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Why Do People Tend to Infer "Ought" From "Is"? The Role of Biases in Explanation

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Abstract

People tend to judge what is typical as also good and appropriate—as what ought to be. What accounts for the prevalence of these judgments, given that their validity is at best uncertain? We hypothesized that the tendency to reason from "is" to "ought" is due in part to a systematic bias in people's (nonmoral) explanations, whereby regularities (e.g., giving roses on Valentine's Day) are explained predominantly via inherent or intrinsic facts (e.g., roses are beautiful). In turn, these inherence-biased explanations lead to value-laden downstream conclusions (e.g., it is good to give roses). Consistent with this proposal, results from five studies (N = 629 children and adults) suggested that, from an early age, the bias toward inherence in explanations fosters inferences that imbue observed reality with value. Given that explanations fundamentally determine how people understand the world, the bias toward inherence in these judgments is likely to exert substantial influence over sociomoral understanding.

Keywords

cognitive development, inherence heuristic, sociomoral judgments, explanation, open data, open materials, preregistered

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In his dissent from the Supreme Court decision recognizing a federal constitutional right for people to marry a same-sex partner, Chief Justice Roberts noted that heterosexual marriage has been around "for millennia" in societies all over the world: "the Kalahari Bushmen and the Han Chinese, the Carthaginians and the Aztecs" (*Obergefell v. Hodges*, 2015). A possible reading of this remark is that we should take what is typical as a signpost for what is good—how things ought to be.[1] Whatever the correct interpretation here, the tendency to move seamlessly from "is" to "ought" is a mainstay of everyday reasoning (Hume, 1740/2000; for a review, see Eidelman & Crandall, 2014). However, the validity of such "is"-to-"ought" inferences (or *ought inferences*) is at best uncertain. The mere existence of a pattern of behavior does not, by itself, reveal that the behavior is good.[2] For instance, slavery and child labor were common throughout history, and still are in some parts of the world, yet it does not follow that people ought to engage in these practices. Why, then, do people frequently draw ought inferences and find them persuasive?

Our goal in the current studies was to identify the psychological underpinnings of this tendency. We proposed that the basic processes that underlie explanation are partly responsible for the permeable boundary between "is" and "ought." Across development, everyday explanations are often generated off the cuff rather than via careful deliberation (e.g., Cimpian & Salomon, 2014a, 2014b; Wilson & Keil, 1998). The heuristic nature of this process gives rise to systematic bias in the explanations generated, which ultimately leads people to overestimate the extent to which the phenomenon being explained ought to be that way. We detail this proposal before describing the five studies that tested it.

The Explanatory Roots of Ought Inferences

The motivation to explain is present from infancy (e.g., Baillargeon, 1994; Saxe, Tenenbaum, & Carey, 2005). Many phenomena are complex, however, and humans'

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cognitive systems are limited in many respects that affect explanation (e.g., memory retrieval is fallible). Thus, when people are generating explanations, they must often settle for "good enough" (Cimpian & Salomon, 2014a, 2014b; Thomas, Dougherty, & Buttaccio, 2014; Wilson & Keil, 1998), as they do with respect to other judgments (e.g., Kahneman, 2011; Shah & Oppenheimer, 2008; Stanovich & West, 2000). That is, people often take information retrieved on the spot and use it to assemble a *heuristic* explanation—an explanation that, although not guaranteed to be accurate, seems intuitively plausible.

The fact that everyday explanations tend to be based on information that is easily retrieved has an important corollary: Any systematic biases in the content of the most accessible information are likely also to bias the explanations generated. A finding that bears on this argument is that when people retrieve information about an entity, the information that comes to mind first tends to concern the entity itself (i.e., *inherent* information) rather than its context, history, or relations with other entities (i.e., *extrinsic* information; e.g., Ashcraft, 1978; Hussak & Cimpian, 2014; McRae, Cree, Seidenberg, & McNorgan, 2005). For example, when thinking about roses, people may retrieve inherent facts, such as that roses have a beautiful look and a sweet smell. In contrast, extrinsic facts about roses that are also available in memory (e.g., that flower shops sell them all year) are seldom among the first retrieved.[3]

In turn, this retrieval bias skews the explanation-generation process toward inherence—that is, explanation often exhibits an *inherence bias* (Cimpian, 2015; Cimpian & Salomon, 2014a, 2014b). For example, if people wonder why roses are a typical gift for Valentine's Day, an intuitive answer might invoke roses' beautiful appearance or some other inherent feature.[4] However, the actual reason has more to do with the fact that, as Valentine's Day became popular, businesses needed a flower that could be imported in bulk from remote countries with milder February temperatures (Goldmark, 2015). The contrast between the more intuitive answer and the actual, largely extrinsic explanation for the association between roses and Valentine's Day illustrates the broad inherence bias that characterizes heuristic explanations (e.g., Cimpian & Steinberg, 2014; Hussak & Cimpian, 2015; Salomon & Cimpian, 2014; Sutherland & Cimpian, 2015).

But why would this inherence bias lead to ought inferences? One possible mechanism involves intuitions that form downstream of the explanation process. A phenomenon explained via inherent features often acquires an aura of obviousness, even necessity: "Of course we choose roses for Valentine's Day," one might reason. "They have the perfect look. It couldn't have been any other way." Because inherent explanations lead people to understand a phenomenon as a by-product of the entities that make it up, it becomes difficult to imagine how this phenomenon could be different. Further intuitions are likely to follow: For example, if roses are the obvious choice for Valentine's Day, then it is also reasonable to conclude that people ought to give roses—that it is a good thing to do. In contrast, extrinsic explanations are less likely to lead to such conclusions because they highlight the contingent (rather than necessary) nature of the phenomenon explained—they reveal how things could have easily turned out otherwise. If, for example, one considers the historical transformation of Valentine's Day into a business opportunity, it may not seem necessary or particularly desirable that people give roses for this holiday. Thus, the inherence bias in explanation may foster ought inferences in part because inherent explanations are often accompanied by intuitions about necessity ("it has to be this way")[5] and, subsequently, obligation ("one ought to do it"). Note that we do not claim that either of these inferential links is deterministic: Explanations relying on inherent facts (rather than extrinsic facts) may generally be more likely to foster downstream intuitions about how things could not have been otherwise, which may then give rise to value-laden judgments.[6]

The inferential links in this potential mechanism are independently supported. For instance, whenever people attribute certain features to deeper essences (which are a specific sort of inherent feature), they also expect these features to be immutable and necessary (e.g., Gelman, 2003; Haslam, Rothschild, & Ernst, 2000; see also Cimpian & Salomon, 2014a, 2014b). There also seems to be considerable overlap in the cognitive mechanisms used to reason about physical modality (e.g., what is physically possible vs. impossible, or necessary vs. contingent) and moral modality (e.g., what is morally permissible vs. impermissible, or obligatory vs. optional; e.g., see Shtulman & Tong, 2013). Judgments in one domain (e.g., about physical necessity) might thus influence one's endorsement of parallel judgments in the other domain (e.g., about moral obligation).

Theoretical Contribution and Relation to Prior Work

Given that explanations are the primary vehicle through which humans understand the world (e.g., Keil, 2006; Lombrozo, 2012), a bias in these judgments may exert a deep influence on sociomoral reasoning. Our proposal adds a unique perspective to current theories concerning the sources of value in people's sociomoral judgments (good/bad, right/wrong, etc.). For instance, prior research has suggested that people's evaluations of other people's actions are influenced by skeletal principles evolved via natural selection (e.g., Graham et al., 2013; Hamlin, Wynn,

& Bloom, 2007; Sloane, Baillargeon, & Premack, 2012), by domain distinctions constructed through early interactions with other people (e.g., Helwig & Turiel, 2011; Smetana, 2006), and by explicit knowledge acquired through socialization and enculturation (e.g., Dahl & Campos, 2013; Shweder, Mahapatra, & Miller, 1987). According to our proposal, the explanatory bias under investigation in the current studies is an independent source of sociomoral value that shapes how people understand what is appropriate and right.

To clarify, our account goes beyond simply asserting a relation between explanations and sociomoral reasoning. Such a relation is featured, although somewhat implicitly, in prior accounts. For instance, social-domain theorists have argued that people's *informational assumptions*—roughly, their explanations—influence their evaluations of a phenomenon (e.g., Turiel, Hildebrandt, & Wainryb, 1991; see also Eidelman & Crandall, 2014). In the current studies, however, we tested the causal influence of a specific, key aspect of explanatory reasoning (i.e., its inherence bias) on sociomoral reasoning across development. Recognizing this bias is essential to a mechanistic understanding of ought inferences.

Predictions

We tested two predictions of our proposal. First, we tested whether the inherence bias in participants' explanatory preferences predicted their tendency to infer "oughts" from typical behavior (Studies 1–3). Second, we tested whether this relationship was causal by experimentally manipulating the bias in participants' explanations and measuring downstream effects on their ought inferences (Studies 4 and 5). These predictions were tested in adult participants (Studies 1, 2, and 4) and in children (Studies 3 and 5) because everyday explanations are inherence-biased throughout development (e.g., Cimpian & Steinberg, 2014). The sample size and data-collection stopping rule for all studies were determined with power analyses using effect sizes from studies on related topics (e.g., Hussak & Cimpian, 2015; Salomon & Cimpian, 2014; Sutherland & Cimpian, 2015).

Study 1

In Study 1, we tested whether adult participants' preference for inherent explanations predicted the extent to which they thought things ought to be as they are.

Method

Participants. The participants (N = 122; mean age = 37.2 years, SD = 13.0; 37 men, 85 women) were recruited from Amazon's Mechanical Turk service. They received $0.75 for their participation. Nine additional participants were tested but excluded because they had Internet protocol (IP) addresses from outside the United States (n = 2) or because they failed the catch questions embedded in the explanation measure (n = 7; for details, see the section titled Inherence Bias).

Materials. To test our prediction, we devised measures of participants' tendency to infer oughts and to prefer inherent explanations. The study also included four control measures (assessing education, fluid intelligence, political orientation, and belief in a just world).

Ought inferences. Participants read six passages that were structured like and derived from actual press releases. The passages described a typical societal practice (i.e., what is). For example, one was titled "America's Pizza Obsession: By The Numbers" and read as follows:

> The quintessential American food may be apple pie, but its popularity pales beside our national love affair with pizza pies. *The Daily* reports that Americans consume a staggering 100 acres of pizza a day, according to data from the National Association of Pizza Operators (NAPO). Over $38 billion of pizza is sold in America annually, according to *Pizza Today*, and 3 billion pizzas are sold in the U.S. each year according to NAPO. 350 slices of pizza are sold every second, according to NAPO, and the average American eats an average of 46 slices of pizza a year, according to *Packaged Facts*. Overall, a total of 94% of Americans eat pizza (adapted from "America's pizza obsession: By the numbers," 2011).

After reading each press release, participants were asked five questions: one *ought question* (e.g., "Do you think it should be that so many Americans eat pizza?" 1 = *definitely no*, 9 = *definitely yes*) and four filler questions that served to camouflage the main focus of the study (e.g., "Do you think the amount of pizza sold will grow in the next 5 years?" "What do you think accounts for the current prices of pizza?"). For three of the press releases, the ought question was phrased with "should" (see the example in the first sentence of this paragraph), and for the other three, the ought questions were phrased with "good"—for example, "Do you think that it's good that so many Americans drive to work?" (1 = *really not good*, 9 = *really good*), which was presented after a passage claiming that 88% of Americans drive to work. Participants' average scores for the "good" and "should" questions were significantly correlated, $r(122) = .37$, 95% confidence interval (CI) = [.20, .51], $p < .001$.

Note that the press releases were purposely about behaviors that fall outside the scope of most existing

accounts of sociomoral reasoning (eating pizza, driving to work, drinking coffee, owning a TV, using e-mail, and watching football) so that our results would highlight the unique contribution of our account. All passages were factual in tone, without evaluative language, to avoid influencing participants' normative judgments (for the full text of the passages, see the Supplemental Material at Open Science Framework, https://osf.io/4kanr/).

Responses to the six ought questions were averaged into a composite score, which we refer to as the *ought measure* (α = .58). The lowest correlation between a particular question and the average of all six questions (i.e., the lowest item-total correlation) was .33. (Note that the results remained the same when excluding the item with the lowest item-total correlation.) The ought measure served as our main dependent variable.

Inherence bias. Fifteen items were used to assess the extent to which participants preferred explanations in terms of inherent facts (e.g., "Black is associated with funerals because of something about the color black or about funerals—maybe because the darkness of black conveys how people feel at funerals"; α = .85; lowest item-total correlation = .47; see Table 1 for other sample items). All items were rated using a 9-point scale (1 = *disagree strongly*, 9 = *agree strongly*) and were presented in random order. Note that, as with the ought measure, the items in the measure of inherence bias were worded factually and did not contain evaluative language. Two catch items were included to detect inattention (e.g., "Please click on the number three below to indicate that you are paying attention"). Participants who missed either of these attention checks were excluded (n = 7).

Control measures. Four control measures were administered to investigate alternative explanations for the predicted relationship between participants' explanations and their ought inferences. These measures tapped into dimensions that could influence both variables of interest, giving rise to a correlation between them in the absence of a causal relationship. First, we measured participants' level of education using a scale from 1, *less than high school*, to 6, *doctoral (Ph.D., J.D., M.D.)*. Second, we measured their fluid intelligence with one 12-item set of Raven's Progressive Matrices (Raven, 1960; see also Salomon & Cimpian, 2014). Third, we measured participants' political views: "How would you describe your political attitudes?" (1 = *strongly liberal*, 9 = *strongly conservative*). (Because higher scores on this measure indicate more conservative attitudes, we occasionally refer to it as a measure of conservatism.) Fourth, a measure related to the measure of political views assessed participants' belief in a just world: for example, "Basically, the world is a just place" (1 = *disagree strongly*, 9 = *agree strongly*; Rubin & Peplau, 1975).

Table 1. Sample Items From the Measure of Inherence Bias Used in Study 1

We use red in traffic lights to mean "stop" because of something about the color red or about stop lights—maybe the color red inherently acts as a warning.
We don't keep chipmunks as pets because of something about chipmunks or about pets—maybe because chipmunks don't like to be picked up or held.
We drink orange juice for breakfast because of something about orange juice or about breakfast—maybe the citrus aroma is refreshing and helps us to wake up.
Toothpaste is flavored with mint because of something about toothpaste or about mint—maybe the tingling sensation of mint makes one's teeth and gums feel extra clean.

Table S1 in the Supplemental Material (at Open Science Framework, https://osf.io/4kanr/) provides descriptive statistics for these measures.

Procedure. Participants were tested online via Qualtrics (Qualtrics Labs Inc., Provo, UT). The ought measure, the measure of inherence bias, the belief-in-a-just-world scale, and Raven's Progressive Matrices were presented in random order. Item order was randomized for all scales except Raven's Progressive Matrices, which were presented in increasing order of difficulty. The measures of participants' education and conservatism were administered at the end of the sessions, along with other demographic questions. Finally, participants were debriefed.

Results

As predicted, participants with a greater inherence bias in their explanations were also more likely to think that current patterns of behavior are good and as they should be, $r(120)$ = .30, 95% CI = [.13, .46], $p < .001$. Moreover, this relationship remained significant even when we used multiple regression to statistically adjust for participants' education, fluid intelligence, conservatism, and belief in a just world, β = 0.31, 95% CI = [0.12, 0.49], p = .001. None of these other variables approached significance, $|\beta s| < .11$, $ps > .25$ (for full regression results, see Table 2; for the correlation matrix, see Table S2 in the Supplemental Material at Open Science Framework, https://osf.io/4kanr/).

The results of Study 1 suggest that the inherence bias in participants' explanations accounts for unique variance in their likelihood of inferring oughts, above and beyond that accounted for by a number of control variables such as their education, intelligence, and political views. One might wonder, however, whether Study 1 truly captured participants' tendency to draw ought inferences. An alternative possibility is that it simply tapped a shallow tendency to agree with ought statements, regardless of whether they concern typical behaviors (i.e., what is). In

Table 2. Results From Study 1: Multiple Regression Analysis Predicting Ought Inferences From the Measure of Inherence Bias and the Control Variables ($N = 122$)

Predictor	β	*t*	*p*
Inherence bias	0.31	3.27	.001
Education level	–0.07	–0.80	.425
Raven's Progressive Matrices	–0.02	–0.24	.807
Conservatism	0.10	1.14	.258
Belief in a just world	–0.09	–0.93	.357
R^2 total	.113		

Study 2, to test the specificity of the link between intuitive explanations and ought inferences, we manipulated whether the stimulus behaviors were typical or atypical. We predicted that the inherence bias in participants' explanations should track their ought inferences only when participants were reasoning about behaviors that are relatively widespread. Such evidence would provide stronger support for the claim that the inherence bias in explanation leads people to draw inferences about what ought to be on the basis of observations of what is (i.e., typical behaviors). In addition to exploring this alternative interpretation, we tested the robustness of the hypothesized relationship between explanations and ought inferences by changing various aspects of the methods used in Study 1, as explained in the next section.

Study 2

Method

Participants. The participants ($N = 112$; mean age = 37.61 years, $SD = 12.90$; 45 men, 67 women) were recruited from Amazon's Mechanical Turk service. Participants received $0.75 for participation. An additional 27 participants were tested but were excluded because they had IP addresses from outside the United States ($n = 2$), because they failed two or more of our four attention checks ($n = 23$), or because they indicated during the debriefing that they had not been paying attention during the study ($n = 2$).

Ought inferences. The main prediction tested in this study was that the inherence bias in participants' explanations would be positively related to participants' ought inferences only when they were reasoning about typical behaviors (i.e., about what is). We should not find this positive relationship when participants reason about atypical behaviors. To test this prediction, we assessed participants' reasoning about 12 pairs of behaviors (for examples, see Table 3; for the full list, see pp. 9–11 in the Supplemental Material at Open Science Framework, https://osf.io/4kanr/). Each pair consisted of a typical behavior (e.g., "people typically give roses as gifts on Valentine's Day") and a matched atypical behavior (e.g., "people don't typically give sweaters as gifts on Valentine's Day"). Each participant saw only one member of each pair, never both. Thus, each participant was asked about 12 behaviors. Six of these behaviors were typical, and 6 were atypical. The order of the 12 behaviors was randomized for each subject.

For each behavior, participants were asked two ought questions. The first question concerned whether people "should" engage in that behavior; for example, "Should people give roses [sweaters] as gifts on Valentine's Day?" (0 = *definitely no*, 100 = *definitely yes*). The second question concerned whether it is "wrong or right" to engage in that behavior; for example, "Is it wrong or right for people to give roses [sweaters] as gifts on Valentine's Day?" (0 = *wrong*, 100 = *right*). Changing the ought questions relative to Study 1 was a means of exploring the robustness of the link between the inherence bias in explanation and participants' sociomoral judgments. Participants' average ratings on the two kinds of ought questions were significantly correlated, $r(110) = .63$, 95% CI = [.50, .73], $p < .001$. This section of the study also included two attention checks (e.g., "For this question, please select 'somewhat agree' below to indicate that you are paying attention"), randomly interspersed among the other items.

Inherence bias. Participants' inherence bias was assessed more comprehensively than in Study 1. In this study, we measured participants' relative preference for inherent over extrinsic explanations. Endorsement of inherent explanations was measured with the same 15 items from Study 1. Each of these, however, was now accompanied by an extrinsic explanation presented on the same page (e.g., "Black is associated with funerals because of some historical or contextual reason—maybe because an ancient people originated the practice for some idiosyncratic reason and then spread it to many parts of the world"; for the full list, see pp. 4–7 of the Supplemental Material at Open Science Framework, https://osf.io/4kanr/). All 30 explanations (15 inherent, 15 extrinsic) were rated on a 9-point scale (1 = *disagree strongly*, 9 = *agree strongly*). Participants' inherence bias was computed as the difference between their endorsement of inherent explanations and their endorsement of extrinsic explanations. Higher difference scores indicated a stronger inherence bias ($M = 0.65$, $SD = 1.74$). A *t* test revealed that these scores were significantly different from 0, $t(111) = 3.94$, $p < .001$. All analyses reported used this difference score, but separate analyses using only participants' endorsement of inherent explanations (as in Study 1) revealed similar results.

Table 3. Sample Typical and Atypical Behaviors Used to Assess Participants' Ought Inferences in Study 2

Typical behavior	Atypical behavior
Consider that couples typically live in a different house than their relatives.	Consider that couples don't typically live in the same house as their relatives.
Consider that most men wear their hair short.	Consider that few men wear their hair long.
Consider that people often pay money to watch others play sports.	Consider that people seldom pay money to watch others play video games.
Think about how a lot of professionals wear dark-colored clothing.	Think about how few professionals wear clothing that has bright colors or bold patterns.
Think about how men and women typically have separate public bathrooms.	Think about how men and women typically don't share the same public bathrooms.
Think about how people typically give roses as gifts on Valentine's Day.	Think about how people don't typically give sweaters as gifts on Valentine's Day.

Note: Participants saw one behavior from each pair, never both.

This measure also included two attention-check items (e.g., "For this item, can you please choose three?"), randomly interspersed among the other items. Thus, across this and the ought measure, there were four attention checks in total. Participants who missed two or more of these checks were excluded from further consideration, as noted earlier (n = 23).

Control measures. Study 1 left open the possibility that both the inherence bias in explanation and the tendency to make ought inferences reduce to a basic tendency to think heuristically (rather than analytically), without a direct causal link between these two phenomena. To test this possibility, we included the Cognitive Reflection Test (CRT; Frederick, 2005) as a control measure in Study 2. The CRT is a common assessment of analytic thinking that consists of three problems with intuitively obvious but incorrect solutions. The extent to which people can reject these highly available solutions in favor of the less intuitive but correct ones is an index of their tendency to reason reflectively and analytically rather than heuristically. Because the original CRT items are familiar to most Mechanical Turk workers (Chandler, Mueller, & Paolacci, 2014), we used a less familiar, equivalent version of the CRT developed by Finucane and Gullion (2010; M = 56.5% correct, SD = 34.9). Two additional control measures were included: participants' level of education, measured using a scale from 1, *less than high school*, to 6, *doctoral (Ph.D., J.D., M.D.)*, and their political views, measured as in Study 1 ("How would you describe your political attitudes?" 1 = *strongly liberal*, 9 = *strongly conservative*).

Procedure. Participants were tested online via Mechanical Turk using Qualtrics software. The ought measure, the measure of inherence bias, and the CRT were presented in random order. Item order was randomized for all scales. The measures of participants' education and conservatism were administered with other demographic questions at the end of the survey.

Results

Analytic strategy. Because we manipulated behavior typicality within subjects, we used a multilevel model to analyze our data. The model included cross-classified random effects (specifically, intercepts) for subjects and items. Participants' ought inferences, calculated as the average of their responses to the two ought questions on each trial, served as the dependent variable. The model included as independent variables the typicality of each stimulus behavior (0 = atypical, 1 = typical), participants' scores on the measure of inherence bias, and the three control measures (i.e., CRT, education, and conservatism). The model also included the two-way interactions between behavior typicality and each of the latter four variables. We hypothesized a positive relationship between participants' inherence bias and their ought inferences for typical—but not atypical—behaviors. Thus, our main prediction was of a significant two-way interaction between the measure of inherence bias and behavior typicality. Including the other two-way interactions (with CRT, education, and conservatism) in the model enabled us to explore whether the relationships between these control variables and ought inferences also differed for typical and atypical behaviors. Adjusting for these potential relationships was a conservative analysis strategy; in alternative models that did not include these interactions, the predicted relationship was estimated to be larger in magnitude.

For ease of interpretation, we present unstandardized coefficients below. Given the coding of the behavior-typicality variable, the first-order coefficients for the measure of inherence bias, CRT, education, and conservatism in this model are simply the slopes of the relationships between these variables and ought inferences for atypical behaviors. Moreover, the slopes for typical behaviors can easily be calculated by adding each first-order coefficient to the coefficient for the corresponding two-way interaction.

Table 4. Results From Study 2: Multilevel Model Predicting Ought Inferences ($N = 112$)

Predictor	*b*	*SE*	*z*	*p*
Behavior typicality (0 = atypical, 1 = typical)	11.79	5.55	2.13	.034
Inherence bias	−0.98	0.68	−1.45	.148
Inherence Bias × Behavior Typicality	2.44	0.85	2.88	.004
Cognitive Reflection Test	0.88	3.09	0.28	.776
Cognitive Reflection Test × Behavior Typicality	−4.89	3.86	−1.27	.205
Education	−0.50	1.05	−0.47	.635
Education × Behavior Typicality	1.40	1.32	1.06	.287
Conservatism	−1.93	0.49	−3.95	< .001
Conservatism × Behavior Typicality	3.55	0.62	5.75	< .001

Main findings. The predicted interaction between the measure of inherence bias and behavior typicality was significant in this model, $b = 2.44$, 95% CI = [0.78, 4.10], $p = .004$ (for results for the full model, see Table 4). The results were consistent with our argument: Participants' inherence bias was positively related to their ought inferences about typical behaviors, $b = 1.45$, 95% CI = [0.12, 2.79], $p = .032$, but not atypical behaviors, $b = -0.98$ [−2.31, 0.35], $p = .148$ (see Fig. 1). Because our analysis took into account participants' political views, their education, and their more general tendency to reason heuristically, these findings speak against the possibility that the relationship between explanatory biases and ought inferences is simply a by-product of one of these other variables.

The only other significant relationships in this model involved conservatism. Greater conservatism predicted more positive views of typical behaviors, $b = 1.61$, 95% CI = [0.65, 2.57], $p = .001$, and more negative views of atypical behaviors, $b = -1.93$ [−2.89, −0.97], $p < .001$.

Replication. We conducted a preregistered replication of this experiment (study plan available at https://aspredicted.org/public/205223581.pdf) with a final total of 168 participants after excluding 34 according to the criteria described previously. This replication was successful. As we predicted, we found a significant interaction between the inherence bias in participants' explanations and their tendency to make ought inferences, $b = 3.20$, 95% CI = [1.93, 4.47], $p < .001$ (for the full model, see Table S3 in the Supplemental Material at Open Science Framework, https://osf.io/4kanr/). Participants whose explanations showed greater inherence bias were also more likely to think that people ought to behave as they typically do, $b = 2.17$, 95% CI = [1.19, 3.15], $p < .001$. In contrast, the greater the inherence bias in participants' explanations, the more likely they were to think that people ought not to behave in atypical ways, $b = -1.03$, 95% CI = [−2.01, −0.52], $p = .039$. Although the latter negative relationship was not significant in the main study and was not predicted a priori, it is consistent with the overall argument that an inherence bias in explanation leads people to view current patterns of behavior as appropriate. As a result of this tendency, anything outside the norm (e.g., giving people sweaters on Valentine's Day) might be seen as inappropriate and wrong rather than simply unusual.

This study supplies further evidence for a unique relationship between the inherence bias that characterizes everyday explanations and the tendency to infer that observed patterns of behavior are good, right, and as things should be.[7] In Study 3, we investigated whether this relationship was present in children's thinking as well; a positive finding would suggest that this relationship plays a part in sociomoral reasoning across development. Previous research has demonstrated that children can differentiate between inherent and extrinsic explanations and often prefer the former (e.g., Cimpian &

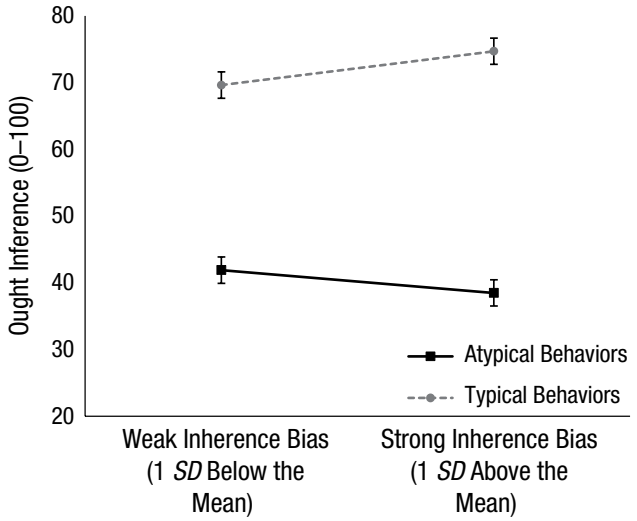

Fig. 1. Results from Study 2: ought inferences as a function of inherence bias (1 *SD* below the mean vs. 1 *SD* above the mean), presented separately for typical and atypical behaviors. The error bars represent ±1 *SE*.

Steinberg, 2014; Hussak & Cimpian, 2015; Sutherland & Cimpian, 2015). Thus, we predicted that the bias toward inherence in children's explanations would be linked with their intuitions about oughts, just as it was for adults.

Study 3

Method

Participants. The participants were 80 children between 4 and 7 years old (mean age = 5.98 years, *SD* = 1.13; 39 girls, 41 boys) who were recruited from a small city in the midwestern United States. We selected this age group so that we would be able to draw conclusions about a relatively broad stretch of development, as well as to ensure that we would see sufficient variability in children's sociomoral and explanatory reasoning (e.g., Cimpian & Steinberg, 2014). Six additional children were tested but were excluded from the final sample because they refused to complete the study. The children were mostly European American and represented a variety of socioeconomic backgrounds.

Materials and procedure. As in Studies 1 and 2, our main measures concerned children's tendency to draw ought inferences and to prefer inherent explanations. The order of these measures was counterbalanced across participants. Between the measures, the children completed a 1-min distractor task (coloring) that served to maintain their engagement and minimize interference between the two sets of questions.

Ought inferences. The children were read a mock newspaper featuring four facts familiar to young children (e.g., money is green; see p. 15 in the Supplemental Material at Open Science Framework, https://osf.io/4kanr/). After reading aloud a fact from the newspaper, the experimenter asked the children three ought questions pertinent to that fact: (a) whether the fact was good (answer options were "no," "sort of good," "good," and "really good"), (b) whether it was the way things should be (answer options were "yes" and "no"), and (c) whether it would be bad if things were otherwise (answer options were "no," "sort of bad," "bad," and "really bad"). (For the exact wording of these questions, see p. 16 in the Supplemental Material.) The order of the newspaper facts and the questions was counterbalanced across children. The children's responses to these questions were averaged across the four facts and then converted to a common scale from 0 to 1; higher scores indicated stronger ought intuitions. These question-specific averages were then averaged into a composite, α = .58; lowest item-total correlation = .52 (*M* = .66, *SD* = .23).

Inherence bias. We adapted a broad measure of children's explanatory preferences from prior work on this topic (Cimpian & Steinberg, 2014; Sutherland & Cimpian, 2015). The first item in this measure asked the children to evaluate inherent and extrinsic explanations for everyday patterns—for example, whether birthday cakes have candles "just because they are birthday cakes" (inherent) or "just because people thought it might be a nice idea" (extrinsic). The children used a 4-point scale to indicate their agreement with these explanations (1 = *really not right*, 2 = *sort of not right*, 3 = *sort of right*, 4 = *really right*).

The other items in this measure tapped intuitions that might follow inherent explanations. As discussed in the introduction, inherent explanations often make it appear that the phenomenon explained is necessary (rather than contingent). To assess these downstream intuitions about necessity, we asked the children

- whether observed facts are temporally stable (e.g., "Do you think birthday cakes will always have candles, even way into the future when the last birthday cake is made?"; answer options were "yes" and "no"),
- whether observed facts are inalterable (e.g., "Imagine if people wanted birthday cakes to not have candles, and everyone agreed that they wanted birthday cakes to not have candles. Would it be okay to make a change so that birthday cakes do not have candles or would it not be okay?"; answer options were "okay," "sort of not okay," "not okay," and "really not okay"), and
- whether words are inherently suited for their referents and thus could not be otherwise (e.g., when people were first coming up with the name for a candle, "could they have called it something else, like a 'diby' or a 'peara,' or did they have to call it a 'candle'?"; answer options were "had to" or "something else"; see Sutherland & Cimpian, 2015). (The children could indicate their answers to this question either verbally or nonverbally, by pointing to a body part; for a previous use of this procedure, see Cimpian & Park, 2014.)

Overall, the greater the inherence bias in children's explanations, the more they should think that a phenomenon being explained is temporally stable and inalterable. These questions were asked about two facts (namely, that birthday cakes have candles and that coins are round); these facts were different from those used for the ought measure. Both question order and fact order were counterbalanced across children. The children's answers to these questions (averaged across the two facts) were converted to a common scale from 0 to 1; higher scores indicated stronger inherence bias. These question-specific averages were then averaged into a composite, α = .60; lowest item-total correlation = .55 (*M* = .51, *SD* = .24).

Control measures. Our analyses included two control measures. First, we adjusted for the children's chronological age. The inherence bias in explanation declines somewhat with age (Cimpian & Steinberg, 2014), and if the same is true of ought inferences, then these two variables could correlate coincidentally, simply because they both happen to decline with age. Partialing out the children's age also serves to minimize the potential influence of other variables that change with development (e.g., working memory, inhibitory control). Second, because young children may be prone to say "yes" in response to complex questions of the sort we were asking, we included a measure of "yes" bias. Specifically, we embedded in the ought measure a question about whether the relevant patterns (e.g., money being green) were interesting (1 = *no*, 4 = *really interesting*). This question should be fairly opaque to 4- to 7-year-olds, so it should capture a tendency for children to say "yes" when they are unsure of an answer (M = 2.65, SD = 1.01). (Note, however, that several of the questions in the ought and inherence-bias measures were reverse-coded; thus, a "yes" bias would be an unlikely alternative for the predicted correlation even if we did not adjust for it.)

Results

Just as we found for the adults in Studies 1 and 2, the children with higher scores on the measure of inherence bias were also more likely to make ought inferences, $r(78)$ = .45, 95% CI = [.26, .61], $p < .001$. Moreover, this relationship was not due to coincidental changes with age or to a "yes" bias: Evidence for it was also found in a regression analysis that accounted for these two alternatives, β = 0.43, 95% CI = [0.21, 0.65], $p < .001$ (for full regression results, see Table 5; for the correlation matrix, see Table S4 in the Supplemental Material at Open Science Framework, https://osf.io/4kanr/). These results did not change (ps ≤ .024) when we used a narrower measure of children's explanations—namely, only the item that asked children to evaluate inherent explanations for everyday patterns.

Thus, the tendency to explain the world in inherent terms and the tendency to make ought inferences from observations of typical behavior appear to be linked even among preschoolers. Our last two studies tested whether this link was causal by manipulating adults' explanations (Study 4) and children's explanations (Study 5) and measuring subsequent changes in their is-to-ought reasoning.

Table 5. Results From Study 3: Multiple Regression Analysis Predicting Children's Ought Inferences From the Measure of Inherence Bias and the Control Variables (N = 80)

Predictor	β	t	p
Inherence bias	0.43	3.91	< .001
Chronological age	0.04	0.38	.708
"Yes" bias	0.14	1.30	.196
R^2 total	.223		

Study 4

Method

Participants. The participants were 267 adults (mean age = 30.5 years, SD = 12.9; 108 men, 158 women, 1 did not report gender) from Amazon's Mechanical Turk service or a university subject pool. Participants were compensated with $0.75 or course credit, respectively. An additional 26 subjects were tested but were excluded from the final sample because their IP addresses were from outside the United States (n = 3), because they failed our catch items (n = 21), or because they indicated during debriefing that they had not paid attention (n = 2).

Manipulation. We used a manipulation that has previously been found to lower the inherence bias in participants' explanations (Salomon & Cimpian, 2014). This manipulation consisted of a 10-item mock scale; its purpose was not to assess some construct or other but rather to temporarily alter participants' habitual thinking patterns (e.g., Bryan, Dweck, Ross, Kay, & Mislavsky, 2009). Participants were randomly assigned to either an anti-inherence condition (n = 132) or to a control condition (n = 135). The mock scale in the anti-inherence condition was designed to influence participants' explanatory intuitions by exposing them to strongly worded extrinsic explanations: for example, "We give flowers as gifts for a variety of occasions (e.g., Valentine's Day, funerals) because of effective advertising and marketing by florists—not because flowers effectively convey a variety of sentiments" or "The only reason our paper, money, and books are rectangular is historical happenstance." To maximize the influence of these extrinsic primes, we also used response scales that were skewed toward agreement (1 = *disagree*, 2 = *agree somewhat*, 3 = *agree*, 4 = *agree very strongly*). The mock scale in the control condition was matched in content but did not contain any explanations: for example, "People often give flowers as gifts on a variety of different occasions (e.g., Valentine's Day, funerals)" or "Most books, paper, and money are rectangular in shape."

Materials and procedure. After the manipulation, participants completed a brief distractor task (a "Where's Waldo?" game). They then filled out two measures, in random order: a check for the effectiveness of the manipulation (the Inherence Heuristic Scale; Salomon &

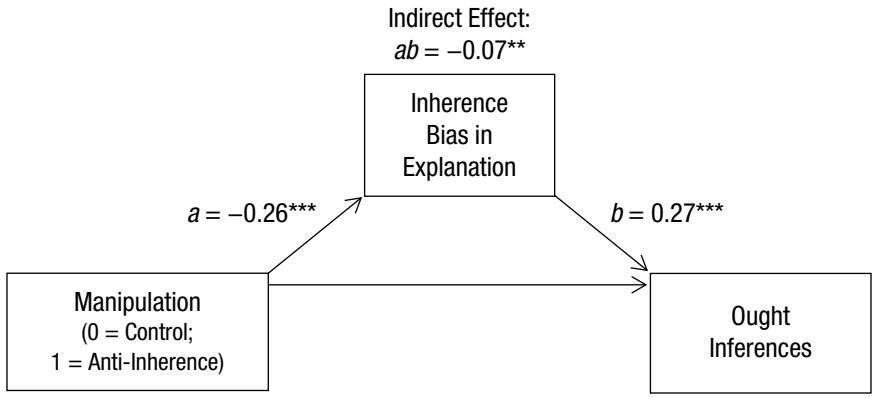

Fig. 2. Results from Study 4: the effect of the experimental manipulation on participants' ought inferences, as mediated by the inherence bias in their explanations. Asterisks indicate significant coefficients (**$p < .01$, ***$p < .001$).

Cimpian, 2014) and an ought measure, which was the same as in Study 1 ($\alpha = .63$; lowest item-total correlation = .46). At the end of the study, participants completed a demographics questionnaire and a debriefing.

Results

We predicted that our scale manipulation would lower the extent to which participants' explanations were biased toward inherence and, in turn, the likelihood that they would make ought inferences.

Manipulation check. Participants in the anti-inherence condition ($M = 5.64$, $SD = 1.23$) had lower scores on the Inherence Heuristic Scale than did participants in the control condition ($M = 6.28$, $SD = 1.18$), $t(265) = 4.29$, $p < .001$, $d = 0.53$. Thus, our manipulation appears to have been effective in reducing the inherence bias in participants' explanatory intuitions.[8]

Effect of the manipulation on ought inferences. In results consistent with our main prediction, participants in the anti-inherence condition ($M = 5.45$, $SD = 1.15$) also had lower scores on the ought measure than did participants in the control condition ($M = 5.78$, $SD = 1.19$), $t(265) = 2.24$, $p = .026$, $d = 0.27$. Next, we tested whether the manipulation's effect on participants' is-to-ought reasoning was mediated by its effect on their explanations. Indeed, this indirect effect was significant in a bootstrapped product-of-coefficients mediation analysis, $ab = -0.07$, 95% CI = [−0.12, −0.03], $SE = 0.02$ (see Fig. 2). In other words, participants' weaker ought inferences in the anti-inherence condition were due in part to their diminished preference for inherent explanations.

These results suggest that experimentally lowering the extent to which participants rely on inherent facts in their explanations also lowers the extent to which their inferences about how things should be are based on how things are. In the final study, we tested this causal link in a sample of 4- to 7-year-old children.

Study 5

Method

Participants. The participants were 48 children between 4 and 7 years old (mean age = 6.07 years, $SD = 1.21$; 24 girls, 24 boys) who were recruited from a small city in the midwestern United States. The children were demographically similar to those in Study 3. Seventeen additional children were tested but were excluded from the final sample because they refused to complete the study ($n = 6$) or failed a comprehension check ($n = 11$).

Manipulation. For a precise test of the causal link between explanation and ought inferences, we manipulated how children explained the very same facts about which we later asked them ought questions. (By comparison, the manipulation in the previous study was aimed at inherent explanations more globally.) For each of six familiar facts (e.g., that brides wear white at weddings), we first provided children with either an inherent explanation or an extrinsic explanation. The inherent explanations appealed to the inherent features of the entities in the phenomena to be explained (e.g., white is really bright), whereas the extrinsic explanations appealed to historical events and processes (e.g., an important queen wore white at her wedding, so then everyone started doing it; for the full text, see pp. 18–19 in the Supplemental Material at Open Science Framework, https://osf.io/4kanr/). This manipulation was within subjects: Three facts were given an inherent explanation, and three were given an extrinsic explanation. The three explanations of each type were presented as a block, and the

order of the inherent and extrinsic blocks was counterbalanced across children.

Main measures. After each explanation, the children were asked the following questions, in counterbalanced order: (a) the ought questions from Study 3 ("Is it good that. . . ?" "Is it the way things should be?" "Would it be bad if things were different?"; $\alpha = .58$; lowest item-total correlation = .59), and (b) the inalterability question from Study 3 ("If everyone agrees, can it be changed?"), which served as a brief manipulation check. Before each of these questions, the experimenter reminded the children of the relevant (inherent or extrinsic) explanation.

Attention and comprehension checks. To check that the children were paying attention and understanding the explanations, the experimenter asked them to recall the explanations immediately after hearing them and again after answering the ought and inalterability questions. If a child could not recall any portion of the explanation after three prompts by the experimenter, the child was excluded from the sample ($n = 11$).

Control measures. As before, we adjusted for participants' chronological age in our analyses. In addition, we adjusted for any superficial differences in the valence of the inherent and extrinsic explanations. If inherent explanations just happened to include more positive words or content than the extrinsic explanations, then the children might judge the corresponding patterns as "good," for example, for that very reason. To capture responses based on such shallow cues to positivity versus negativity, we created a shallow-cues measure by asking the children to rate how "fun" they thought each fact was on a 6-point scale (1 = *really not fun*, 6 = *really fun*; $M = 5.08$, $SD = 0.87$). These questions were asked at the very end of the sessions, and the children were briefly reminded of the relevant explanation for each fact before answering the question about fun. This question was administered to a random subset of the children ($n = 22$; mean age = 5.88 years, $SD = 1.08$; 11 girls, 11 boys).

Results

We predicted that extrinsic explanations (compared with inherent explanations) would lead the children to view the facts being explained as less necessary and inalterable, which would in turn weaken the children's tendency to make ought inferences.

Manipulation check. The children were less likely to judge the facts as inalterable when they heard extrinsic explanations ($M = .44$, $SD = .37$) than when they heard inherent explanations ($M = .54$, $SD = .42$), $t(47) = 2.21$, $p = .032$, $d = 0.25$. This difference also held up when we adjusted for the children's chronological age in a multilevel model with random intercepts for subjects and items (inherent = 0, extrinsic = 1), $\beta = -0.10$, 95% CI = [−0.18, −0.03], $p = .009$. Moreover, adjusting for both age and the shallow-cues measure in the subsample of children who received this question led to the same conclusion, $\beta = -0.12$, 95% CI = [−0.23, −0.01], $p = .036$. As in prior work (Cimpian & Steinberg, 2014), the children's intuitions about the immutability of observed facts decreased with age, $\beta = -0.40$, 95% CI = [−0.59, −0.21], $p < .001$. This relationship with age was also found when we adjusted for the shallow-cues measure, $\beta = -0.52$, 95% CI = [−0.72, −0.31], $p < .001$.

Effect on ought inferences. As predicted, the manipulation also affected the children's ought inferences: These inferences were weaker for facts explained extrinsically ($M = .66$, $SD = .26$) than for facts explained inherently ($M = .74$, $SD = .21$), $t(47) = 2.71$, $p = .009$, $d = 0.36$. This difference between inherent (0) and extrinsic (1) explanations remained significant when we adjusted for the children's age (in the full sample), $\beta = -0.15$, 95% CI = [−0.24, −0.06], $p = .001$, and when we jointly adjusted for the children's age and the shallow-cues measure (in the relevant subsample), $\beta = -0.13$, 95% CI = [−0.25, −0.002], $p = .046$. Note that the strength of the children's ought inferences also declined with age, $\beta = -0.28$, 95% CI = [−0.46, −0.09], $p = .003$. This relationship with age was found again when we adjusted for the shallow-cues measure, $\beta = -0.32$, 95% CI = [−0.56, −0.07], $p = .010$.

Finally, we tested whether the effect of the explanation manipulation on children's ought inferences was mediated by its effect on their intuitions about necessity. A bootstrapped product-of-coefficients multilevel mediation model that also included the children's age as a covariate found evidence for the predicted indirect effect, $ab = -0.06$, 95% CI = [−0.12, −0.01], $SE = 0.03$ (see Fig. 3). This indirect effect remained significant when we added the shallow-cues measure to the model as a covariate, $ab = -0.05$, 95% CI = [−0.13, −0.01], $SE = 0.03$. Thus, extrinsic explanations weakened the children's ought inferences in part because they also weakened their tendency to view the phenomena explained as necessary and immutable.

The results of Study 5 suggest that explanatory biases might play an important role in the development of children's sociomoral reasoning and may lead them to attach "shoulds" and "oughts" to an overly broad range of observed behavioral patterns.

General Discussion

We proposed that the inherence bias in everyday explanations (e.g., Cimpian & Salomon, 2014a, 2014b) leads people to view what is typical as also being good and desirable.

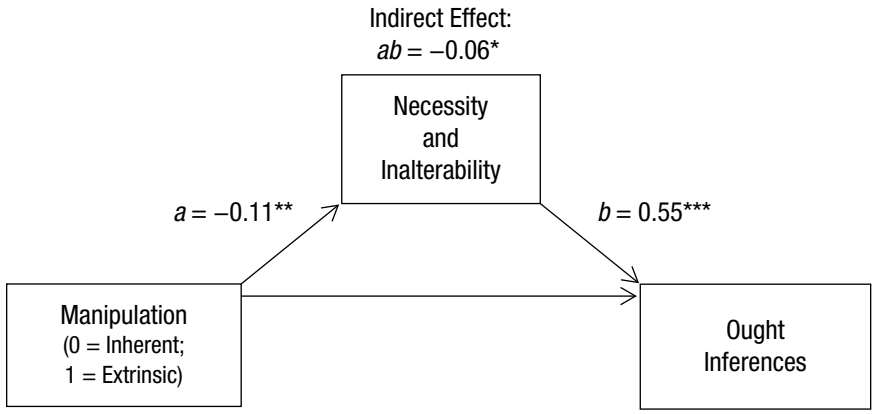

Fig. 3. Results from Study 5: the effect of the experimental manipulation on the children's ought inferences, as mediated by their intuitions about necessity and inalterability. Asterisks indicate significant coefficients (*$p < .05$, **$p < .01$, ***$p < .001$).

Five studies provided correlational and experimental evidence for this proposal in both children and adults. These results provide new mechanistic insight into the tendency to reason from "is" to "ought," and they also identify a previously unexplored source of sociomoral value.

This work connects meaningfully with other research in moral psychology. For instance, our studies suggest that people move seamlessly from factual judgments to value-based judgments, which is consistent with prior evidence of continuity between nonmoral and moral reasoning (e.g., Cushman & Young, 2011; Knobe, 2010; Shtulman & Tong, 2013). The link between explanatory biases and sociomoral judgments may also suggest answers to open questions in the developmental literature. We might predict, for example, that individual differences in children's inherence bias track individual differences in how children draw the distinction between social-conventional and moral violations (e.g., Smetana et al., 2012): The stronger this bias, the more likely children might be to imbue social-conventional regularities with quasimoral force. In adults, individual differences in reliance on inherent explanations could provide new insight into why some people value tradition and custom more than other people do (e.g., Eidelman & Crandall, 2014) and why loyalty and respect for authority are central to sociomoral judgment for some people more than for others (e.g., Graham et al., 2013). Such areas of overlap further highlight the theoretical contribution of these studies.

In conclusion, the present research uncovers the psychological origins of an inferential pattern that has preoccupied moral philosophers since Hume (1740/2000). According to our evidence, the tendency to assign value to what is typical is due in part to a systematic bias in the process of explanation. Given that explanations fundamentally determine how people understand the world they inhabit, the influence of a bias in these judgments on people's sociomoral evaluations may be substantial.

Action Editor

Ralph Adolphs served as action editor for this article.

Author Contributions

C. M. Tworek and A. Cimpian designed the study concept and the experiments. C. M. Tworek performed the data collection and analysis. C. M. Tworek drafted the manuscript, and A. Cimpian provided critical revisions. Both authors approved the final version of the manuscript for submission.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Open Practices

All data and materials have been made publicly available via Open Science Framework and can be accessed at https://osf.io/4kanr/. The plan for Study 2 was registered at Aspredicted.org and can be accessed at https://aspredicted.org/public/205223581.pdf. The complete Open Practices Disclosure for this

article can be found at http://pss.sagepub.com/content/by/supplemental-data. This article has received badges for Open Data, Open Materials, and Preregistration. More information about the Open Practices badges can be found at https://osf.io/tvyxz/wiki/1.%20View%20the%20Badges/ and http://pss.sagepub.com/content/25/1/3.full.

Notes

1. Alternatively, this could be a Burkean argument about the value of institutions that have withstood the test of time (Burke, 1790/2012).
2. "Is"-to-"ought" inferences are sometimes confused with the *naturalistic fallacy* (Moore, 1903/2004), which is the (conceptually distinct) assumption that what is natural is also good.
3. Roughly, inherent facts are those that, if changed, would lead to a change in the object itself (e.g., the color of a rose or its thorns, but not where it is sold or who owns it).
4. In this case, an inherent fact about roses (i.e., their appearance) is used to explain an extrinsic fact about them (i.e., they are given for Valentine's Day). The converse is also possible, as well as using inherent facts to explain inherent facts and extrinsic facts to explain extrinsic facts. However, the facts used to explain may be inherent more often than is warranted.
5. In principle, explaining via an inherent feature (e.g., the beauty of roses) could highlight counterfactual possibilities (e.g., many things are beautiful), making the phenomenon being explained seem contingent, not necessary. However, these counterfactual possibilities are unlikely to be spontaneously generated because intuitive, heuristic reasoning tends to operate only with the entities that are most salient in the moment (e.g., Kahneman, 2011; Legrenzi, Girotto, & Johnson-Laird, 1993; Spiller, 2011).
6. It is the inherent nature of the *explanation* for a fact—not of the fact itself—that is hypothesized to influence the likelihood of ought inferences.
7. In this study, the prevalence contrast between typical and atypical behaviors was sharp: Most people perform the typical behaviors we asked about, and few people perform the atypical behaviors. In another study, we found that a weaker prevalence contrast did not give rise to the hypothesized interaction between explanatory biases and behavior typicality in predicting ought inferences (for details, see pp. 13–14 in the Supplemental Material).
8. The anti-inherence condition operates in part by putting people in an analytic mind-set (i.e., by making them less likely to trust the first explanation that comes to mind). For instance, Salomon and Cimpian (2014, Study 4) found that participants in the anti-inherence condition (compared with those in the control condition) were significantly less likely to agree with statements such as "People who follow their gut instincts when trying to explain something usually get it right." This greater skepticism in turn predicted lower endorsement of inherent explanations.

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