptions (Kay et al., 2008). In our final study, we conducted a full test of our hypothesis that communication affirming scientific progress diminishes feelings of disorder and consequently reduces environmentally friendly attitudes, intentions, and behaviours, whereas communication questioning scientific progress enhances feelings of disorder and consequently heightens environmentally friendly attitudes, intentions, and behaviours. Thus, in Study 4, we investigated whether the effects of reading a newspaper article that affirms (vs questions) scientific progress on environmentally friendly behavioural intentions is mediated by perceptions of disorder.

Participants and Design

Forty-three university students ($M_{\text{age}} = 24.68$, $SD_{\text{age}} = 6.91$, 70.7% women) participated in the study in exchange for a monetary reward. They were randomly assigned to one of two conditions (newspaper article: affirmed vs questioned belief in scientific progress) of a between-subjects design. Two extremes (i.e. multivariate outliers) were excluded on the basis of the Mahalanobis distance (Pallant, 2001; Tabachnick & Fidell, 2007).

Procedure

Upon arrival in the lab, participants received a paper-and-pencil questionnaire that ostensibly consisted of several unrelated questionnaires. Participants first read one out of two counterfeit newspaper articles concerning the progress of science. In one condition, the progress of science was questioned, whereas in the other condition, the progress of science was affirmed (as in Study 1). Next, participants were asked to complete a questionnaire that measured disorder perceptions with the item 'our lives are ruled by randomness' (Kay et al., 2008), on a 7-point

scale from 1 (*completely disagree*) to 7 (*completely agree*). Hereafter, participants answered six items measuring environmentally friendly attitudes and behavioural intentions (e.g. 'I intend to wash my clothes at a lower temperature for the sake of the environment' and 'I believe waste sorting is unnecessary', reverse coded) that were measured on a 7-point scale ranging from 1 (*completely disagree*) to 7 (*completely agree*), $\alpha = .79$.

Next, participants continued with an additional task pertaining to environmental consumer behaviour. Previous research has shown that consumers associate organic products with caring for the environment and that green consumers are more likely to purchase organic products (Sparks & Shepherd, 1992; Tacken, de Winter, & Wertheim-Heck, 2007; Thøgersen & Ölander, 2003). Therefore, we operationalized environmentally friendly consumer behaviour by measuring the number of organic food items that participants chose in this task. Participants were asked to imagine that they are shopping at a grocery shop unknown to them. They were asked to look at six product categories (e.g. pasta, spinach, and beans). For each category, they were instructed to choose one product out of three available options. One of the options was always an organic, environmentally friendly one (products did not differ in terms of price). Lastly, participants were thanked and debriefed.

Results and Discussion

Disorder

First, we replicated the results of Study 1 showing that affirming (vs questioning) belief in scientific progress lowers perceptions of disorder. An ANOVA showed that participants who read a newspaper article affirming scientific progress experienced lower feelings of disorder ($M = 3.14$, $SD = 0.73$) than participants who read a newspaper article that questioned belief in scientific progress ($M = 4.10$, $SD = 1.17$), $F(1, 39) = 10.06$, $p = .003$, $\eta_p^2 = 0.21$.

Environmentally Friendly Attitudes and Intentions

Next, we averaged the scores on the attitude and intention items into an index and used this as the dependent variable in an ANOVA, which yielded a significant effect, $F(1, 39) = 9.40$, $p = .004$, $\eta_p^2 = 0.19$. As expected, participants who read an article affirming belief in scientific progress displayed less environmentally friendly attitudes and intentions ($M = 5.11$, $SD = 0.95$) than participants who read an article questioning belief in scientific progress ($M = 5.93$, $SD = 0.73$). Next, we assessed whether feelings of disorder mediate the effect of belief in scientific progress on environmentally friendly attitudes and intentions. We performed a mediation analysis and computed three regression equations (Figure 3). A bootstrapping analyses with 5000 samples (Preacher & Hayes, 2004) confirmed mediation through feelings of disorder (indirect effect = 0.26, $SE = 0.14$, 95% confidence interval [0.039, 0.624]). This result confirms our hypothesis that communication that questions (vs affirms) belief in scientific progress increases environmentally friendly behaviour via perceptions of disorder.

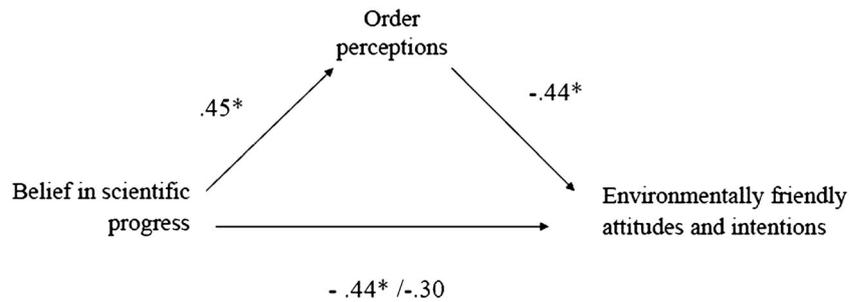


Figure 3. Standardized regression coefficients for the relationship between belief in scientific progress (manipulated) and environmentally friendly attitudes and intentions, mediated by order perceptions in Study 4, $*p < .05$. Order perceptions reflect the reverse-coded disorder measure

Organic Food Preference

We added the number of organic products that participants chose in the grocery shopping task and entered this as a dependent variable in an ANOVA, which revealed a marginally significant effect, $F(1, 39) = 3.91$, $p = .055$, $\eta_p^2 = 0.09$. Participants who read an article affirming belief in scientific progress chose less organic products ($M = 1.95$, $SD = 1.63$) than participants who read an article questioning belief in scientific progress ($M = 3.10$, $SD = 2.07$). The amount of environmentally friendly products that participants chose correlated significantly with participants' environmentally friendly attitudes and intentions, $\beta = .31$, $p = .048$.¹

GENERAL DISCUSSION

Although most people understand the importance of environmentally friendly behaviour, they generally appear to find it difficult to put this into practice (Dunlap, Gallup, & Gallup, 1993; Tanner & Kast, 2003). The current research demonstrates that one explanation for this lies in the way science communication is framed. A strong focus on a rapidly progressing science that has the potential to provide solutions to pressing problems negatively affects environmentally friendly intentions and behaviour. We have argued that the underlying reason is that a progress frame increases order perceptions, consequently rendering personal actions less necessary. In contrast, questioning scientific progress results in a relative increase in disorder perceptions, which in turn triggers the motivation to restore order via personal actions such as engaging in environmentally friendly behaviour.

The current findings complement recent research on how environmentally friendly behaviour may be influenced by communication (e.g. Bain, Hornsey, Bongiorno, & Jeffries, 2012; Feinberg & Willer, 2011; Gifford & Comeau, 2011; Nisbet & Mooney, 2007; Rabinovich, Morton, & Birney,

2011; Ter Mors, Weenig, Ellemers, & Daamen, 2010). Research has, for example, shown that perceptions of the scientific agenda when communicating about climate change influence people's willingness to perform environmentally friendly behaviours and that the way climate change is framed influences engagement in environmental issues (O'Neill & Nicholson-Cole, 2009; Rabinovich et al., 2011). Our paper advances knowledge on the effects of (science) communication by showing that the often-employed progress frame negatively impacts on people's environmentally friendly attitudes, intentions, and behaviours.

So far, the way in which people's beliefs about how science is advancing affect their subsequent behaviours has been largely unstudied. The current research fills this gap by showing that beliefs about scientific progress influence environmental behaviour. Second, this paper underpins the importance of investigating how media and science communication affect behaviour. There is not much known yet on how science-related uncertainties and contradictions influence people's environmentally friendly attitudes and behaviours (but see Lewandowsky, Gignac, & Vaughan, 2013; Morton, Rabinovich, Marshall, & Bretschneider, 2011). It could be argued that media reports on contradictory scientific findings and even fraud might decrease people's belief in science as an institution, which in turn increases feelings of disorder and—somewhat ironically—the likelihood of engaging in environmentally friendly behaviour. Alternatively, it could also be the case that such reports increase scepticism and perhaps even a disregard for science all together (Gleick et al., 2010). As a consequence, this might undermine the idea that environmentally friendly behaviour is necessary in the first place and thus decrease environmentally friendly behaviour—especially among the scientific illiterate (Nisbet et al., 2002). This poses an interesting question for future research. Finally, our research complements other work that documents variables that have what could be labelled ironic effects on environmentally friendly behaviours (such as recent work suggesting that validating the purchase of green products hampers subsequent green behaviours; Meijers, Noordewier, & Avramova, 2013).

The current paper also contributes to the understanding of order motivation and compensatory control. First, it shows that affirming belief in an external source of control has a downside in the sense that people are less likely to take control themselves; they become more passive. It is plausible that this is not only the case for a strong belief in scientific progress but also holds in the context of strong beliefs in God, government,

¹Although the main effect of belief in scientific progress on organic food preference was marginal, we tested whether disorder might (partially) mediate this effect, similar to the mediation effect on attitudes and intentions. This was not the case; a bootstrapping analysis with 5000 samples revealed an indirect effect of 0.13 (confidence interval $[-0.89, 0.45]$). This lack of mediation might be due to the main effect of condition that was marginal, which might have been caused by the following: (i) a low sample size and dependent variable consisting of a series of nominal choices and (ii) participants having already affirmed their intentions on the previous task.

and other external agents or institutions that may provide order (e.g. Laurin et al., 2012). Therefore, it may be interesting for future research to investigate how a strong belief in governmental institutions could affect the motivation to exert personal control over outcomes in a wide range of domains. Indeed, other types of personal action in different domains are likely to increase feelings of control as well. At the same time, we believe that environmentally friendly behaviours and prosocial behaviours in general are particularly potent providers of control. For example, as Banfield (2011) has argued and shown in her research, these behaviours give people the possibility to not only influence an outcome in their personal life but also instil the notion that they can exert control over their environment. This sense of being able to influence or alter the environment likely renders such behaviours especially suitable for providing people with a sense of control over outcomes. Moreover, it is likely that the substitutability of personal and external control is strongest when these concern similar domains, as is the case with environmentally friendly behaviour and scientific progress.

Second, this research is among the first to provide evidence for the functional value of affirming external sources of order (i.e. whether it actually helps to enhance perceptions of order; Rutjens et al., 2013). Notably, the psychological value of affirming external control (enhanced order perceptions) is accompanied by inertia.

ALTERNATIVE EXPLANATIONS: URGENCY AND OUTSOURCED RESPONSIBILITY

It could be argued that there are alternative explanations for our findings, particularly those of Studies 1 and 4. When people learn about science progressing at a rapid rate, they might simply infer from this information that it is less necessary, or less important, for them to act against climate change. Engaging in environmentally friendly behaviour could moreover be argued to be costly, making it particularly appealing to outsource responsibility for the problem to science. Such an explanation would converge with previous research in the domain of CCT, which has shown that belief in a controlling God leads to decreases in active goal pursuit (personal action; Laurin et al., 2012) because outcomes are influenced by God and are therefore perceived to be beyond the individual's control. Similarly, recent research has shown that the more people believe in powerful, intervening gods, the less they rely on themselves to impose order on the world via punishment of norm violators (i.e. punishment is outsourced to God; Laurin, Shariff, Henrich, & Kay, 2012).

We believe that it is likely that our participants outsourced responsibility to science when they learned about rapid progress but that this occurs—at least partly—because science helps to exert control and restore order perceptions. Thus, a reduced sense of urgency (and possibly other motivations) will likely have played a role in Studies 1 and 4, in parallel with the motivation to maintain order perceptions. Importantly, results of the mediation analysis in Study 4 and the results of Studies 2 and 3 suggest that the need for order is an especially powerful explanation that best accounts for the overall results

reported in this paper. One way to further illustrate the key role of the need to maintain order perceptions would involve making salient the possibility that rapid progress in science will help find solutions to environmental problems but that these solutions come with potentially hazardous consequences and the potential for disorder and chaos (e.g. rapid technological advances in the domain of genetically modified food or nuclear energy). In that case, perceptions of the world as orderly would be threatened (regardless of the solution that is offered to solve the problem at hand), which consequently would trigger alternative compensatory control efforts (such as engaging in personal action). Thus, we argue that it need not always be the case that a rapidly progressing science leads to less engaging in environmentally friendly behaviour; it depends on whether the way science is progressing instigates a feeling of order.

CONCLUSION

Our findings have important practical implications for understanding how environmentally friendly behaviour can be increased and encouraged. When media outlets paint a picture of omniscient science and unconditional and ongoing progress, one consequence may be that people become passive and less motivated to behave in environmentally friendly ways. Instead, looking more critically at the power of science and the limits of progress could—somewhat ironically—encourage people to take matters in their own hands and make environmentally friendly choices.

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