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# The Inherence Heuristic as a Source of Essentialist Thought

Erika Salomon<sup>1</sup> and Andrei Cimpian<sup>1</sup>

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## Abstract

Humans are essentialists: They believe hidden “essences” underlie membership in natural and social kinds. Although essentialism has well-established implications for important societal issues (e.g., discrimination), little is known about its origins. According to a recent proposal, essentialism emerges from a broader inherence heuristic—an intuitive tendency to explain patterns in terms of the inherent properties of their constituents (e.g., we have orange juice for breakfast [pattern] because citrus aromas [inherent feature] wake us up). We tested two predictions of this proposal—that reliance on the inherence heuristic predicts endorsement of essentialist beliefs, even when adjusting for potentially confounding variables (Studies 1 and 2), and that reducing reliance on the inherence heuristic produces a downstream reduction in essentialist thought (Studies 3 and 4). The results were consistent with these predictions and thus provided evidence for a new theoretical perspective on the cognitive underpinnings of psychological essentialism.

## Keywords

psychological essentialism, inherence heuristic, stereotyping, prejudice, heuristics and biases

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When asked about his being Jewish on a recent episode of National Public Radio’s *Fresh Air*, actor Dustin Hoffman responded, “I do feel my ethnicity . . . I love borscht. I think I understand what Jewish humor means. And I have a penchant for vodka. I’m a Jew, I think, in my bones” (Gross & Hoffman, 2013). Hoffman’s phrasing reveals hints of a phenomenon known as *psychological essentialism*, the common assumption that membership in natural and social categories (e.g., tigers, gold, women) is determined by possession of some internal, microstructural property—an *essence* (e.g., Bloom, 2004; Dar-Nimrod & Heine, 2011; Gelman, 2003; Haslam, Rothschild, & Ernst, 2000; Medin & Ortony, 1989; Rhodes & Gelman, 2009). This essence is assumed to be responsible not only for membership in the category but also for possession of the features typically associated with that category. For instance, Hoffman expresses a prototypical bit of essentialist reasoning by suggesting that features such as *loving borscht* and *having a penchant for vodka* arise not from exposure to social influences (e.g., he had an Eastern European grandmother who most likely cooked borscht) but rather from a mysterious essence that resides deep within his bones.

As illustrated by this example, essentialism can lead to a number of intuitions about social groups: For example, that they are homogeneous (e.g., Jewish people share a common sense of humor), that they are natural parts of our world (e.g., Jewishness is “in the bones” rather than a product of culture),

and that they have sharp boundaries (e.g., you are either a Jew or not a Jew). In turn, stronger endorsement of these essentialist intuitions has been linked to stronger endorsement of stereotypes (e.g., Bastian & Haslam, 2006; Levy, Stroessner, & Dweck, 1998), greater acceptance of racial inequities (Williams & Eberhardt, 2008), and more blatant prejudice toward members of minority groups (e.g., Haslam, Rothschild, & Ernst, 2002; Keller, 2005; for reviews, see Dar-Nimrod & Heine, 2011; Haslam & Whelan, 2008).

Despite the evidence that essentialism may be at the root of these important phenomena, little work has investigated what gives rise to essentialism itself and, relatedly, to the variability in individuals’ endorsement of essentialist beliefs (e.g., Bastian & Haslam, 2006; Keller, 2005). Because the consensus among scientists seems to be that the categories essentialized by humans do not actually possess essences (e.g., Leslie, 2013; Maglo, 2011; Needham, 2011; Sober, 1994), it is unlikely that essentialism is a “discovery” people make about the world. Yet, it also does not appear that humans are born essentialists. Rather, current theorizing on the origins of psychological essentialism suggests that it

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might emerge from antecedent cognitive processes that coalesce into an essentialist framework over the course of development (e.g., Gelman, 2003). Building on this theorizing, Cimpian and Salomon (2014, in press) proposed that essentialist thought emerges from a broader *inherence heuristic* whose output about natural and social kinds is gradually elaborated into full-blown essentialist beliefs.

The present studies investigate this novel proposal by testing two predictions that follow from it. First, we tested whether individual differences in people's endorsement of intuitions arising from this inherence heuristic predict individual differences in people's endorsement of essentialist beliefs. Second, we tested whether reducing reliance on the intuitions supplied by the inherence heuristic leads to a corresponding reduction in endorsement of essentialist beliefs, as might be expected if this heuristic provided the foundation for essentialism.

### The Inherence Heuristic

From a young age, humans have a powerful drive to understand the world (e.g., Gelman, 2003; Gopnik, 1998; Murphy & Medin, 1985; Ross, 1977; Weiner, 1985). Consequently, noticing a pattern in one's environment (e.g., orange juice is usually had for breakfast) often prompts thoughts about *why* things are so. The inherence heuristic is a basic cognitive process that supplies quick, effortless responses to such questions, responses that often appeal to the *inherent features* of the entities that make up the relevant patterns (Cimpian & Salomon, 2014, in press). This (over)reliance on inherent features occurs because, similar to other heuristics, the inherence heuristic only makes use of information that is readily called to mind, which often turns out to be information about the stable, constitutive properties of the entities under consideration (e.g., McRae, Cree, Seidenberg, & McNorgan, 2005). In principle, however, there is no rational basis for systematically preferring inherence-based explanations over ones that recruit extrinsic (e.g., historical, cultural) forces. Thus, the inherence heuristic biases our explanatory judgments because it, like other heuristics, leads to a *question substitution* (Kahneman, 2011; Kahneman & Frederick, 2002): Without realizing it, people actually answer a different, easier question than the one they set out to answer. Specifically, in their search for a quick means of fulfilling their drive to understand, people end up answering not "What explains this pattern?" but the more tractable "What inherent features explain this pattern?"

Next, we describe in more detail the process underlying the inherence heuristic. This process begins with a shallow memory search, followed by a phase in which the retrieved information is integrated into an intuitive explanation, which, finally, is perfunctorily checked for plausibility and often accepted without further thought. To elaborate, the first step is memory retrieval: As soon as one wonders about the reason for a pattern (e.g., why is orange juice for breakfast?),

potentially relevant information is rapidly activated (e.g., Gilovich, Griffin, & Kahneman, 2002; Kahneman, 2011). Importantly, this information often consists of only the most highly accessible relevant facts. More precisely, this shallow memory search will often end up retrieving only the stable, enduring features of the pattern's constituents (e.g., orange juice has vitamin C and a refreshing smell) that are tightly bound up with these entities' representation in semantic memory (e.g., McRae et al., 2005; Murphy, 2004; Rosch & Mervis, 1975). These stable aspects of the relevant entities' constitution are what we define as *inherent features*. That is, the inherent features of an entity are the features it is believed to possess simply by virtue of the way that entity is; they are the features that collectively describe its constitution (Lewis, 1983).<sup>1</sup> Another simple way to think about inherent features is that they are the features of an entity that if changed, would produce an actual change in that entity. For example, changing the nutritional content of orange juice (an inherent feature) would cause a change in orange juice itself; however, changing whether it is sold in cartons or bottles (an extrinsic feature) would not. This definition of inherence includes a wide range of perceptual (e.g., is orange, has a refreshing smell) and non-perceptual (e.g., has vitamin C, is healthy) features but excludes any facts that involve entities other than the one under consideration (e.g., is kept in the fridge, is sold in cartons). Note that the inherent features invoked by our account are not the essences described in the literature on psychological essentialism: These inherent features (e.g., orange juice's refreshing smell) are not necessarily internal, non-obvious, and microstructural. Neither are these inherent features thought to define membership in the relevant category or to be the sole source of the category's other features.

As may already be apparent, information about extrinsic (e.g., historical or cultural) forces that might be responsible for the pattern are likely to be neglected in this rapid search for an explanation. This is so for several reasons. To begin, information about extrinsic factors is usually less *familiar* than information about inherent features. For example, most of us may be unaware of an orange crop surplus in the early 20th century (see Laszlo, 2007). However, even when such information is available, it is likely neither as *salient* nor as *accessible* as information about inherent properties. This is so partly because we encounter extrinsic facts only on occasion. Each time we drink orange juice, for example, we perceive its color and flavor but we may not learn or recall facts about its history, thereby leading to greatly unequal exposure frequency for inherent and extrinsic information. Because frequency of exposure increases retrieval speed (e.g., Doshier, 1984), inherent facts may be more rapidly accessible than extrinsic ones.

After the memory search phase, the heuristic organizes the available information into a "story" that explains the pattern. To do so, this stage of the heuristic makes opportunistic use of any available explanatory notions that can quickly

integrate the information at its disposal into a plausible explanatory intuition. For example, one might conclude that orange juice is a morning drink because the refreshing, citrusy aroma of orange juice wakes us up. The goal of this stage is to cobble together a sensible explanatory story as fast as possible, so it will typically settle on any such story it happens to generate first, relying on the rapidly accessed inherent information and terminating as soon as a plausible explanation is generated.

Finally, these quick-and-easy explanatory intuitions will tend to be accepted without much scrutiny. Across a wide range of circumstances, people tend to endorse any plausible answer that comes to mind rather than striving for accuracy with every single judgment (e.g., Epley & Gilovich, 2006; Gilovich et al., 2002; Kahneman, 2011; Stanovich, 2011). However, just as with other heuristics, it is likely that there are substantial individual differences in the extent to which people accept the output of the heuristic (e.g., Epley & Gilovich, 2006; Stanovich & West, 2000). For example, people with greater cognitive abilities or more reflective cognitive styles may be more likely to override the typical output of the heuristic—among other things, they may be more motivated to produce accurate judgments and thus to scrutinize the first thought that comes to mind.

### The Link Between the Inherence Heuristic and Essentialism: The Present Studies

In the present research, we investigated two hypotheses derived from our proposal that essentialism emerges as an elaboration of the inherence heuristic's output. Specifically, we hypothesized that (a) individual variability in reliance on the intuitions supplied by the inherence heuristic would explain the widespread individual differences in endorsement of essentialist beliefs (e.g., Bastian & Haslam, 2006; Keller, 2005; Williams & Eberhardt, 2008), and that (b) reducing reliance on the inherence heuristic would in turn lead to reduced endorsement of essentialist beliefs. Before spelling out these hypotheses in more detail, we provide a brief description of the proposal that motivated them.

Although here we are concerned with the relationship between the inherence heuristic and essentialism in adults, our predictions stem from a theoretical account of the development of essentialist beliefs. Cimpian and Salomon (2014, in press) proposed that essentialism emerges over development as an elaboration of the intuitions supplied by the inherence heuristic. When children try to make sense of an observed pattern (e.g., why girls wear pink), they may often lack the necessary knowledge or skill to construct a full-fledged explanation. Instead, they may be left with the vague intuition that *some* of the inherent facts retrieved from memory must explain the pattern. Over time, however, children's vague inherent intuitions may be fleshed out into essentialist beliefs using other relevant knowledge. To illustrate, children

may combine intuitions stemming from the inherence heuristic with preexisting beliefs about *insides* as a general causal force that enables movement and maintains life (e.g., Newman, Herrmann, Wynn, & Keil, 2008; Setoh, Wu, Baillargeon, & Gelman, 2013). By way of such enrichment processes, the early inherence-based notion that there must be some feature of girls and/or pink that explains their pairing may ultimately develop into the essentialist belief that girls prefer pink because they have certain internal, essential features.

According to this proposal, the inherence heuristic is part of the process by which each of us constructs essentialist beliefs over the course of development. This is not to say, however, that the end state of development with respect to essentialism is the same for everyone: There is, for instance, considerable evidence that essentialist beliefs vary in strength across people (e.g., Bastian & Haslam, 2006; Keller, 2005; Williams & Eberhardt, 2008). The question then arises as to whether this variation is predictable on the basis of individuals' susceptibility to the inherence heuristic. If our general account of the origins of essentialism is correct, it seems plausible to expect that the extent to which one engages in inherence-based thinking would influence the extent to which one ultimately endorses essentialist beliefs. Therefore, individual differences in susceptibility to the inherence heuristic should be significantly correlated with individual differences in adults' essentialist reasoning. This is our first prediction.

We could, however, make an even stronger, causal prediction concerning the link between the two phenomena in adulthood. Although essentialist beliefs have already formed by this point in development, it is possible that their endorsement still depends to some degree on the strength of the inherence-based intuitions out of which these beliefs were previously elaborated. If so, any weakening of the inherence-based foundation for essentialist beliefs might in turn make them seem less sensible. Thus, our second prediction is that experimentally undermining the appeal of inherence-based intuitions should also lower endorsement of essentialist beliefs.

Consistent with these predictions, we found that adults' essentializing was strongly and uniquely predicted by their inherence-based reasoning (Studies 1 and 2) and that priming participants with extrinsic explanations reduced their reliance on the inherence heuristic, which in turn lowered their endorsement of essentialist beliefs (Studies 3 and 4). All data reported in this paper are archived at <http://thedata.harvard.edu/dvn/dv/IH-Ess>.

### Study 1

In this study, we tested whether reliance on the inherence heuristic predicts endorsement of essentialist beliefs. Each participant completed measures of inherence-based reasoning and essentialism, as well as one of three sets of control

**Table 1.** The 15 Items of the Inherence Heuristic Scale, Plus the 4 “Catch” Items.

	M (Study 1)	Factor loadings
Inherence Heuristic Scale items		
1. It seems natural to use red in a traffic light to mean “stop.”	7.26	.72
2. It seems natural for parents and children to sleep in separate beds.	7.17	.46
3. It seems natural that engagement rings typically have diamonds.	5.35	.75
4. There are good reasons why dollar bills are green.	4.82	.52
5. There are good reasons why we don’t keep chipmunks as pets.	6.37	.32
6. There are good reasons why orange juice is typically consumed for breakfast.	5.78	.53
7. It seems right that pink is the color typically associated with girls.	5.35	.71
8. It seems right to use white for wedding dresses.	6.28	.74
9. It seems right that black is the color associated with funerals.	6.31	.62
10. It seems ideal that toothpaste is typically flavored with mint.	6.47	.49
11. It seems ideal that there are 7 days in a week.	6.38	.66
12. It seems ideal that weekends consist of Saturday and Sunday.	6.15	.74
13. If intelligent organisms were discovered on another planet, they would probably have two arms and two legs.	3.98	.47
14. If intelligent organisms were discovered on another planet, they would probably have eyes and ears.	5.40	.42
15. If intelligent organisms were discovered on another planet, they would probably communicate through sounds.	5.70	.41
Catch items		
1. It seems right to kill other people for fun.	1.08	
2. It seems natural to stand on one’s head.	1.99	
3. It seems ideal for hotel rooms to have bathrooms.	8.61	
4. If intelligent organisms were discovered on another planet, they would probably reproduce.	7.42	

Note. Items are rated with 9-point Likert-type scales and scored positively. The catch items are used to exclude participants who exhibit signs of inattention or response sets. The first two catch items are designed to elicit *disagree* responses. The last two catch items are designed to elicit *agree* responses. Participants who answer two or more catch items incorrectly should be excluded from further analyses. Factor loadings are drawn from the confirmatory factor analysis described in the Method of Study 1.

scales measuring (a) cognitive style, (b) cognitive ability and flexibility, or (c) system justification tendencies. These variables are plausible sources of individual differences in endorsement of both inherence-based intuitions (as we argued above) and essentialist beliefs (e.g., Keller, 2005; Levy et al., 1998). However, if our proposal is correct and the inherence heuristic is indeed the foundation for essentialism, the heuristic should predict essentialism above and beyond these control variables.

## Method

**Participants.** Participants ( $N = 323$ ;  $M_{age} = 27$ ; 123 men, 200 women) were recruited from three sources: a university undergraduate subject pool, a university paid subject pool, and Amazon’s Mechanical Turk service. Participants received partial course credit, US\$5, or US\$0.75, respectively, for participation. Thirty-seven additional participants were tested but excluded for having non-U.S. IP addresses (16 participants) or for failing to pay attention (21 participants; see description of the Inherence Heuristic Scale for more details).

**Materials.** The 11 scales used in Study 1 were as follows.

**Inherence Heuristic Scale.** A 15-item scale was designed to tap the varied explanatory intuitions produced by the inherence heuristic (see Table 1 for items). For example, if someone thinks that the inherent qualities of orange juice and breakfast explain their association, this person might also agree that it is *natural*, *right*, or even *ideal* for orange juice to be consumed for breakfast. These ideas are easily expressed in short, comprehensible sentences that can be applied to readily observable patterns. We thus created 12 items using 4 stems: “It seems natural . . .”; “It seems right . . .”; “It seems ideal . . .”; and “There are good reasons why . . .” Three additional items tap a related inherence-based intuition: If a pattern is thought to be due to the inherent features of its constituents rather than mutable historical factors, it will also be assumed to be nearly universal. These three items all begin with the stem, “If intelligent organisms were found on another planet, they would probably . . .”

Because the scale items are all positively coded, four additional “catch” items were created to identify participants who failed to pay attention or exhibited response sets (e.g.,

acquiescence). These items were designed to elicit either strong disagreement (e.g., “It seems right to kill other people for fun”) or strong agreement (e.g., “It seems ideal for hotel rooms to have bathrooms”). Participants who answer in the unexpected direction (at or past the midpoint) on more than one of these items are likely to be paying little attention to the task or to be systematically agreeing or disagreeing. Twenty-one participants were excluded for this reason.

All items were scored using a 9-point Likert-type scale (1 = *disagree strongly*, 9 = *agree strongly*) and were presented in a random order.

**Construct validation.** Our scale asks participants about their beliefs that patterns are natural, ideal, right, and so on, because items such as these, using concrete examples and simple language, are easier to understand and rate than items we might construct expressing endorsement of the inherence heuristic as an abstract principle (such as, “Patterns in the world are best explained through the inherent features of their constituents”). However, it is important to demonstrate that endorsement of our items indeed varies as a function of inherence-based reasoning. Thus, we recruited 35 Mechanical Turk participants for a construct validation study consisting of two tasks.

In one of the tasks, participants were simply asked to judge whether they agreed or disagreed with our scale items (forced choice) and then to justify their answer for each item. The logic of this validation task was as follows: If our scale taps inherence-based explanatory intuitions, as we claim it does, then participants who agree with the items in the scale should justify their agreement mostly by referring to inherent facts (e.g., orange juice is refreshing). Conversely, disagreement with the items in our scale should be justified most often with extrinsic considerations (e.g., orange juice for breakfast is just a convention). Two raters blind to agreement coded the justifications for evidence of inherence-based reasoning (e.g., “Red is a warning sign in nature” for the item concerning stop signs being red; Cohen’s  $\kappa = .72$ ) and extrinsic reasoning (e.g., “We have learned that red means stop so I feel this is why red means stop”; Cohen’s  $\kappa = .73$ ). Because participants’ responses could theoretically incorporate both types of reasoning or neither, these codes were assigned independently. The results of this task provided clear validation of the link between our scale and inherence-based reasoning. When participants agreed, their justifications showed evidence of inherent reasoning an average of 84% of the time but only showed evidence of extrinsic reasoning 11% of the time,  $t(34) = 16.43$ ,  $p < .001$ ,  $d = 4.92$  [3.94, 5.90].<sup>2</sup> Participants showed the opposite pattern when they disagreed, giving extrinsic justifications on average 38% of the time and inherent justifications only 8% of the time,  $t(33) = -5.60$ ,  $p < .001$ ,  $d = -1.37$  [-1.92, 0.83].<sup>3</sup>

In the other validation task, we tested whether naive participants share our intuition that people who endorse inherent explanations for the relevant patterns would agree more strongly with our scale items than people who endorse extrinsic explanations for the same patterns. For each item,

participants read about (a) a character who believed that the relevant pattern was due to the *inherent features* of the pattern’s constituents (e.g., “Albert believes that engagement rings typically have diamonds because of something about engagement rings or about diamonds—maybe diamonds’ rarity and value is a match for the value of romantic love”) and (b) a different character who believed that *extrinsic reasons* best explain the pattern (e.g., “Dave believes that engagement rings typically have diamonds because of some historical or contextual reason—maybe a major marketing campaign is responsible for the association of diamonds with romantic love”). Participants were then asked to predict how the characters (e.g., Albert and Dave) would answer the relevant scale item (e.g., “It seems natural that engagement rings typically have diamonds”). The questions were blocked such that participants read all of the inherent explanations first followed by the extrinsic explanations or vice versa. The order of questions within blocks was randomized. The results again validated the content of our scale: Participants predicted that characters who endorse inherence-based explanations would agree more strongly with our items ( $M = 7.40$ ,  $SD = 1.08$ ) than would characters who endorse extrinsic explanations ( $M = 5.23$ ,  $SD = 1.65$ ),  $t(34) = 6.70$ ,  $p < .001$ ,  $d = 1.56$  [1.00, 2.11]. This difference held up for each of the 15 items considered individually,  $t_s(34) > 2.86$ ,  $p_s \leq .007$ .

In summary, these tests provide two forms of evidence supporting the use of our scale items to measure reliance on the inherence heuristic. First, people who agree with our items overwhelmingly cite inherent justifications and extrinsic ones relatively rarely, whereas those who disagree show the opposite pattern. Second, people who are naive to our research program share our intuition that these scale items are more strongly endorsed by those who believe that patterns are best explained by referring to inherent properties rather than extrinsic forces.

**Factor structure.** To test the assumption that our scale measures a single construct, we recruited 230 additional participants from Mechanical Turk. (Another 10 participants were tested but excluded for non-U.S. IP addresses, catch-item responses, or missing data.) We conducted a confirmatory factor analysis using a correlated uniqueness model in which the items beginning with the same sentential frames (e.g., “It seems natural that . . .”) were allowed to have correlated error variances to account for the common method variance they potentially share (see Kenny & Kashy, 1992; Marsh, 1989).

We evaluated the fit of our model in relation to Hu and Bentler’s (1999) two conditions: (a) The value of the standardized root mean squared residual (SRMR; Bentler, 1995) should be close to .08 (or lower), and (b) the value of a fit index such as the Comparative Fit Index (CFI; Bentler, 1990) should be close to .95 (or higher). Our model showed good fit to the data: SRMR = .04 and CFI = .97. In addition, the value of the root mean square error of approximation (RMSEA), .050, is also conventionally viewed as reflecting good fit (e.g., MacCallum, Browne, & Sugawara, 1996;

Steiger, 2007). Note, however, that the test against the saturated model was significant,  $\chi^2(75, N = 230) = 117.37, p = .001$ . All of the items except for one (“There are good reasons why we don’t keep chipmunks as pets”) had factor loadings of .40 or higher (see Table 1). Removing the item with a low factor loading did not affect the results of further analyses, so all analyses are reported using the entire 15-item scale. In sum, these results suggest that the Inherence Heuristic Scale measures a single theoretical construct: reliance on inference-based explanations.

**Discriminant validity with essentialism.** Our scale was designed so as to avoid content overlap with psychological essentialism: Its items do not ask about the various facets of essentialist thought (e.g., Haslam et al., 2000), nor about internal, microstructural essences. There is little overlap with essentialism even at the level of the objects/entities it asks about: Orange juice, funerals, weekends, and so on are not usually construed in essentialized terms (e.g., Gelman, 2003). However, we conducted two formal tests to empirically assess the discriminant validity of our scale with essentialism: one assessing whether our scale and various essentialism scales are better modeled with separate latent variables (as we would predict), and a second assessing whether the Inherence Heuristic Scale and essentialism have unique relationships with a relevant criterion.

For the first test, we predicted that the structure of the relationship between the Inherence Heuristic Scale and measures of essentialism would be better represented by two distinct latent constructs than by a single factor. We asked the 230 participants in our factor analysis sample to also complete three measures of essentialism: one adapted from Haslam et al. (2000; described below), the Lay Theory of Race Scale (No et al., 2008), and an essentialism scale developed by Rhodes and Gelman (2009). (The latter two scales are described more fully in the Methods of Studies 2a and 2b, respectively.) We compared two structural equation models: one in which the correlation between the inference heuristic latent variable (with the 15 scale items as observed variables) and the essentialism latent variable (with the averages of the three essentialism scales as observed variables) was constrained to 1 (the *constrained model*) and another in which their correlation was free to vary (the *default model*; Widaman, 1985). These models differed significantly in their fit,  $\Delta\chi^2(\Delta df = 1, N = 230) = 8.08, p = .005$ . The default model (SRMR = .05, CFI = .95, RMSEA = .053) demonstrated better fit than the constrained model (SRMR = .07, CFI = .94, RMSEA = .055). This analysis thus provides evidence that our scale measures a different construct than the essentialism scales.

For the second test, we predicted that the Inherence Heuristic Scale and a measure of essentialism would show different relationships with a measure of intuitive thinking. The inference heuristic relies on fast, intuitive processes, and people who score high on our scale should be those who also prefer intuitive thinking styles in general. Essentialism,

however, is a more crystalized belief system about the nature of categories—something learned or built over many years rather than intuitively constructed on the spot. To test whether intuitive thinking would have a stronger correlation with the Inherence Heuristic Scale than with a measure of essentialism, we collected data from an additional sample of 278 Mechanical Turk workers (30 additional participants were excluded for non-U.S. IP addresses or catch-item responses). We asked these participants to complete the Inherence Heuristic Scale, the Lay Theory of Race Scale (No et al., 2008), and a version of the Cognitive Reflection Test (CRT; Frederick, 2005; see also Chandler, Mueller, & Paolacci, 2013; Finucane & Gullion, 2010). The CRT is a well-validated measure of heuristic thinking (e.g., Liberali, Reyna, Furlan, Stein, & Pardo, 2011; Toplak, West, & Stanovich, 2011) that consists of three problems with obvious intuitive—but incorrect—answers.<sup>4</sup> Consistent with our predictions, we found that participants who scored highly on the Inherence Heuristic Scale got more problems wrong on the CRT,  $r(276) = -.22 [-.33, -.11], p < .001$ . However, there was no relationship between essentialism scores and number of CRT problems solved,  $r(276) = -.08 [-.20, .04], p = .179$ . These two correlation coefficients were significantly different,  $z = 2.28, p = .025$  (using Lee & Preacher’s, 2013, test for dependent correlations; see also Steiger, 1980). That is, the Inherence Heuristic Scale and a common essentialism scale showed discriminant relationships with a relevant criterion.

**Essentialism Scale.** As a dependent measure in this study, we adapted an essentialism scale from Haslam et al. (2000). The scale asked participants to rate the extent to which 12 social categories exhibit five facets of essentialism (randomly ordered; Table 2 provides exact wording of the scale prompts). Each prompt was presented on a single page with all 12 categories in a random order. Higher ratings indicated more essentialist responses. The 12 categories were chosen to represent a variety of social dimensions (e.g., race/ethnicity: Asians; religion: Catholics; occupation: musicians). Participants’ scores on the Essentialism Scale consisted of their average rating across all 60 items (5 essentialism dimensions  $\times$  12 categories).

**Control Scales.** Three sets of control scales were selected to measure three possible confounding variables. Example items and scoring methods for these scales (except Raven’s Progressive Matrices) are given in Table 3.

First, three scales were selected to assess *cognitive style*. People with a less complex cognitive style may exhibit both greater reliance on the inference heuristic (because it is a fast, intuitive process) and stronger psychological essentialism of social categories (e.g., Keller, 2005; Levy et al., 1998; Roets & Van Hiel, 2011). To address the possibility that cognitive style accounts for the hypothesized relationship between the inference heuristic and essentialism, we included three measures of cognitive style: the Need for

**Table 2.** Prompts From the Essentialism Scale Used in Studies 1 and 4, Assessing Five Dimensions of Essentialism.**1. Uniformity**

Some categories contain members who are very similar to one another; they have many things in common. Members of these categories are relatively uniform. Other categories contain members who differ greatly from one another and do not share many characteristics. Please rate the following categories on this dimension.

**2. Informativeness**

Some categories allow people to make many judgments about their members; knowing that an individual belongs to the category tells us a lot about that individual. Other categories only allow a few judgments about their members; knowledge of membership is not very informative. Please rate the following categories on this dimension.

**3. Underlying Reality**

Some categories have an underlying reality; although their members have similarities and differences on the surface, underneath, they are basically the same. Other categories also have similarities and differences on the surface but do not correspond to an underlying reality. Please rate the following categories on this dimension.

**4. Innateness**

Some traits are biologically predisposed. Genes determine whether a person displays a certain trait. Other traits are shaped by the environment. The environment in which a person grows up affects whether the person displays a certain trait. Please rate the traits of the members of the following categories on this dimension.

**5. Stability**

Some traits are stable over time. They do not change much through a person's life. Other traits are less stable. They change substantially over time. Please rate the traits of the members of the following categories on this dimension.

*Note.* Participants in Study 1 were asked to rate 12 social categories on each of these dimensions: Asians, athletes, Catholics, girls, messy people, musicians, optimists, poor people, schizophrenics, shy people, smart people, and vegetarians. Participants in Study 4 were asked to rate four social categories on each of these dimensions: Asians, Catholics, girls, and poor people. Items were adapted from Haslam, Rothschild, and Ernst (2000).

Cognition (Cacioppo, Petty, & Kao, 1984), Need for Closure (Kruglanski, Webster, & Klem, 1993), and Attributional Complexity (Fletcher, Danilovics, Fernandez, Peterson, & Reeder, 1986) Scales.

Second, three scales were selected to assess *cognitive ability and flexibility*. General intelligence, creativity, and the ability to think counterfactually may provide some of the cognitive resources necessary to reconsider and possibly discard the intuitions supplied by the inherence heuristic (Stanovich & West, 2000). It is also possible that cognitive ability and flexibility influence psychological essentialism. Recent evidence suggests, for example, that creativity is negatively related to essentialism (Tadmor, Chao, Hong, & Polzer, 2013). To rule out the possibility that the relationship between the inherence heuristic and essentialism is due to cognitive ability/flexibility, we measured this dimension with three scales. First, we created a shortened version of Raven's Progressive Matrices (Raven, 1960), an intelligence test that requires participants to determine which figure will complete a pattern. We sampled 12 items from the original test that varied in difficulty and gave participants 1 min to complete each. Pilot data revealed that participants were, on average, correct on 43% of the sampled items. This measure was scored by summing the number of correct items. As the second and third measures in this set, we included a creativity scale (the Creative Personality Checklist; Gough, 1979) and a measure of counterfactual thinking (Stanovich & West, 1997).

Finally, three scales were selected to assess *system-justifying tendencies* (e.g., Jost, Banaji, & Nosek, 2004). People who are motivated to justify current societal arrangements (such as differences between social groups in wealth and power) may also be more likely to both (a) accept the

intuition that patterns observed within one's society are due to the inherent features of the entities involved (leading to inherent thinking) and (b) believe that social groups have causal, microstructural essences (leading to essentialist thinking; for example, Keller, 2005). To address the possibility that system-justifying ideologies may account for the potential relationship between the inherence heuristic and essentialist reasoning, we included three scales assessing the tendency to defend the status quo: the Belief in a Just World (Rubin & Peplau, 1975), Social Dominance Orientation (Pratto, Sidanius, Stallworth, & Malle, 1994), and Right-Wing Authoritarianism (Altemeyer, 2006) Scales.

**Procedure.** Twenty-four participants completed a paper-and-pencil version of the measures; the rest were tested online via Qualtrics (Qualtrics Labs Inc., Provo, UT). To prevent fatigue due to the large number of measures, each participant was assigned to receive only one of the three sets of control scales, forming three subsamples: cognitive style (106 participants), cognitive ability and flexibility (105 participants), and system justification (112 participants). The scales were presented in a random order, and question order was randomized for all scales except for Raven's Progressive Matrices, which was presented in order of increasing item difficulty. After completing the test scales, participants completed a demographics questionnaire and a funnel debriefing.

## Results and Discussion

*The link between the inherence heuristic and essentialism.* Consistent with our prediction that participants who are more likely to reason inherently about patterns in the world should

**Table 3.** Control Scales From Study 1 With Sample Items and Scoring Methods.**Cognitive Style****Need for Cognition**

I find satisfaction in deliberating hard and for long hours.

Learning new ways to think does not excite me very much. (R)

Scoring: Mean of 18 Likert-type scale items (1 = disagree strongly, 9 = agree strongly)

**Need for Closure**

I enjoy having a clear and structured mode of life.

I would describe myself as indecisive. (R)

Scoring: Mean of 42 Likert-type scale items (1 = disagree strongly, 9 = agree strongly)

**Attributional Complexity**

I really enjoy analyzing the reasons or causes for people's behavior.

I am not really curious about human behavior. (R)

Scoring: Mean of 28 Likert-type scale items (1 = disagree strongly, 9 = agree strongly)

**Cognitive Ability and Flexibility****Raven's Progressive Matrices (see description in text)****Creative Personality Checklist**

Inventive

Conventional (R)

Scoring: Difference between number of positively and negatively coded items checked

**Counterfactual Thinking**

My beliefs would not have been very different if I had been raised by a different set of parents. (R)

Even if my environment (family, neighborhood, schools) had been different, I probably would have the same religious views. (R)

Scoring: Mean of two Likert-type scale items (1 = disagree strongly, 9 = agree strongly)

**System Justification****Social Dominance Orientation**

Some groups of people are simply not the equal of others.

In an ideal world, all nations would be equal. (R)

Scoring: Mean of 14 semantic differential items (1 = very negative, 9 = very positive)

**Belief in a Just World**

By and large, people deserve what they get.

Good deeds often go unnoticed and unrewarded. (R)

Scoring: Mean of 20 Likert-type scale items (1 = disagree strongly, 9 = agree strongly)

**Right-Wing Authoritarianism**

Women should have to promise to obey their husbands when they get married.

Gays and lesbians are just as healthy and moral as anybody else. (R)

Scoring: Mean of 20 Likert-type scale items (1 = disagree strongly, 9 = agree strongly)

Note. The items marked with an (R) were reverse scored.

also be more likely to demonstrate psychological essentialism, the bivariate correlation between the Inherence Heuristic Scale and the Essentialism Scale was significant,  $r(321) = .39$  [.29, .48],  $p < .001$ . This relationship was also significant in the cognitive style,  $r(104) = .38$  [.20, .53],  $p < .001$ ; cognitive ability and flexibility,  $r(103) = .38$  [.20, .53],  $p < .001$ ; and system justification,  $r(110) = .40$  [.23, .55],  $p < .001$ , subsamples. Given the lack of content overlap between the two scales (one was about toothpaste, weekends, and so on, whereas the other was about athletes, schizophrenics, and so on), this result provides strong evidence for a link between the inherence heuristic and essentialist thinking.

Most importantly, the Inherence Heuristic Scale remained a significant predictor of essentialism scores in regression analyses using the three sets of control scales (see Table 4).

That is, the Inherence Heuristic Scale predicted essentialism even when adjusting for the three cognitive style variables,  $\beta = .40$  [.20, .58],  $p < .001$ ; the three cognitive ability/flexibility variables,  $\beta = .33$  [.14, .50],  $p = .001$ ; or the three system justification variables,  $\beta = .40$  [.22, .61],  $p < .001$  (see Table 4). Thus, the inherence heuristic predicts essentialism even when cognitive style, cognitive ability/flexibility, or system justification tendencies are accounted for.<sup>5</sup>

Below, we discuss the relationships between our scale and the control variables. For brevity, we discuss only the significant results. Full correlation results are presented in Table 5.

**Cognitive style subsample.** Consistent with the argument that the inherence heuristic is a quick, effortless process, scores on the Inherence Heuristic Scale were negatively related to scores

**Table 4.** Regression Analysis Predicting Essentialism From the Inherence Heuristic and Control Variables in Study 1.

Predictor	$\beta$	<i>t</i>	<i>p</i>	$r_{XY.123}$
<b>Cognitive Style Subsample</b>				
Inherence Heuristic	.40***	3.98	<.001	.37***
Need for Cognition	.03	0.32	.750	.03
Need for Closure	-.06	-0.63	.529	-.06
Attributional Complexity	-.11	-1.03	.307	-.10
$R^2$ total	.159			
<i>F</i>	4.76**			
<i>N</i>	106			
<b>Cognitive Ability and Flexibility Subsample</b>				
Inherence Heuristic	.33**	3.52	.001	.33**
Raven's Progressive Matrices	-.21*	-2.20	.030	-.22*
Creative Personality Checklist	.10	1.05	.296	.11
Counterfactual Thinking	<.01	0.01	.989	<.01
$R^2$ total	.193			
<i>F</i>	5.96***			
<i>N</i>	105			
<b>System Justification Subsample</b>				
Inherence Heuristic	.40***	4.25	<.001	.38***
Social Dominance Orientation	.28**	3.11	.002	.29**
Belief in a Just World	-.01	-0.14	.885	-.01
Right-Wing Authoritarianism	-.03	-0.33	.741	-.03
$R^2$ total	.232			
<i>F</i>	8.08***			
<i>N</i>	112			

Note.  $r_{XY.123}$  = correlation between the relevant predictor and the Essentialism Scale after partialling out the variance attributable to all the other predictors.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 5.** Inter-Correlations Among the Scales in Study 1.

Scale	1	2	3	4	5	6	7	8	9	10	11
1. ESS <sup>a</sup>	(.86)	.39***	-.15	.02	-.13	-.29**	.06	-.08	.29**	.08	.20*
2. IH <sup>a</sup>		(.85)	-.36***	.17 <sup>†</sup>	-.11	-.28**	-.05	-.15	.06	.27**	.36***
3. COG <sup>b</sup>			(.92)	-.06	.43***	—	—	—	—	—	—
4. CLO <sup>b</sup>				(.80)	-.14	—	—	—	—	—	—
5. AC <sup>b</sup>					(.92)	—	—	—	—	—	—
6. RPM <sup>c</sup>						(.60)	.09	.12	—	—	—
7. CPC <sup>c</sup>							(.62)	-.08	—	—	—
8. CFT <sup>c</sup>								(.50)	—	—	—
9. SDO <sup>d</sup>									(.89)	-.02	.34***
10. BJW <sup>d</sup>										(.76)	.25**
11. RWA <sup>d</sup>											(.93)

Note. Values on the diagonal represent Cronbach's alphas. ESS = Essentialism; IH = Inherence Heuristic; COG = Need for Cognition; CLO = Need for Closure; AC = Attributional Complexity; RPM = Raven's Progressive Matrices; CPC = Creative Personality Checklist; CFT = Counterfactual Thinking; SDO = Social Dominance Orientation; BJW = Belief in a Just World; RWA = Right-Wing Authoritarianism.

<sup>a</sup>*N* = 323.

<sup>b</sup>*N* = 106.

<sup>c</sup>*N* = 105.

<sup>d</sup>*N* = 112.

<sup>†</sup> $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

on the Need for Cognition Scale,  $r(104) = -.36 [-.52, -.18], p < .001$ . This relationship suggests that people who prefer effortful cognitive activities are generally less likely to endorse the output of the inference heuristic. Similarly, the correlation between the Inference Heuristic and the Need for Closure Scales was positive, but only marginally significant,  $r(104) = .17 [-.02, .35], p = .090$ . That is, people who seek simple, clear explanations for things may also be somewhat more likely to accept the kinds of intuitions supplied by the inference heuristic.

**Cognitive ability and flexibility subsample.** Scores on the Inference Heuristic Scale were negatively related to scores on Raven's Progressive Matrices,  $r(103) = -.28 [-.45, -.09], p = .004$ . This result suggests that participants with greater cognitive resources may be less likely to rely on inference-based reasoning.

**System justification subsample.** Scores on the Inference Heuristic Scale were positively related to two of the system justification scales, Belief in a Just World,  $r(110) = .27 [.09, .43], p = .004$ , and Right-Wing Authoritarianism,  $r(110) = .36 [.19, .51], p < .001$ . This result is consistent with the possibility that those who seek to justify the social order are also more likely to accept the intuition that observed patterns are explained by inherent features.

## Summary

In line with our main prediction, the findings suggested that psychological essentialism is strongly and uniquely predicted by inference-based reasoning: Our new Inference Heuristic Scale predicted participants' endorsement of essentialist beliefs above and beyond three sets of control scales and correlated in the predicted manner with cognitive style, cognitive ability/flexibility, and system-justifying ideologies.

In Study 2, we address two alternative explanations for this relationship. First, it is possible that the essentialism scale we used in Study 1 had, for whatever reason, a unique relationship with our Inference Heuristic Scale. Thus, in Study 2 we tested whether these results would replicate even if we chose different operationalizations of essentialism. Second, it is possible that people who tend to conform to social conventions or to subordinate their opinions to others would be more likely to agree both with the items on our Inference Heuristic Scale (e.g., that parents and children should sleep in different beds) and with conventional, essentialist ideas about social categories (e.g., that differences between race/ethnicity groups are stable and innate). Thus, in Study 2, we tested whether the relationship between inference-based reasoning and essentialist beliefs can be explained by this third variable, social conventionality.

## Study 2

In Study 1, participants' reliance on the inference heuristic uniquely predicted their endorsement of essentialist beliefs.

Study 2 extended this finding with two goals. First, we investigated whether the relationship between the inference heuristic and essentialism generalizes across measures of essentialism. To test this, we asked two samples of participants to complete the Inference Heuristic Scale and one of two additional measures of essentialism: the Lay Theory of Race Scale (No et al., 2008; Study 2a) and an essentialism scale developed by Rhodes and Gelman (2009; Study 2b). Second, we sought to establish that the relationship between the inference heuristic and essentialism does not reflect participants' social conventionality or willingness to simply go along with others' opinions or demands. Thus, we included two new sets of control variables selected to adjust for this potential confound.

## Study 2a Method

**Participants.** Participants ( $N = 107$ ;  $M_{age} = 34$ ; 60 men, 47 women) recruited from Amazon's Mechanical Turk service were paid US\$0.75 for participation. Thirteen additional participants were tested but excluded for having non-U.S. IP addresses (2 participants) or for giving more than 1 "incorrect" answer on the catch items (11 participants).

**Materials.** The five scales used in this study were as follows.

**Inference Heuristic Scale.** The Inference Heuristic Scale was presented as in Study 1.

**Essentialism.** In this study, we used the Lay Theory of Race Scale (No et al., 2008) as a measure of psychological essentialism. This scale consists of eight items expressing either essentialist (e.g., "A person's race is something very basic about them and it can't be changed much") or anti-essentialist (e.g., "Racial categories are fluid, malleable constructs" [reverse scored]) beliefs about racial categories rated on a 9-point Likert-type response scale (1 = *disagree strongly*, 9 = *agree strongly*). This scale differed substantially from the one used in Study 1, in that it asked participants to rate only racial categories considered in the abstract (rather than a broader range of specific social categories, such as athletes or Catholics) and included reverse-coded items (rather than having only positively scored items).

**Control Scales.** Study 2a used three control scales. The first was the Conformity Scale (Mehrabian & Steffl, 1995), which consists of 11 items (3 reverse coded) expressing the tendency to subjugate one's preferences and behavior to the opinions of others (e.g., "I often rely on, and act upon, the advice of others"), rated on a 9-point Likert-type response scale (1 = *disagree strongly*, 9 = *agree strongly*). In addition to this measure, we included as controls the two best predictors of psychological essentialism from Study 1 (other than the Inference Heuristic Scale): Raven's Progressive Matrices and Social Dominance Orientation. This set of control

**Table 6.** Regression Analysis Predicting Lay Theory of Race (Essentialism) From the Inherence Heuristic and Control Variables in Study 2a.

Predictor	$\beta$	$t$	$p$	$r_{XY.123}$
Inherence Heuristic	.24*	2.56	.012	.25*
Raven's Progressive Matrices	-.12	-1.28	.203	-.13
Social Dominance Orientation	.24*	2.62	.010	.25*
Conformity	-.04	-0.48	.630	-.05
$R^2$ total	.172			
$F$	5.29**			
$N$	107			

Note.  $r_{XY.123}$  = Correlation between the relevant predictor and the Lay Theory of Race Scale after partialling out the variance attributable to all the other predictors.

\* $p < .05$ . \*\* $p < .01$ .

**Table 7.** Inter-Correlations Among the Scales in Study 2a.

Scale	1	2	3	4	5
1. Lay Theory of Race (Essentialism)	(.80)	.31**	-.20*	.30**	-.03
2. Inherence Heuristic		(.88)	-.20*	.19 <sup>†</sup>	.12
3. Raven's Progressive Matrices			(.65)	-.13	.10
4. Social Dominance Orientation				(.93)	.00
5. Conformity					(.84)

Note.  $N = 112$ . Values on the diagonal represent Cronbach's alphas.

<sup>†</sup> $p < .10$ . \* $p < .05$ . \*\* $p < .01$ .

variables afforded a stringent test of the hypothesized relationship between the inherence heuristic and essentialism.

**Procedure.** All participants completed the survey on Qualtrics. Scales were randomly ordered, as were questions for all scales except for Raven's Progressive Matrices, which was presented in order of increasing item difficulty. After completing the test scales, participants completed a demographic questionnaire and a funnel debriefing.

### Study 2a Results

Consistent with our proposal, the Inherence Heuristic Scale significantly predicted scores on No et al.'s (2008) measure of race essentialism,  $r(105) = .31$  [.13, .47],  $p = .001$ . When entered into a regression with the three control variables, the Inherence Heuristic Scale remained a significant predictor of essentialism,  $\beta = .24$  [.05, .43],  $p = .012$  (Table 6; see Table 7 for full correlation matrix). That is, people's reliance on the inherence heuristic predicts their levels of essentialism even

when accounting for participants' tendency to go along with others' opinions and controlling for two measures selected for their strong relationship with essentialism.

### Study 2b Method

**Participants.** Participants ( $N = 111$ ;  $M_{age} = 35$ ; 52 men, 59 women) recruited from Amazon's Mechanical Turk service were paid US\$0.75 for participation. Thirteen additional participants were tested but excluded for non-U.S. IP addresses (five participants) or for giving more than one "incorrect" answer on the catch items (eight participants).

**Materials.** The five scales used in this study were as follows.

**Inherence Heuristic Scale.** The Inherence Heuristic Scale was presented as in Study 1.

**Essentialism.** In this study, we used the gender and ethnicity forms of the scale developed by Rhodes and Gelman (2009) as a measure of essentialism. The gender form has eight items expressing essentialist beliefs about gender categories (e.g., "Knowing someone's gender tells you a lot about a person") rated on a 9-point Likert-type response scale (1 = *disagree strongly*, 9 = *agree strongly*). The ethnicity form consists of seven parallel items where "gender" is replaced by "ethnicity." (The last two items on the gender form are collapsed into a single item on the ethnicity form.) Like the scale used in Study 2a, this scale asks about general ethnicity categories (rather than the specific categories used in Study 1). However, the inclusion of a gender form means that it is not restricted to essentialism of just one sort of social category.

**Control Scales.** Study 2b used three control scales, all of which measured aspects of social conventionality, submission, or subordination of the self to others. The first was Right-Wing Authoritarianism, which includes a substantial conventionality component (e.g., "The 'old-fashioned ways' and the 'old-fashioned values' still show the best way to live"). This scale also exhibited the highest correlation with the Inherence Heuristic Scale in Study 1, which makes it a strong control. Second, we selected an additional measure of authoritarianism, the Group Authoritarianism Scale (Stellmacher & Petzel, 2005). This scale consists of 12 statements (half reverse scored) expressing conventionalism (e.g., "Sometimes a group member may counteract group rules" [reverse scored]), aggression against transgressors (e.g., "A group member who has violated group rules should be punished severely"), and submission to authority (e.g., "Instructions of group leaders should be obeyed under all circumstances") rated on 9-point Likert-type response scales (1 = *strongly disagree*, 9 = *strongly agree*). Third, we asked participants to complete the Socially Desirable Responding Scale (Crowne & Marlowe, 1960). This scale consists of 33

**Table 8.** Regression Analysis Predicting Essentialism From the Inherence Heuristic and Control Variables in Study 2b.

Predictor	$\beta$	$t$	$p$	$r_{XY.123}$
Inherence Heuristic	.35**	3.44	.001	.32**
Right-Wing Authoritarianism	.27**	2.65	.009	.25**
Group Authoritarianism	-.09	-0.84	.402	-.08
Socially Desirable Responding	-.07	-0.75	.458	-.07
$R^2$ total	.236			
$F$	8.18***			
$N$	111			

Note.  $r_{XY.123}$  = Correlation between the relevant predictor and the Essentialism Scale (Rhodes & Gelman, 2009) after partialling out the variance attributable to all the other predictors.

\*\* $p < .01$ . \*\*\* $p < .001$ .

*yes/no* response items constructed such that although one response is most likely true, the other response has a much higher social desirability. For example, although most people might want to be seen as someone who could respond *yes* to “I am always courteous, even to people who are disagreeable,” it is unlikely that any person is *always* courteous in the face of rude behavior. The Socially Desirable Responding Scale was scored by calculating the proportion of items answered in the socially desirable direction.

**Procedure.** All participants completed the survey on Qualtrics. Scales were randomly ordered, as were questions for all scales. After completing the test scales, participants completed a demographics questionnaire and a funnel debriefing.

### Study 2b Results

Consistent with our proposal, the Inherence Heuristic Scale significantly predicted scores on Rhodes and Gelman’s (2009) measure of essentialism,  $r(109) = .43$  [.27, .57],  $p < .001$ . When entered into a regression with the three conventionality controls, the Inherence Heuristic Scale remained a significant predictor of essentialism,  $\beta = .35$  [.15, .56],  $p < .001$  (Table 8; see Table 9 for full correlation matrix). That is, the inherence heuristic predicts essentialism even when several measures of social conventionality are accounted for.

### Discussion

Study 2 demonstrated that the relationship between the inherence heuristic and psychological essentialism holds across two new operationalizations of essentialism. Moreover, this predicted relationship was not explained by social conventionality or willingness to subjugate oneself to others’ opinions. These results thus provide further evidence in support of the hypothesis that individual differences in

**Table 9.** Inter-Correlations Among the Scales in Study 2b.

Scale	1	2	3	4	5
1. Essentialism Scale	(.90)	.43***	.38***	.20*	.06
2. Inherence Heuristic		(.88)	.47***	.48***	.16 <sup>†</sup>
3. Right-Wing Authoritarianism			(.96)	.44***	.28**
4. Group Authoritarianism				(.87)	.16
5. Socially Desirable Responding					(.83)

Note.  $N = 111$ . Values on the diagonal represent Cronbach’s alphas.

<sup>†</sup> $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

reliance on the inherence heuristic are uniquely predictive of individual differences in endorsement of essentialist beliefs.

### Study 3

Studies 1 and 2 demonstrated that reliance on the inherence heuristic strongly predicts essentialist thinking. This evidence is consistent with our proposal that essentialism emerges as an elaboration of the output of the inherence heuristic. However, at the core of this proposal is a causal claim for which the evidence so far cannot provide direct support: namely, that the inherence heuristic provides the foundation on which essentialist beliefs are constructed. A simple prediction that follows from this proposal is that if we were able to experimentally weaken people’s reliance on the inherence heuristic, the essentialist framework supported by this heuristic foundation should in turn become weaker. Thus, in Study 3, we tested whether prompting participants to question their inherence-oriented explanatory impulses would lead to a corresponding decrease in their endorsement of essentialist beliefs.

In this experiment, half of the participants filled out a “scale” (in reality, a manipulation) that required them to rate their agreement with *extrinsic* explanations for 10 societal patterns. For example, one item read, “The fact that longer clothing (e.g., pants, gowns) is seen as more formal than shorter clothing (e.g., shorts, miniskirts) is only a convention, and the opposite trend (shorter = more formal) could’ve been implemented just as easily.” For participants in this *anti-inherence* condition, the act of processing and evaluating these explanations might highlight the insufficiency of inherence-based explanations. The other half of the participants were assigned to a *control* condition in which the “scale” items simply described the same societal patterns (e.g., “Clothing that is longer in length [e.g., pants, gowns] is viewed as more formal than clothing that is shorter in length [e.g., shorts, miniskirts]”). The key prediction was as follows: If there is a link between the inherence heuristic and essentialist beliefs, then there should be a significant indirect effect of the experimental manipulation on participants’ endorsement of essentialist beliefs through the manipulation’s effect on

inherence-based reasoning. We did not, however, make strong predictions regarding the *total* effect of the manipulation on essentialism: In principle, it is possible that unobserved indirect paths are operating in the direction opposite to our prediction (i.e., increasing essentialism), which would cause the total effect to become non-significant (for discussion of this statistical point, see Hayes, 2009; Rucker, Preacher, Tormala, & Petty, 2011). For instance, the anti-inherence scale might threaten participants' sense of belonging to a stable, orderly social system, which might in turn lead them to cling to their essentialist beliefs as an ideological antidote (e.g., Kay, Jost, & Young, 2005). Because it is infeasible to measure and partial out all such possible indirect paths, we limit our predictions to the presence of an indirect effect on essentialism via inherence.

## Method

**Participants.** Participants ( $N = 512$ ;  $M_{age} = 34$ ; 195 men, 317 women) recruited from Amazon's Mechanical Turk service were paid US\$0.75 for participation. Forty seven additional participants were tested but excluded for having non-U.S. IP addresses (8 participants), for giving more than 1 "incorrect" answer on the catch items (36 participants), or for indicating in the debriefing that they did not pay attention during the study (3 participants).

**Materials.** Participants completed the following tasks.

**Manipulation.** Participants were randomly assigned to either an anti-inherence or a control condition (adapted from Hussak & Cimpian, 2014). Participants in both conditions were asked about their agreement with 10 statements (presented in a fixed order) about patterns in the world. Critically, however, for participants in the anti-inherence condition, the scale items gave extrinsic explanations for these patterns (e.g., "The only reason our paper, money, and books are rectangular is historical happenstance"). The response scale was skewed toward agreement (1 = *disagree*, 2 = *agree somewhat*, 3 = *agree*, 4 = *agree very strongly*), thereby encouraging participants to endorse statements that explain patterns in extrinsic terms (for a similar strategy, see Bryan, Dweck, Ross, Kay, & Mislavsky, 2009). Participants in the control condition used this scale to indicate their agreement with items that simply affirmed the existence of the same patterns (e.g., "Most books, paper, and money are rectangular in shape"). To encourage deeper encoding, we asked all participants to justify their responses.

**Check for analytic versus heuristic thinking.** We argued that the anti-inherence condition should lower participants' reliance on the quick-and-easy intuitions supplied by the inherence heuristic. To check whether this condition did in fact put participants in a more analytic "mood," we asked them to rate their agreement with three items: (a) "People who

follow their gut instincts when trying to explain something usually get it right"; (b) "It's important to always question your assumptions when you think about why the world is a certain way"; and (c) "When you try to make sense of the world, you can make big mistakes if you just go with the first thought that comes to mind." Responses were marked on 9-point Likert-type scales (1 = *strongly disagree*, 9 = *strongly agree*).

**Inherence Heuristic Scale.** The Inherence Heuristic Scale was presented as in Study 1.

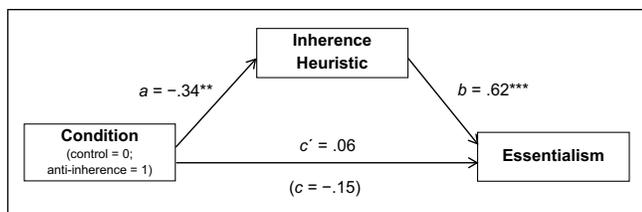
**Essentialism Scale.** Participants completed the ethnicity and gender forms of the Rhodes and Gelman (2009) Essentialism Scale, as described in Study 2b. We used this scale because it provided a good balance between breadth (it covers both race and gender) and length (it consists of only 15 items).

**Procedure.** Participants were randomly assigned to fill out either the anti-inherence or the control scale. Next, they completed a picture-search distractor task, which lasted 60 s, followed by the check for analytic versus heuristic thinking. Participants then completed the Inherence Heuristic Scale and the Essentialism Scale (randomly ordered). The order of items within the scales was randomized. Finally, participants completed a demographics questionnaire and a funnel debriefing.

## Results and Discussion

**Check for analytic versus heuristic thinking.** The three analytic versus heuristic check items did not form a reliable composite index ( $\alpha = .50$ ; average inter-item correlation =  $.25$ ); thus, we analyzed them separately. A MANOVA on these items uncovered a significant multivariate effect of condition, Wilks's  $\Lambda = 0.98$ ,  $F(3, 508) = 3.07$ ,  $p = .028$ . Follow-up univariate analyses revealed that only one item differed significantly across conditions: perhaps not coincidentally, the item that asked explicitly about *explanations* ("People who follow their gut instincts when trying to explain something usually get it right"). As predicted, participants in the anti-inherence condition ( $M = 5.64$ ,  $SD = 1.74$ ) expressed less confidence in explanatory "gut instincts" than did participants in the control condition ( $M = 6.04$ ,  $SD = 1.63$ ),  $F(1, 510) = 7.49$ ,  $p = .006$ ,  $d = 0.24$  [0.07, 0.42].<sup>6</sup> Also as predicted, lower endorsement of this item was accompanied by lower scores on the Inherence Heuristic Scale,  $r(510) = .26$  [.18, .34],  $p < .001$ . In sum, these results provide some support for the claim that our anti-inherence manipulation undermined the general appeal of quick heuristic explanatory intuitions.

**Effect on the inherence heuristic.** In line with our predictions, participants in the anti-inherence condition ( $M = 5.43$ ,  $SD = 1.28$ ) had lower scores on the Inherence Heuristic Scale than



**Figure 1.** Mediation model predicting essentialism from control versus anti-inherence condition and reliance on the inference heuristic (Study 3).

Note.  $c$  = total effect.  $c'$  = direct effect.

\*\* $p < .01$ . \*\*\* $p < .001$ .

those in the control condition ( $M = 5.77$ ,  $SD = 1.26$ ),  $t(510) = 3.00$ ,  $p = .003$ ,  $d = 0.27$  [0.09, 0.44]. Thus, exposure to a series of strongly worded extrinsic explanations, embedded in what was ostensibly a scale, proved to be a successful strategy for (at least temporarily) reducing participants' reliance on the inference heuristic.

**Indirect effect on essentialism via the inference heuristic.** Essentialism scores were lower in the anti-inherence condition ( $M = 5.45$ ,  $SD = 1.61$ ) than in the control condition ( $M = 5.60$ ,  $SD = 1.44$ ). However, this difference (i.e., the total effect) did not reach significance,  $t(510) = 1.13$ ,  $p = .259$ ,  $d = 0.10$  [−0.07, 0.27].

Recall, however, that our key prediction concerned whether the manipulation would lower participants' endorsement of essentialist beliefs *through a reduction in their inherent reasoning*. This indirect effect was in fact significant in a bootstrapped (10,000 samples) product-of-coefficients mediation analysis,  $ab = -0.21$ , standard error ( $SE$ ) = 0.07, bias-corrected confidence interval ( $CI$ ) = [−0.36, −0.08] (Figure 1). That is, participants in the anti-inherence condition showed reduced reliance on the inference heuristic, which *in turn* led them to show reduced essentialist thinking.

## Summary

Participants who had to process and evaluate a series of extrinsic explanations for societal patterns exhibited less reliance on the inference heuristic. This reduction in inherent thinking produced a downstream effect on participants' endorsement of essentialist beliefs. This is consistent with our proposal that the inference heuristic is a cognitive foundation for psychological essentialism. In Study 4, we investigated whether these findings would hold for a different operationalization of essentialism.

## Study 4

Study 3 provided initial support for our argument that inherent thinking promotes the adoption of essentialist beliefs. In

Study 4, we sought further evidence for this claim with a study that replicated the design of Study 3 with two key changes. First, we included a more reliable measure of participants' preference for analytic versus heuristic explanations to provide a better test of the manipulation's influence on this variable. Second, we sought again to demonstrate that the relationship between inherent thinking and essentialism is stable across measures of essentialism and so used a different measure of essentialism than that used in Study 3.

## Method

**Participants.** Participants ( $N = 516$ ;  $M_{age} = 33$ ; 206 men, 310 women) recruited from Amazon's Mechanical Turk service were paid US\$0.75 for participation. Thirty-six additional participants were tested but excluded for having duplicate or non-U.S. IP addresses (10 participants) or for giving more than one "incorrect" answer on the catch items (26 participants).

**Materials.** Participants completed the following tasks.

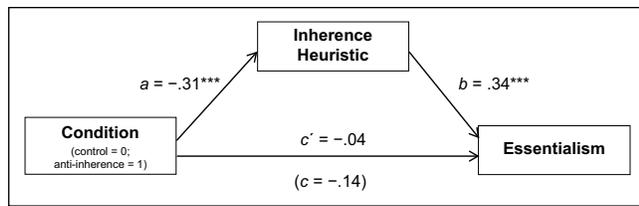
**Manipulation.** Participants were randomly assigned to the same *anti-inherence* and *control* conditions as in Study 3.

**Check for analytic versus heuristic thinking.** To more reliably assess participants' reliance on heuristic versus analytic processes when explaining, we asked participants to rate their agreement with three closely matched statements: (a) "People who follow their gut instincts when trying to explain something usually get it right," (b) "When it comes to figuring out why things are a certain way, people's initial feelings tend to point in the right direction," and (c) "The best reasons for things often come when people go with their intuitions." Responses were marked on 9-point Likert-type scales (1 = *strongly disagree*, 9 = *strongly agree*).

**Inherence Heuristic Scale.** The Inherence Heuristic Scale was presented as in Study 1.

**Essentialism Scale.** Participants completed the same essentialism scale used in Study 1 (see Table 2) but with 4 (rather than 12) categories: Asians, Catholics, girls, and poor people. We reduced the number of categories to lessen fatigue for participants due to the overall length of the study.

**Procedure.** Participants were randomly assigned to fill out either the anti-inherence or the control scale. Next, they completed a picture-search distractor task, which lasted 60 s, followed by the check for analytic versus heuristic thinking. Participants then completed the Inherence Heuristic Scale and the Essentialism Scale (randomly ordered). The order of items within the scales was randomized. Finally, participants completed a demographics questionnaire and a funnel debriefing.



**Figure 2.** Mediation model predicting essentialism from control versus anti-inherence condition and reliance on the inherence heuristic (Study 4).

Note.  $c$  = total effect.  $c'$  = direct effect.

\*\*\* $p < .001$ .

## Results and Discussion

**Check for analytic versus heuristic thinking.** The revised analytic versus heuristic items in Study 4 showed much higher reliability than those in the previous study ( $\alpha = .86$ ; average inter-item correlation = .68). Thus, we computed an average score on the three items for each participant. As expected, participants in the anti-inherence condition ( $M = 5.77$ ,  $SD = 1.51$ ) scored lower on this measure than did participants in the control condition ( $M = 6.12$ ,  $SD = 1.40$ ),  $t(514) = 2.76$ ,  $p = .006$ ,  $d = 0.24$  [0.07, 0.42], indicating that participants in the anti-inherence condition exhibited less trust in their intuitions as a source of explanations. In addition, the less participants trusted intuitive explanations, the lower were their scores on the Inherence Heuristic Scale,  $r(514) = .36$  [.28, .43],  $p < .001$ .

**Effect on the inherence heuristic.** As predicted, participants in the anti-inherence condition had lower scores on the Inherence Heuristic Scale ( $M = 5.58$ ,  $SD = 1.27$ ) than those in the control condition ( $M = 5.89$ ,  $SD = 1.25$ ),  $t(515) = 2.81$ ,  $p = .005$ ,  $d = 0.25$  [0.07, 0.42]. As in Study 3, exposure to extrinsic explanations in the anti-inherence condition reduced participants' reliance on the inherence heuristic.

**Indirect effect on essentialism via the inherence heuristic.** Consistent with Study 3, Essentialism scores were lower in the anti-inherence condition ( $M = 4.55$ ,  $SD = 1.11$ ) than in the control condition ( $M = 4.69$ ,  $SD = 1.08$ ), although this difference (i.e., the total effect) did not reach significance,  $t(514) = 1.49$ ,  $p = .137$ ,  $d = 0.13$  [-0.04, 0.30].

Our key prediction, however, was again that the manipulation would lower participants' endorsement of essentialist beliefs through a reduction in their inherent reasoning. As in the previous study, this indirect effect was in fact significant in a bootstrapped (10,000 samples) product-of-coefficients mediation analysis,  $ab = -0.11$ ,  $SE = 0.04$ , bias-corrected CI = [-0.19, -0.03] (Figure 2). That is, participants in the anti-inherence condition showed reduced reliance on the inherence heuristic, which *in turn* led them to show reduced essentialist thinking.

## Summary

Study 4 replicated the findings of Study 3. Participants who considered extrinsic explanations for societal patterns exhibited less reliance on the inherence heuristic, which led to lower endorsement of essentialist beliefs. Combined, these results provide promising support for our hypothesis that essentialist beliefs are built from intuitions supplied by the inherence heuristic.

## Meta-Analysis of Studies 3 and 4

In Studies 3 and 4, we found that contemplating extrinsic explanations for social patterns decreased participants' reliance on the inherence heuristic, and in both studies, there was a significant indirect path linking this effect to lower endorsement of essentialist beliefs. Prompted by recent recommendations to generate meta-analytic effect size estimates for even small batches of studies (e.g., Cumming, 2012, 2014), we conducted a meta-analysis of these two studies to summarize their findings and to estimate more precisely the effects of our anti-inherence manipulation.

## Method

We used Hedges and Vevea's (1998) method for fixed-effects meta-analysis, as implemented in SPSS by Field and Gillet (2010),<sup>7</sup> to calculate meta-analytic effect size estimates for the difference between the anti-inherence and the control conditions on three dependent variables: (a) analytic versus intuitive thinking scores (using participants' average scores on the three items from each study), (b) Inherence Heuristic Scale scores, and (c) essentialism scores.

## Results and Discussion

Despite using a conservative test for the effect of the manipulation on intuitive versus analytic thinking (by including all three items from Study 3, despite their low internal consistency), the meta-analytic estimate for this measure was significant,  $d^+ = 0.19$  [0.07, 0.31],  $z = 3.02$ ,  $p = .003$ . As expected based on the findings of Studies 3 and 4, the meta-analytic estimate of the effect of the manipulation on inherence-based thinking was also significant,  $d^+ = 0.26$  [0.13, 0.38],  $z = 4.09$ ,  $p < .001$ . Finally, we observed a marginally significant meta-analytic estimate of the effect of our anti-inherence manipulation on essentialism,  $d^+ = 0.12$  [-0.01, 0.24],  $z = 1.85$ ,  $p = .064$ . These results provide better estimates of the magnitude of the effects in Studies 3 and 4, as well as greater confidence in the claim of a causal link between the inherence heuristic and essentialism.

## General Discussion

The present article marks an advance in our theoretical understanding of essentialist beliefs, a phenomenon with

tremendous implications for social attitudes and behavior. According to our proposal, essentialism is an offshoot of a broader explanatory heuristic that leads people to make sense of the patterns they observe in the world in terms of the inherent features of the entities that make up these patterns (Cimpian & Salomon, 2014, in press). This general proposal gave rise to two specific predictions.

First, if essentialism is elaborated from the antecedent intuitions supplied by the inherence heuristic, then people who are particularly likely to go along these intuitions should also be particularly likely to formulate and endorse essentialist beliefs. In other words, individual differences in reliance on the inherence heuristic should predict individual differences in essentialist reasoning. The results of Studies 1 and 2 were consistent with this hypothesis, in that the scale we developed to measure individual differences in inherence-based reasoning emerged repeatedly as a significant predictor of individual differences in psychological essentialism. The relationship between inherent reasoning and essentialism remained significant even when accounting for the variables we deemed to be the most plausible potential confounds: cognitive style, cognitive ability and flexibility, system-justifying tendencies, and social conventionality. It is striking that a scale asking people's opinions about the flavor of toothpaste and the color of wedding dresses emerged as a stronger predictor of essentialist beliefs about social groups than even scales whose content is explicitly about social groups (e.g., Social Dominance Orientation, Right-Wing Authoritarianism).

Studies 3 and 4 provided support for our second prediction, which followed directly from the causal claims of our account: If essentialism is built on top of an inherence-based foundation, then undermining this foundation might lead to a corresponding decrease in the plausibility of essentialist beliefs. In both of these studies and in a meta-analysis, we found that exposure to statements endorsing extrinsic (i.e., anti-inherent) explanations lowered essentialist thinking by reducing reliance on the inherence heuristic. This finding speaks to the plausibility of the proposal linking the origins of essentialism to a broader inherence heuristic.

We might make a further prediction here: If essentialism is constructed from heuristic intuitions about inherent features, and if people's tendency to endorse these quick-and-easy heuristic intuitions is in turn influenced by their cognitive style, it is reasonable to expect that cognitive style would exert an indirect effect on essentialism through its influence on the inherence heuristic. We tested this prediction with data from Study 1, using (a) need for cognition and (b) need for closure as independent variables in two bootstrapped product-of-coefficients mediation analyses (Hayes, 2013). With respect to need for cognition, we found a significant indirect effect of this cognitive style variable on essentialism through the inherence heuristic,  $ab = -0.08$ ,  $SE = 0.03$ , bias-corrected CI =  $[-0.16, -0.03]$ , such that participants with greater need for cognition exhibited less reliance

on the inherence heuristic and in turn, less essentialism. Similarly, need for closure had an indirect effect on essentialism through the inherence heuristic,  $ab = 0.09$ ,  $SE = 0.05$ , bias-corrected CI =  $[0.01, 0.22]$ , such that participants with a greater need for closure exhibited greater reliance on the inherence heuristic and in turn, greater endorsement of essentialist beliefs. Importantly, however, neither of the indirect paths was significant when essentialism was entered as the mediator instead, and the inherence heuristic as the dependent variable (need for cognition:  $ab = -0.04$ ,  $SE = 0.04$ , bias-corrected CI =  $[-0.13, 0.01]$ ; need for closure:  $ab = -0.03$ ,  $SE = 0.08$ , bias-corrected CI =  $[-0.10, 0.20]$ ). These analyses provide additional evidence for our claim that an intuitive cognitive mechanism, the inherence heuristic, gives rise to essentialist beliefs. Moreover, the asymmetry whereby cognitive style predicted essentialism via inherent thinking but *not* inherent thinking via essentialism underscores the fact that although related, the inherence heuristic and essentialism are distinct constructs whose relationships with other cognitive and motivational dimensions are likewise distinct.

Together, the present findings provide considerable support for the presence of a deep causal link between inherent reasoning and essentialism. However, the evidence reported here comes exclusively from adult participants, whereas our predictions were initially derived from a theoretical account of the *development* of essentialism. Thus, one limitation of this research is that it does not address the developmental dimension of our account. Nevertheless, current work in our lab is addressing precisely this dimension, with findings similar to those we report here in adults. That is, results of completed studies indicate that (a) children's preference for inherent explanations predicts their essentialist beliefs and that (b) manipulating children's reliance on the inherence heuristic in turn affects the strength of essentialist beliefs (Sutherland & Cimpian, 2014).

At a broader level, the inherence heuristic provides a promising framework for future research on social-psychological phenomena. For example, it is possible that the inherence heuristic could provide a new, more general understanding of the cognitive underpinnings of the correspondence bias (i.e., the tendency to attribute behaviors to dispositional attributes; Jones & Harris, 1967), which has also been conceptualized as a low-effort heuristic (e.g., Gilbert & Malone, 1995). As Cimpian and Salomon (2014) have argued, the heuristic process that explains patterns in the world through inherent properties may also give rise to the intuition that specific behaviors are due to the inherent traits of the individuals performing them. Similarly, as we have already hinted, the tendency to think inherently about patterns in the world may also promote system-justifying tendencies (e.g., Jost et al., 2004). That is, endorsing the intuition that the powerful and the powerless in society are in their positions because of their inherent features (e.g., intelligence, work ethic) could lead to a belief that such social divisions are right, inevitable, and fair.

To conclude, the studies we report here suggest that the inferences heuristic is a basic component of human cognition that may be involved in the emergence of essentialist attitudes and that has implications for a variety of social judgments and behaviors. In the long term, by contributing to our understanding of the origins of essentialism, this work may also lead to interventions designed to counteract essentialist beliefs about social categories and thus, reduce prejudice and discrimination.

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### Notes

1. The distinction between what is inherent/intrinsic and what is extrinsic is a matter of philosophical debate (for a review, see Weatherson & Marshall, 2013). We do not intend to settle this debate. Our argument is a *psychological* one, and thus, our definition of *inherent features* is also psychological. We intend this term to pick out those features that lay people *understand* to be inherent—even if, at a different level of analysis, the status of some of these features may turn out to be more complex (e.g., color involves an interaction between the physical properties of an object and the sensory capabilities of an observer; but see Byrne & Hilbert, 2003).
2. Throughout the text, we present 95% confidence intervals (CI) on effect sizes in brackets. Confidence intervals for correlation coefficients were calculated using the ESCI package for Excel (Cumming, 2012). Cohen's *ds* and their confidence intervals were calculated using scripts developed by Wuensch (2012).
3. The degrees of freedom for this test are smaller because one participant did not disagree with any of the items.
4. An example is the following: "Sally is making sun tea. Every hour, the concentration of the tea doubles. If it takes 6 hours for the tea to be ready, how long would it take for the tea to reach half of the final concentration?" The intuitive answer is 3 (half of 6), but the correct answer is 5.
5. To explore the possibility that the relationship between the Inference Heuristic Scale and the Essentialism Scale is due to yea-saying or acquiescence (as both scales use only positively worded items), we constructed an additional regression model for each subsample with an additional predictor: the average of participants' responses to the catch items in the Inference Heuristic Scale. Recall that of the four catch items, two ought to ordinarily elicit *agree* responses and two ought to ordinarily elicit *disagree* responses. The average of these items does not

represent a coherent conceptual variable and thus, may be considered an index of participants' tendency to yea-say, regardless of item content (see Couch & Keniston, 1960). The Inference Heuristic Scale remained a significant predictor of Essentialism when this model was applied to the cognitive style,  $\beta = .39$  [.19, .58],  $p < .001$ ; cognitive ability/flexibility,  $\beta = .34$  [.14, .51],  $p = .001$ ; and system justification,  $\beta = .39$  [.21, .60],  $p < .001$ , subsamples. We conducted analogous tests, using the catch average as a control, for all additional analyses in the article and likewise never found that including this control variable influenced the conclusions reached, suggesting that the relationship between the inferences heuristic and essentialism cannot be accounted for by acquiescence.

6. The means for one of the other items ("When you try to make sense of the world, you can make big mistakes if you just go with the first thought that comes to mind") were also (slightly) in the predicted direction,  $M_{anti-inference} = 6.52$  ( $SD = 1.87$ ) versus  $M_{control} = 6.41$  ( $SD = 1.78$ ). However, the means for the third item ("It's important to always question your assumptions when you think about why the world is a certain way") were not,  $M_{anti-inference} = 7.04$  ( $SD = 1.67$ ) versus  $M_{control} = 7.14$  ( $SD = 1.52$ ).
7. For these two studies, fixed- and random-effects models produce the same results.

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