In Sickness and in Filth: Developing a Disdain for Dirty People

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Abstract

Cleanliness is universally valued, and people who are dirty are routinely marginalized. In this research, we measured the roots of negative attitudes toward physically unclean individuals and examined the differences that exist in these attitudes between childhood and adulthood. We presented 5- to 9-year-olds and adults (total $N = 260$) with paired photographs of a dirty person and a clean person, and we measured biases with a selective trust task and an explicit evaluation task. In Study 1, in which images of adults were evaluated, both children and adults demonstrated clear biases, but adults were more likely to selectively trust the clean informant. Study 2 instead utilized images of children and included several additional tasks measuring implicit attitudes (e.g., an IAT) and overt behaviors (a Resource Distribution Task), and also manipulated the cause of dirtiness to include illness, enjoyment of filth, and accidental spillage. Children and adults again revealed strong biases, regardless of the cause of dirtiness, but only children exhibited a bias on the explicit evaluation task. Study 3 replicated these findings in India, a country that has historically endorsed strong purity norms. Overall, this research indicates that dirty people are targets of discrimination from early in development, that this is not merely a Western phenomenon, and that this pervasive bias is most strongly directed at individuals of similar ages.

Keywords: dirtiness; cleanliness; social bias; selective trust; purity; development

Introduction

Propaganda and slurs frequently portray the Other as infecting or polluting society. These depictions of dirtiness have been leveraged to facilitate dehumanization, vilification, and stigmatization, and to incite atrocities throughout history and across cultures (Speltini & Passini, 2014, 2016; Taylor, 2007). Reverberations of these rhetorical techniques are showcased in modern disparagements of foreign immigrants and domestic minorities, further indicating that equating physical filth with duplicity is intuitive and carries profound psychological implications (Marshall & Shapiro, 2018). In order to understand the power of metaphorical dirtiness to denigrate marginalized individuals or groups, it is crucial to first understand the link between literal dirtiness and dislike, as beliefs about figurative dirtiness are almost certainly grounded in the actual embodiment of being dirty (Lakoff & Johnson, 1999; Lizardo, 2012). Indeed, people whose jobs involve contact with physical dirtiness are also subject to extreme stigmatization (Rabelo & Mahalingam, 2019). The present research investigates the nature and extent of children's and adults' biases favoring physically clean people and disfavoring physically dirty people, with a focus on the degree to which these potentially deep-seated biases influence selective social learning and explicit attitudes.

Prejudice is not a unitary phenomenon, and the consequences of being biased against dirty individuals may be different from the consequences of other forms of social bias. Unlike anger-fueled biases, which elicit aggression, people who are considered dirty or disgusting are likely to be fastidiously avoided (Cottrell & Neuberg, 2005; Katzir, Hoffmann, & Liberman, 2019). Disgust, which can be elicited by dirtiness, fuels dehumanization and thus diminishes psychological engagement (Buckels & Trapnell, 2013; Harris & Fiske, 2006). Additionally, because even brief contact with a contaminant intuitively renders a person irrevocably

contaminated, even when this is objectively implausible (Rozin, Millman, & Nemeroff, 1986; Rozin & Royzman, 2001), people who are perceived to be dirty will likely be persistently spurned. These tendencies toward enduring evasion preclude understanding or reconciliation and thereby promote further stigmatization. Therefore, understanding why, when, and how people avoid individuals who are dirty or considered disgusting is of immense practical and ethical importance (Curtis, 2011; Kelly, 2011; Nussbaum, 2004).

Studying biases against dirty individuals also carries theoretical significance. Unlike typically studied biases, which target social groups and which involve enduring traits such as accent or race, physical dirtiness is typically a transient state that is not inherently aligned with group membership. Therefore, understanding the manifestation of biases against physically unclean people can illuminate how biases can operate when directed at individuals rather than groups and for surface-level characteristics rather than immutable traits. However, almost nothing is known about the origins or features of biases against dirty individuals. To our knowledge, there is only one previous study that directly investigated this topic. This research demonstrated that cleanliness trumped race in shaping school-aged children's explicit preferences and positive trait attributions (Epstein, Krupat, & Obudho, 1976), suggesting that this is a bias meriting further investigation.

Selective Trust of Clean Individuals

A primary aim of the current research is to examine the extent to which information is learned more readily from clean rather than dirty informants. Selectively learning cultural information from a subset of one's community influences the spread of cultural traditions and values (Henrich, 2016). Therefore, cultural evolution could be impacted by avoiding and ignoring dirty individuals, thereby reinforcing preferences for cleanliness and increasing

tendencies to learn and transmit information from physically clean informants. As a result, studying selective learning tendencies can provide insight into processes of epistemic injustice (Fricker, 2007) that not only have profound implications on patterns of social exclusion in specific contexts, but that also exert lasting intergenerational effects.

By the time children reach their fifth birthday, they are selective in whom they learn from (Harris, 2012; Koenig & Sabbagh, 2013; Mills, 2013). Children preferentially trust individuals who are likely to impart accurate knowledge, either because these people have more knowledge or access to information (Brosseau-Liard & Birch, 2011; Koenig, Clément, & Harris, 2004) or because they possess more benevolent dispositions to share information truthfully (Doebel & Koenig, 2013; Landrum, Mills, & Johnston, 2013; Mascaro & Sperber, 2009). Because these learning biases are generally considered to be rational (Sobel & Kushnir, 2013), and because children's trust in smart, kind, and honest informants cannot be explained wholly through affiliative motivations (Lane, Wellman, & Gelman, 2013), children's selective learning tendencies have not been previously considered as potential roots of injustice. However, it is possible that certain targets of preferential trust – for example, ingroup members (Kinzler, Corriveau, & Harris, 2011), socially prestigious individuals (Chudek, Heller, Birch, & Henrich, 2012), and attractive people (Bascandziev & Harris, 2014) – may reaffirm existing power structures in society. Given that cleanliness is often an epistemically irrelevant quality, tendencies to selectively trust clean individuals could constitute an unjustifiable social bias that contributes to the systematic silencing of people in cleaning professions, people living in squalor, and people whose ethnic background is considered to render them disgusting.

Trait Attributions

Individuals who are perceived to be dirty are likely to only indirectly experience the injustices caused by selective social learning. However, these individuals acutely experience other forms of bias. For example, people who are involved in "dirty" work (e.g., janitors) frequently experience invisibility and dehumanization (Rabelo & Mahalingam, 2019; Simpson, Slutskaya, Lewis, & Höpfl, 2012), which may result from others' explicit inferences about their psychological traits. Measuring overt evaluations can demonstrate more blatant forms of bias, which have been understudied in recent years (Kteily & Bruneau, 2017).

As with selective trust, it may be frequently unwarranted to believe that clean and dirty people possess differing dispositions. Yet, even though dirtiness is generally situational, there are reasons to believe that it might lead to dispositional inferences. People typically believe that others engage in impure acts because of stable characteristics rather than situational causes (Chakroff & Young, 2015), and a single impure act is perceived to be nearly as bad as repeated impure acts (Rottman & Young, 2019), suggesting that becoming dirty once might be treated almost equivalently to repeated or chronic instances of dirtiness.

Disgust Sensitivity

Disgust is a likely candidate mechanism underlying a disdain for dirtiness, as it is well suited to promote avoidance of substances and entities that are slimy, contaminating, or indicative of poor hygiene (Curtis, 2013), and it is often elicited in social situations (Giner-Sorolla & Sabo, 2016; Rottman, DeJesus, & Gerdin, 2018). As such, we expected that people with relatively strong reactions to disgusting stimuli would exhibit stronger biases toward dirty individuals. Higher disgust sensitivity is also associated with distrust (Aarøe, Osmundsen, &

Petersen, 2016), suggesting that this relationship might be especially pronounced for the selective trust of others' testimony.

Aims and Scope of the Current Research

Here, we investigate the extent of children's and adults' favoritism of clean individuals and disdain of dirty individuals. As children do not reliably exhibit avoidance of physical contaminants before five years of age (DeJesus, Shutts, & Kinzler, 2015), and frequently have propensities toward being dirty themselves, the extent to which they harbor negative social attitudes toward people who are physically dirty is an open empirical question. Additionally, the existence of these biases has not been clearly documented in adults, despite indirect indications that they likely exist (e.g., Harris & Fiske, 2006).

We tested children ranging in age from five to nine because the existing literature indicates that middle childhood is a crucial period for the formation and solidification of certain prejudices (e.g., Raabe & Beelmann, 2011). Rather than concentrating our attention on fine-grained developmental differences that may exist within middle childhood, however, we focused our investigation on examining differences occurring on the much coarser timescale between childhood and adulthood. As many biases emerge early in childhood without protracted learning (Dunham, Chen, & Banaji, 2013), this approach of comparing children and adults allowed us to gain insights into overall patterns of stability and modification in the unfolding of biases against dirty individuals.

In Study 1, we examined whether a bias against physically unclean individuals is present in 5- to 9-year-olds and adults, as measured by selective trust and trait attributions. In Study 2, we expanded our range of measures and also varied the causes of dirtiness to investigate possible

mechanisms of this bias. In Study 3, we replicated Study 2 in India to examine the existence of this bias in a relevantly disparate culture.

Study 1

Method

Participants. Participants were 5- to 9-year-old children recruited via a participant database and tested in a college laboratory in the northeastern United States (N = 32; 16 females; M_{age} = 7.53; SD_{age} = 1.44) and adults recruited from Amazon Mechanical Turk, restricted to residents of the United States (N = 32; 16 females, M_{age} = 35.94; SD_{age} = 11.71). Although additional demographic information beyond age and gender was not collected, the child sample was predominantly White and middle- to upper-class.

Materials and procedure. Participants were presented with photographs of adult "twins": one who was clean and one who was dirty (see Fig. 1). They were not provided any information about the twins, nor was the physical state of the twins commented upon by the experimenter. Participants were then presented with three tasks in a fixed order. The photographs of the twins remained visible throughout the two primary tasks (Trust in Testimony and Explicit Evaluation).

Fig. 1. **Photographs of the clean and dirty twins, as presented to female participants.** Males were presented with gender-matched photographs (see Fig. S1 in the Supplementary Materials). Participants were presented with color versions of these images.

Trust in testimony task. We adapted a classic paradigm for measuring children's selective trust (Koenig et al., 2004), in which participants are asked to adjudicate between conflicting testimony provided by two informants. Because trust differs for different domains of information (Chudek et al., 2012; Danovitch & Keil, 2007; Stephens & Koenig, 2015), we varied the target and content of the testimony that was provided. Participants were sequentially presented with two pictures of cages (described as containing novel animals) and two pictures of Tupperware containers (described as containing novel foods). For each picture, participants were provided with paired testimony from the twins that was either factual (e.g., "Petting mogos can make your hands feel very itchy [smooth]") or normative (e.g., "Eating toma is very good

[bad] and right [wrong] to do"). Thus, there was a 2 (Target: Animal vs. Food) X 2 (Content: Fact vs. Norm) design, with one trial per each of the four possible combinations. In each trial, the twin informants provided conflicting testimony, with one twin conveying positively valenced information and the other twin conveying negatively valenced information. Each twin provided positive information twice and negative information twice. The order of the trials, the order of each twin's testimony, and the content of each twin's testimony were counterbalanced across participants. After hearing each pairing of contradictory testimony, participants were asked which information they believed was true ("Belief Formation") and whether they would want to eat/touch the food/animal ("Action Decision"), following the procedure of Boseovski and Thurman (2014). Here and in the following studies, we also asked participants to explain their Action Decision; however, these explanations are beyond the scope of this paper and are not discussed further.

Explicit evaluation task. Next, participants were asked to identify the twin who exemplified a range of positive attributes by indicating who was smarter, nicer, more trustworthy, a better friend, a better teammate, and more likable. After stating which twin was more likable, participants were asked to explain their choice (however, these explanations are beyond the scope of this paper and are not discussed further). As a simple manipulation check, participants were asked who was cleaner. All 64 participants correctly chose the clean twin; this question was not examined further.

Disgust scale. Finally, child participants were presented with an eight-item disgust scale, which was inspired by existing adult measures but created by the research team as a novel child-friendly measure (see Table S1 in the Supplementary Materials). Participants responded to each item by making ratings on a four-point scale, ranging from "Definitely Not" (represented by one

star) to "Definitely Yes" (represented by four stars). Two exploratory questions were additionally asked at the end of this task: "Would you be friends with somebody if other people thought they were weird?" and "Do you think you are a clean person?". None of these questions were administered to adults due to the unacceptably low internal consistency of the disgust scale in the child sample (see Results).

Coding and analyses. Across all studies, the primary outcome of interest was whether participants displayed biases favoring the clean twin and thus disfavoring the dirty twin. Unless otherwise indicated, responses were coded such that preferences for the clean twin were given a score of 1 and preferences for the dirty twin were given a score of -1. As Studies 2 and 3 included tasks for which neutral responses (i.e., responses of "both" or "neither") were possible, these responses were given a score of 0. The presence of bias was determined by conducting one-sample *t*-tests against chance (i.e., 0, or 50%, indicating equal preferences for the clean and dirty twins).

Given the large number of measures and conditions across the three studies, we aimed to reduce the number of tests being conducted and to increase power by first determining whether there were condition differences within each measure and then collapsing across conditions that did not yield significant differences. This was accomplished by fitting mixed models that accounted for both fixed and random effects. Although this analytic strategy led us to focus on different components across studies and measures, all graphs visually present results broken down by the primary variables of interest for ease of comparison across studies. For each study, we have reported all measures, conditions, and data exclusions. All data and analysis code are available at https://osf.io/ay8k2.

Results

Trust in testimony task. As shown in Fig. 2, children and adults were more likely to trust the clean informant than the dirty informant. However, this tendency was much more pronounced in adults.

To test whether preferences to trust the clean informant differed as a function of Age Group (Child vs. Adult), Target (Animal vs. Food), Content (Fact vs. Norm), or Question Type (Belief Formation vs. Action Decision), we conducted a mixed logistic regression model, controlling for the random intercepts of participants. This analysis uncovered a significant effect of Age Group, logistic $b = 0.684$ ($SE = 0.218$), $p = .002$, which indicated that adults were more likely than children to selectively trust the clean informant. There were no effects of Target, Content, or Question Type, logistic bs $< |0.30|$, ps $> .12$.

To evaluate whether participants were significantly more likely to trust the clean informant than the dirty informant, one-sample *t*-tests compared overall tendencies to trust each informant to chance levels. Because the mixed logistic regression only revealed a significant effect of Age Group, we conducted separate *t*-tests for children and adults, and collapsed across the other variables by averaging over the eight trials. These tests indicated that both children, $t(31) = 2.092$, $p = .045$, $d = 0.370$, and adults, $t(31) = 6.111$, $p < .001$, $d = 1.080$, were more likely to trust the testimony of the clean informant than that of the dirty informant.

For children, there were no clear developmental differences in tendencies to trust the clean informant; there was a weak, non-significant positive correlation between Age in Months and performance on the Trust in Testimony Task, $r(30) = .187$, $p = .307$. However, as our sample was not sufficiently powered to detect such fine-grained age differences, we do not draw any conclusions from this or subsequent analyses of age differences within our child samples.

Explicit evaluation task. As shown in Fig. 2, children and adults were more likely to attribute positive traits to the clean twin than to the dirty twin. This tendency was marked for both age groups.

To evaluate whether participants' tendencies to attribute positive traits to the clean twin differed as a function of Age Group (Child vs. Adult), we conducted a mixed logistic regression model, controlling for the random intercepts of participants and questions. There was no significant effect of Age Group, logistic $b = 1.085$ ($SE = 0.679$), $p = .110$.

To evaluate whether participants were significantly more likely to attribute positive characteristics to the clean twin than the dirty twin, a one-sample *t*-test compared overall tendencies to positively evaluate each twin to chance levels. Because the mixed logistic regression revealed no significant effect of Age Group, we combined children's and adults' responses. We additionally averaged responses across the six trait evaluations, as the six ratings formed a reliable scale ($\alpha = .717$). This *t*-test indicated that participants were substantially more likely to attribute positive characteristics (e.g., intelligence, kindness) to the clean twin than to the dirty twin, $t(63) = 11.493$, $p < .001$, $d = 1.437$.

For children, the results did not indicate clear developmental differences in tendencies to favor the clean twin. There was a weak, non-significant positive correlation between Age in Months and performance on the Explicit Evaluation Task, $r(30) = .187$, $p = .306$.

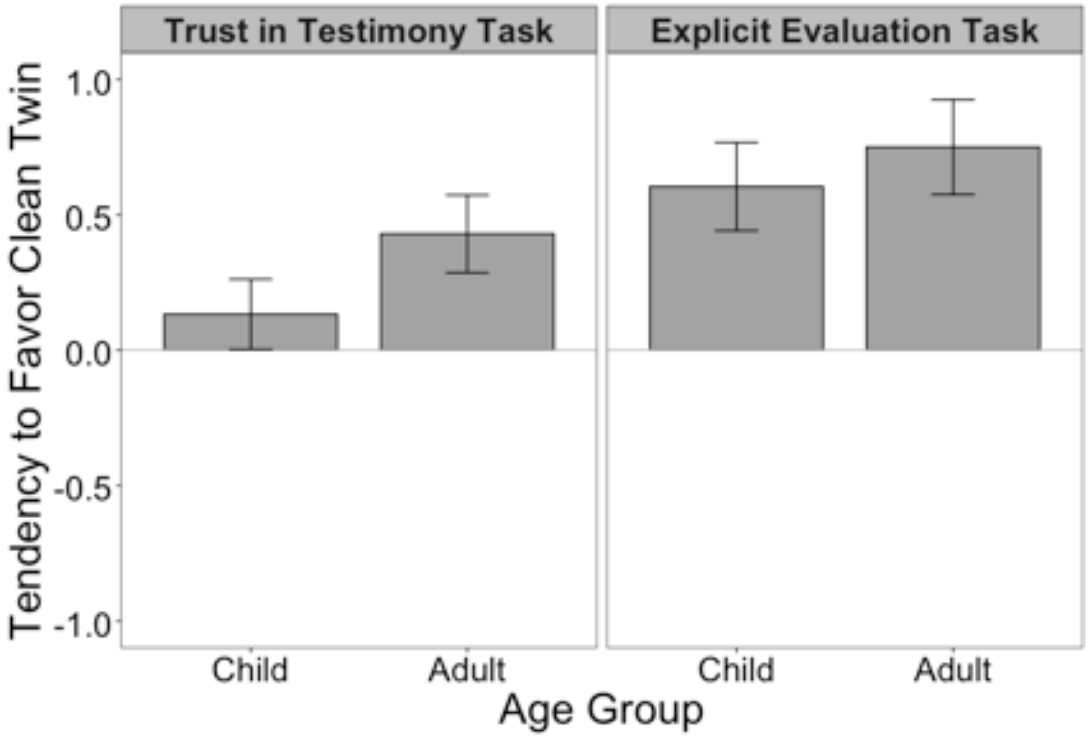

Fig. 2. **Average tendencies to prefer the clean twin, as measured by the primary tasks in Study 1.** Negative values indicate tendencies to favor the dirty twin, while positive values indicate tendencies to favor the clean twin (zero indicates chance performance). Error bars represent 95% confidence intervals.

Individual differences and relationships between measures. Children's ratings on the disgust scale were scored such that 0 indicated low disgust sensitivity and 3 indicated high disgust sensitivity (one item was reverse-scored). Unfortunately, these items did not form a reliable scale ($\alpha = .427$), and the reliability of the scale did not improve by removing any items. Because of this unacceptable internal consistency, relationships between this measure and other variables were not explored.

There were no significant relationships between the primary tasks and children's ratings of how likely they would be to befriend a "weird" person, *p*s > .11, or how clean they believed themselves to be, *p*s > .09. Performance on the Trust in Testimony Task was correlated with performance on the Explicit Evaluation Task, $r(62) = .401$, $p = .001$, and the strength of this relationship was similar for children, $r(30) = .351$, $p = .049$, and adults, $r(30) = .393$, $p = .026$.

Discussion

Overall, our results indicate that both children and adults trust and explicitly prefer physically clean individuals compared to physically dirty individuals. While the nature of these measures did not allow for determining whether these biases were driven primarily by preferences for the clean twin, against the dirty twin, or both, this initial study demonstrated that an evaluative distinction between clean and dirty individuals arises early in development and persists into adulthood. However, while children showed clear explicit preferences and regard for the clean twin, their trust of this clean individual was relatively weaker.

While these data demonstrate the existence of a bias when evaluating clean and dirty individuals, they do not illuminate the causes of this tendency. First, this study was unable to determine whether disgust plausibly underlies this bias, because the items we used to assess disgust sensitivity were not internally consistent. Second, we did not provide any explanation for why the dirty twin was so unkempt. Thus, the present study cannot speak to whether the causes of dirtiness would modulate the strength of participants' biases. Third, while we suggest that these biases are caused by unwarranted and perhaps irrational tendencies underlying social affiliation and exclusion, others may disagree with this assessment. For instance, because dirtiness is often linked to membership in a lower social class (Speltini & Passini, 2014), the distrust and negative trait attributions of the physically dirty twin may have stemmed partially

from beliefs about individuals of low socioeconomic status. Even though inferences about differing SES levels were impeded by emphasizing that the two individuals were twins, some of the "biases" that were uncovered in Study 1 could conceivably have been warranted inferences stemming from beliefs about the dirty individual's reduced education, lower earning potential, or worse living conditions. Additionally, adults have strict expectations for cleanliness, and the filthiness of the dirty twin was non-normative. Because children are more typically untidy and physically dirty, these concerns could be reduced by measuring attitudes toward children instead of adults. Studies 2 and 3 addressed these limitations by (1) utilizing a previously validated measure of disgust sensitivity, (2) manipulating the purported cause of the twins' dirtiness, and (3) replacing the photographs of adults with photographs of clean and dirty children who were approximately the same age as the child participants.

Study 2

What underlies prejudice against unclean people? The "Pathogen Avoidance Hypothesis" claims that avoiding dirty people is adaptive insofar as it minimizes contact with pathogens and reduces the possibility of contracting disease (Curtis, 2013; Oaten, Stevenson, & Case, 2011; Schaller & Park, 2011). Research has demonstrated that perceived vulnerability to disease promotes prejudice (Faulkner, Schaller, Park, & Duncan, 2004; Navarrete & Fessler, 2006), and that disease concerns promote outgroup categorization (Makhanova, Miller, & Maner, 2015), suggesting that sensitivity to disease would plausibly limit social affiliation with physically dirty individuals. Furthermore, unhealthy people are universally avoided (Curtis, 2011), and this tendency emerges by six years of age (Blacker & LoBue, 2016).

Although beliefs about physical cleanliness are presently enmeshed with modern ideas

about hygienic avoidance of diseases, these beliefs were more intimately connected to abstract notions of spiritual purity during earlier historical periods (Speltini & Passini, 2014). It is therefore possible that biases against dirtiness are not directly linked to disease avoidance, but are rather linked to sociomoral beliefs. Indeed, even in the absence of disease cues, perceived dirtiness fuels the exclusion of members of different social groups or individuals who behave in non-normative ways (Giner-Sorolla & Sabo, 2016; Rottman et al., 2018; but see van Leeuwen & Petersen, 2018). The expression of disgust is well-suited for communicating that one's moral principles have been violated (Kupfer & Giner-Sorolla, 2017), such that the avoidance of dirtiness may operate as a means of preventing associations with stigmatized members of society. This line of reasoning suggests a competing "Social Affiliation Hypothesis" claiming that a disdain for dirtiness is primarily adapted for signaling the unacceptability of potential cooperative partners.

Alternatively, a "General Avoidance Hypothesis" suggests that biases against dirtiness result from simple associations between cleanliness and goodness, such that dirtiness should evoke avoidance regardless of its form or its causes. Contrary to this hypothesis, accidental forms of dirtiness may produce less bias than intentional forms of dirtiness, as suggested by evidence that unintentionally contracted diseases are less stigmatizing than diseases that are amenable to volitional control (Crandall & Moriarty, 1995).

In Study 2, we investigated whether different manifestations of uncleanliness would produce distinct forms of social bias. Participants were assigned to one of three conditions, motivated by each of the three aforementioned hypotheses, in which the dirty twin was described as either (1) being sick, with vomit on their shirt, (2) enjoying being dirty, leading them to intentionally pour soup on their shirt, or (3) having had soup accidentally spilled on their shirt by

another child. We then administered a battery of tasks measuring implicit and explicit attitudinal biases, including modified versions of the tasks used in Study 1.

We predicted that the Sick Condition would elicit the strongest biases if the Pathogen Avoidance Hypothesis is true, that the Enjoy Condition would elicit the strongest biases if the Social Affiliation Hypothesis is true, and that there would be few condition differences if the General Avoidance Hypothesis is true. However, we acknowledge that a lack of condition effects is also consistent with either of the first two hypotheses, as it is possible that any sign of dirtiness could activate concerns about either pathogens or unsuitable cooperative partners.

Method

Participants. Participants were 5- to 9-year-old children recruited via a participant database and tested in a college laboratory in the northeastern United States ($N = 48$; 21 females; $M_{age} = 7.44$; $SD_{age} = 1.52$) and adults who were undergraduate students recruited from Introductory Psychology classes at the same college ($N = 48$; 36 females, ages not recorded). Three additional children were tested but excluded due to experimenter error ($n = 1$) or because they withdrew from the study ($n = 2$). Although additional demographic information beyond age and gender was not collected, both samples were predominantly White and middle- to upper-class.

Materials and procedure. Participants were again presented with gender-matched photographs of twin informants: one who was clean and one who was dirty. However, the photographs were of children, and they were more viscerally disgusting than the photographs in Study 1. This was accomplished by spreading a can of Progresso™ Split Pea with Ham soup onto a white shirt, which convincingly resembled vomit (see Fig. 3). Participants were randomly assigned to one of three conditions, in which the description of the twins was varied to describe

different causes of dirtiness. In the Sick Condition (*n* = 32), participants were told that one twin was consistently sick with the flu and had thrown up all over their shirt that day, while the other twin was consistently healthy and had not been sick all year. In the Enjoy Condition (*n* = 32), participants were told that one twin enjoyed being dirty and purposefully spilled soup on their shirt, while the other twin enjoyed being clean and was always careful not to spill anything on their shirt. In the Spill Condition (*n* = 32), participants were told that somebody accidentally bumped into one twin and spilled soup all over their shirt, while nobody bumped into the other twin and so their shirt remained clean. Aside from these initial descriptions, nothing differed across conditions.

Participants again completed a Selective Trust Task and an Explicit Evaluation Task, which were administered alongside four additional tasks measuring implicit attitudes or overt behaviors. These four additional tasks, which facilitated an exploration of the generality of the bias against dirty individuals, were (1) a Drawing Task in which participants drew pictures of themselves and the two twins, and the physical distance between these drawings was measured; (2) an Implicit Association Task (IAT) in which participants quickly categorized photos of the twins and pictures of smiling or frowning faces by pressing one of two keys on a laptop, such that each kind of face was alternatively paired with the clean twin and the dirty twin; (3) an Ambiguous Situations Task in which participants judged whether or not the twins had malicious or disgusting intentions when performing a set of actions; and (4) a Resource Distribution Task in which participants could distribute eight positively or negatively valenced objects to one of the twins or to an empty bucket (see the Supplementary Materials for further details and results). At the very end of the study session, participants were asked to state why the twins looked different

from each other, ensuring that they remembered the reason for the dirtiness (see the Supplementary Materials for results).

These tasks were presented in an order that was optimized to prevent carryover effects from one task to the next. Participants were first presented with the Drawing Task, followed by the Trust in Testimony Task, the Resource Distribution Task, the Ambiguous Situations Task, the IAT, and the Disgust Scale. The Explicit Evaluation Task was presented either after the Resource Distribution Task or after the IAT, counterbalanced across participants.

Fig. 3. **Photographs of the clean and dirty twins, as presented to male participants.** Females were presented with gender-matched photographs (see Fig. S2 in the Supplementary Materials). Participants were presented with color versions of these images.

Trust in testimony task. The same selective trust task from Study 1 was used. However, because we previously found no differences based on target (food vs. animal) or content (factual vs. moral), we reduced the number of trials by half. One trial presented participants with conflicting factual testimony about a novel animal (a "Mogo") and a second trial presented them with conflicting normative testimony about a novel food ("Toma"). Participants were again asked which information was true (Belief Formation) and whether they would want to eat/touch the food/animal (Action Decision).

Explicit evaluation task. The Explicit Evaluation Task from Study 1 was modified in several ways. First, rather than only evaluating positive attributes, participants also rated a number of negative attributes (e.g., meanness, laziness). Second, rather than being given a forced choice, participants were able to ascribe each trait to one, both, or neither of the twins. This was accomplished by allowing participants to place photographs of each twin on a green mat if the experimenter said a word that matched with that person, or on a yellow mat if the word didn't match. Participants were first given three simple warm-up trials to get them accustomed to the task, and they were then asked to categorize the twins as possessing a series of ten (randomly presented) traits: truthful, brave, smart, fun, lazy, annoying, mean, greedy, similar to the participant, and a desirable friend.

Disgust scale. Due to the low reliability of the scale that we constructed for Study 1, we opted to instead use a slightly amended version of a previously validated measure of individual differences in disgust sensitivity in children: the Child Disgust Scale (Viar-Paxton et al., 2015). We made some changes because the Child Disgust Scale was validated with slightly older children and contained some items that we did not think would pertain to all of our youngest participants (e.g., "I don't like seeing the blood in meat at the grocery store"). Our modified

version included 13 items (see Table S2 in the Supplementary Materials), and participants provided responses on a three-point Likert scale ("always", "sometimes", "never") illustrated with thumbs pointing up, sideways, and down. Participants were given three warm-up questions to introduce them to the response scale.

Results

Trust in testimony task. As shown in Fig. 4, adults and children were more likely to trust the clean informant than the dirty informant. This tendency was demonstrated by both age groups and across conditions.

To test whether preferences to trust the clean informant differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), Trial (Mogo vs. Toma), or Question Type (Belief Formation vs. Action Decision), we conducted a mixed logistic regression model, controlling for the random intercepts of participants. This analysis uncovered a significant effect of Question Type, logistic $b = -0.521$ ($SE = 0.219$), $p = .017$, indicating that selective trust was more pronounced for the Belief Formation questions than the Action Decision questions. Neither the Sick condition nor the Enjoy condition were significantly different from the Spill condition, and there were also no significant effects of Age Group or Trial, logistic bs $< |0.35|$, ps $> .16$. Unlike Study 1, therefore, children did not reliably differ from adults in their patterns of selective trust.

To evaluate whether participants were significantly more likely to trust the clean informant than the dirty informant, one-sample t-tests compared overall tendencies to trust each informant to chance levels. Because the mixed logistic regression only revealed a significant effect of Question Type, we conducted separate t-tests for each question type, collapsed across Condition, Age Group, and Trial. These tests indicated that participants were more likely to trust

the testimony of the clean informant than the dirty informant on the Belief Formation questions, $t(95) = 5.784$, $p < .001$, $d = 0.590$, but they were only marginally more likely to be guided by the testimony of the clean informant on the Action Decision Questions, $t(95) = 1.978$, $p = .051$, $d = 0.202$. Although the difference between question types departs from the Study 1 findings, it is unsurprising that biases were weaker for Action Decisions, as many factors beyond testimony can influence decisions about approaching or avoiding unfamiliar foods or animals.

Explicit evaluation task. As shown in Fig. 4, children were more favorable in their attributions of traits to the clean twin than to the dirty twin. This tendency was not observed in adults.

The four negative traits were reverse-coded such that identifying a trait with the dirty twin resulted in a score of 1 (i.e., a preference in the direction of the clean twin) and identifying the trait with the clean twin resulted in a score of -1 (i.e., a preference in the direction of the dirty twin). Identifying the trait with neither or both of the twins resulted in a score of 0. To test whether positive evaluations of the clean twin differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), or Valence (Positive vs. Negative), we conducted a linear mixed regression model, controlling for the random intercepts of participants and questions. Ratings in the Sick condition were significantly more biased in favor of the clean twin than ratings in the Spill condition, $b = 0.188$ ($SE = 0.076$), $p = .016$, and ratings in the Enjoy condition were marginally more biased than ratings in the Spill condition, $b = 0.147$ ($SE = 0.076$), $p = .058$. This analysis also uncovered a significant effect of Age Group, $b = -0.319$ ($SE = 0.062$), $p < .001$, indicating that children were considerably more likely than adults to attribute positive characteristics to the clean twin, which contrasts with children's and adults' similarity in Study 1. There was no significant effect of Valence, $b = 0.015$ ($SE = 0.098$), $p = .885$.

To examine tendencies to positively evaluate the clean twin and negatively evaluate the dirty twin, one-sample *t*-tests compared participants' ratings to chance levels. Because the linear mixed regression revealed significant effects of both Condition and Age Group, the ratings were split accordingly. We averaged responses across the ten trait evaluations, as there were no differences across positively and negatively valenced items and the evaluations formed a reliable scale ($\alpha = .754$). These *t*-tests indicated that children were substantially more likely to attribute positive characteristics to the clean twin and negative characteristics to the dirty twin across each of the conditions, Spill: $t(15) = 2.180$, $p = .046$, $d = 0.545$; Sick: $t(15) = 5.923$, $p < .001$, $d = 1.481$; Enjoy: $t(15) = 4.140$, $p < .001$, $d = 1.035$. Conversely, adults showed no preferences in any of the conditions, Spill: $t(15) = -1.079$, $p = .298$, $d = 0.270$; Sick: $t(15) = 0.102$, $p = .921$, $d = 0.025$; Enjoy: $t(15) = 1.726$, $p = .105$, $d = 0.432$.

Additional measures. Particularly given our modest sample size, we aimed to increase the generalizability of our findings by administering as many distinct measures as possible. Due to space constraints, the results of our four additional measures are fully described in the Supplementary Materials. With the exception of the Drawing Task, for which there were no significant findings, these tasks generally confirmed the existence of a robust bias in favor of clean individuals and against dirty individuals. Specifically, the existence of implicit biases in children as well as in adults was indicated by both the IAT (*p*s < .001) and the Ambiguous Situations Task ($p < .05$). Children also exhibited bias in the Resource Distribution Task ($p < .01$), whereas adults' responses were too inconsistent to analyze.

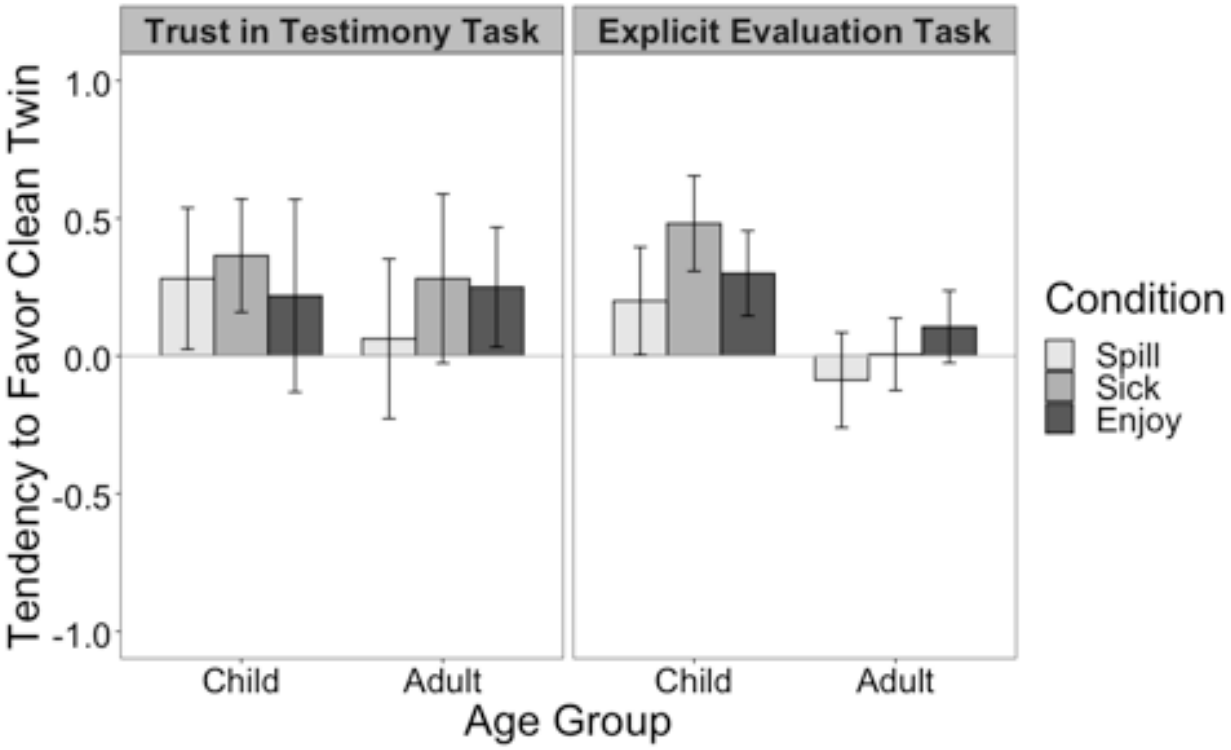

Fig. 4. **Overall preferences for the clean twin, as measured by the primary tasks in Study 2, split by Condition and Age Group.** Negative values indicate tendencies to favor the dirty twin, while positive values indicate tendencies to favor the clean twin (zero indicates a lack of preference). Error bars represent 95% confidence intervals.

Individual differences and relationships between measures. Children's ratings on the Disgust Scale were scored such that 0 indicated low disgust sensitivity and 1 indicated high disgust sensitivity (four items were reverse-scored). These items formed an acceptably reliable scale ($\alpha = .735$). There was a significant association between scores on the Disgust Scale and scores on the Explicit Evaluation Task, $r(92) = .291$, $p = .004$, indicating that participants who were higher in disgust sensitivity showed more bias on this measure, but this relationship did not appear for any other task, rs < |.15|, ps > .17. Additionally, we did not find any developmental

differences amongst the 5- to 9-year-olds in tendencies to favor the clean twin; there were no significant correlations between Age in Months and performance on any of the six tasks, rs < |.22|, ps > .14.

Discussion

Study 2 reliably uncovered biased attitudes favoring clean children and disfavoring dirty children across a large battery of implicit and explicit tasks. With the exception of the Drawing Task, every measure uncovered a clear preference toward clean individuals and against dirty individuals, and for many tasks this bias was particularly pronounced in children. In a departure from Study 1, there were no differences between age groups in the Trust in Testimony Task, and only children exhibited biases in the Explicit Evaluation Task. Children also exhibited stronger biases than adults in the IAT, but not in the Ambiguous Situations Task or the Resource Distribution Task (see Supplementary Materials). The finding that adults were more biased in Study 1 and children were more biased in Study 2 is most plausibly explained by the age of the targets. It seems that adults have stronger preferences when judging adults, while children have stronger preferences when judging children.

A primary aim of Study 2 was to investigate whether the cause of dirtiness would modulate biases. In particular, we tested whether condition differences would reliably occur between the Spill condition (in which bias was arguably the least justified) and the Sick and Enjoy conditions. In the Explicit Evaluation Task, participants showed the weakest biases in the Spill condition. In the Resource Distribution Task, the division of resources was skewed most strongly in the Enjoy condition (see Supplementary Materials). These two findings tentatively suggest that the reason for dirtiness (either illness or intentional soiling) may matter for the manifestation of some biases, thus providing some weak support for the Pathogen Avoidance

Hypothesis and the Social Affiliation Hypothesis, respectively. However, given that there were no condition differences in any of the other tasks, it seems that a disdain for dirtiness most often emerges regardless of the cause of filth, thus providing the strongest support for the General Avoidance Hypothesis.

This general lack of condition effects may be interpreted in several ways. It is possible that the General Avoidance Hypothesis is true, such that the bias against dirtiness is rudimentary and involves minimal cognitive processing. Alternatively, biases against unluckiness may have played a role in the Spill condition, such that the twin who was accidentally spilled upon was disliked merely because they were in the wrong place at the wrong time (Olson, Dunham, Dweck, Spelke, & Banaji, 2008). This account would suggest that several distinct biases produced similarly sized effects. It is additionally possible that general biases against dirtiness are consistent with the Pathogen Avoidance Hypothesis or the Social Affiliation Hypothesis. Biases against dirtiness could be tied to simple perceptual cues indicating abnormalities, perhaps as an adaptive feature of a hyperactive system for detecting pathogen threats (Miller & Maner, 2012), due to the greater risk of false negatives in categorizing the disease potential of various stimuli (Oaten et al., 2011; Schaller & Park, 2011). A general bias could also serve as an adaptive feature of a system designed for eschewing the potential for any non-strategic social bonds, as the causes of a person's dirtiness may not be widely known throughout one's social network and it may thus be important to consistently distance oneself from any person who could be viewed by others to be dirty or contaminating (Rottman et al., 2018). Future research is needed to adjudicate between these different possibilities.

Study 3

The Hindu caste system provides a well-known example of the widespread derision and mistreatment of individuals who are considered dirty. Members of the Dalit caste are considered by some people to be so contaminated as to be "untouchable", largely due to their role in sanitation-based labor (Mahalingam, Jagannathan, & Selvaraj, 2019). Unlike many instances of uncleanliness that are the product of choices or life experiences, this form of perceived dirtiness is something that individuals are born into. Additionally, the religious rituals that sustain Hinduism are heavily rooted in a vertically-oriented moral schema in which upward elevation on a figurative hierarchy is associated with purity and movement down this hierarchy is associated with pollution and degradation (Brandt & Reyna, 2011; Haidt & Algoe, 2004). Therefore, a bias against dirtiness may be particularly pronounced in Hindu cultures, such as in India. To test this hypothesis, we replicated Study 2 with Indian participants.

Method

Participants. Participants were 4.5- to 9-year-old children who were recruited and tested at a private primary school in Mumbai, India ($N = 48$; 23 females; $M_{age} = 7.32$; $SD_{age} = 1.55$) and adults who were recruited from Amazon Mechanical Turk, restricted to accounts based in India ($N = 52$; 10 females, $M_{age} = 30.90$; $SD_{age} = 7.00$). An additional 33 adults were tested but excluded due to failing comprehension checks ($n = 30$) or living outside of India ($n = 3$). Because participants were bilingual in Hindi and English, testing sessions were conducted in English. Although additional demographic information beyond age and gender was not collected, the child sample consisted entirely of ethnically Indian participants who were middle- to upper-class and who came from a diverse array of religious backgrounds.

Materials and procedure. The materials and procedure were replicated from Study 2, with the following exceptions. First, participants were presented with gender-matched photos of Indian children. In order to keep the visual properties of these photos as similar as possible to those in Study 2, the existing photographs were professionally edited such that the faces were replaced with those of Indian children (see Fig. S7 in the Supplementary Materials). Second, given time constraints for the testing sessions, the procedure was shortened by eliminating some of the additional measures. Children were only administered the Trust in Testimony Task, the Explicit Evaluation Task, the Resource Distribution Task, the IAT, and the Disgust Scale (i.e., the Drawing Task and the Ambiguous Situations Task were removed). To keep the procedure as short as possible for participants tested via Amazon Mechanical Turk, the IAT was also removed for adult participants. Finally, one item on the Disgust Scale was changed to increase the cultural appropriateness of the measure (see Table S2 in the Supplementary Materials).

Results

Trust in testimony task. As shown in Fig. 5, adults and children in the Enjoy and Sick conditions were more likely to trust the clean informant than the dirty informant. This tendency was similar in both age groups.

To test whether preferences to trust the clean informant differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), Trial (Mogo vs. Toma), or Question Type (Belief Formation vs. Action Decision), we conducted a mixed logistic regression model, controlling for the random intercepts of participants. This analysis uncovered findings that largely replicated those in Study 2, with the exception that there was a strong effect of Condition. Both the Sick condition, logistic $b = 0.982$ ($SE = 0.274$), $p < .001$, and the Enjoy condition, logistic $b = 1.242$ ($SE = 0.287$), $p < .001$, were significantly different from the Spill

condition. As in Study 2, there was a significant effect of Question Type, logistic $b = -0.515$ ($SE = 0.219$), $z = -2.353$, $p = .019$, indicating that selective trust was more pronounced for Belief Formation questions than Action Decision questions. There were also no significant effects of Age Group or Trial, logistic bs $< |0.37|$, ps $> .11$. Thus, replicating Study 2, similar patterns of selective trust were observed across Indian adults and Indian children.

To evaluate whether participants were significantly more likely to trust the clean informant than the dirty informant, one-sample t-tests compared overall tendencies to trust each informant to chance levels. Because the previous analysis revealed a significant effect of Condition and Question Type, but not Age Group or Trial, responses were split by condition and question type and averaged across the two trials and across both age groups. On the Belief Formation question, participants were more likely to trust the testimony of the clean informant in the Sick condition, $t(33) = 5.320$, $p < .001$, $d = 0.912$, and in the Enjoy condition, $t(31) = 4.546$, $p < .001$, $d = 0.804$, but not in the Spill condition, $t(33) = -0.274$, $p = .786$, $d = 0.047$. On the Action Decision question, participants were more likely to be guided by the testimony of the clean informant in the Enjoy condition, $t(31) = 3.738$, $p < .001$, $d = 0.661$, but not in the Sick condition, $t(33) = 1.304$, $p = .201$, $d = 0.224$, or in the Spill condition, $t(33) = -1.529$, $p = .136$, $d = 0.262$. Overall, therefore, Indian participants in the Spill condition did not demonstrate selective trust in the clean twin, but Indian participants in the other two conditions showed greater trust in the testimony provided by the clean informant on at least one question.

Explicit evaluation task. As shown in Fig. 5, children were more favorable in their attributions of traits to the clean twin than to the dirty twin. This tendency was not observed in adults.

Responses were scored as in Study 2. To test whether positive evaluations of the clean twin differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), or Valence (Positive vs. Negative), we conducted a linear mixed regression model, controlling for the random intercepts of participants and questions. This analysis largely replicated the findings from Study 2, with the exception that the effects of Condition did not reach significance; neither the Sick condition nor the Enjoy condition produced ratings that significantly differed from those in the Spill condition, bs < |0.14|, ps > .13. This analysis uncovered a significant effect of Age Group, $b = -0.459$ ($SE = 0.091$), $p < .001$, which indicated that, as with the American participants in Study 2, Indian children were considerably more likely than Indian adults to attribute positive characteristics to the clean twin. There was no significant effect of Valence, $b = 0.005$, $p = .926$.

To examine tendencies to positively evaluate the clean twin and negatively evaluate the dirty twin, one-sample t-tests compared participants' ratings to chance. Because the linear mixed regression revealed a significant effect of Age Group, but not Condition, ratings were averaged across conditions and split across the two age groups. We averaged responses across the ten trait evaluations, as there were no differences across positively and negatively valenced items and the evaluations formed a reliable scale ($\alpha = .834$). These t-tests indicated that Indian children were substantially more likely to attribute positive characteristics to the clean twin than to the dirty twin, $t(47) = 7.485$, $p < .001$, $d = 1.080$, whereas Indian adults showed no tendency to do so, $t(51) = 0.029$, $p = .977$, $d = 0.004$.

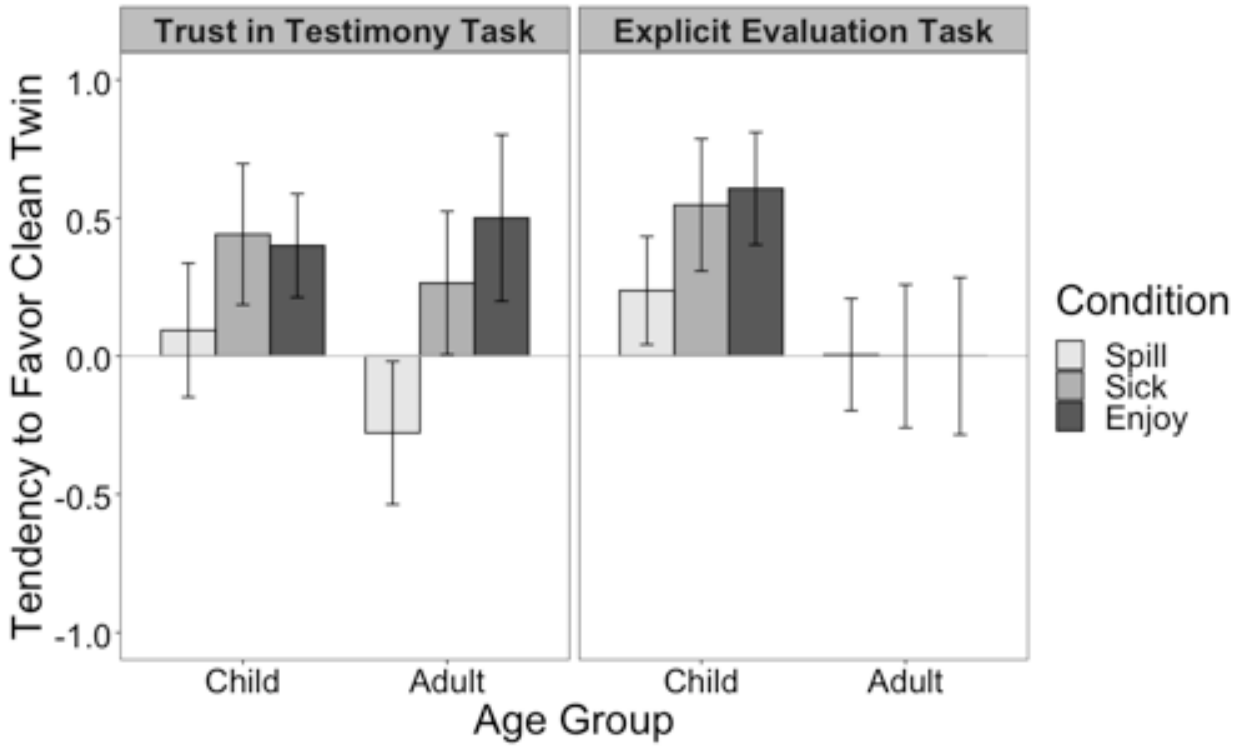

Fig. 5. **Overall preferences for the clean twin, as measured by the primary tasks in Study 3, split by Condition and Age Group.** Negative values indicate tendencies to favor the dirty twin, while positive values indicate tendencies to favor the clean twin (zero indicates a lack of preference). Error bars represent 95% confidence intervals.

Additional measures. Due to space limitations, detailed analyses of the IAT and Resource Distribution Task are presented in the Supplementary Materials. Again, both tasks uncovered strong biases in our child sample ($ps \leq .001$), while adults' responses in the Resource Distribution Task were too inconsistent to analyze.

Individual differences and relationships between measures. Children's ratings on the Disgust Scale were scored as in Study 2 (and three items were reverse-scored). These items were averaged into a single index ($\alpha = .677$). There was a significant association between scores

on the Disgust Scale and scores on the Trust in Testimony Task, $r(96) = .215$, $p = .033$, the Explicit Evaluation Task, $r(96) = .213$, $p = .035$, and the Resource Distribution Task, $r(96) = .201$, $p = .048$, but not the IAT, $r(44) = .116$, $p = .301$. Overall, therefore, there is some indication that an increased sensitivity to disgust may amplify biases toward clean individuals and against dirty individuals. There was a negative correlation between children's age and their IAT difference scores, $r(46) = -.304$, $p = .035$, but there were no significant correlations between Age in Months and performance on any of the other tasks, rs $< |.28|$, ps $> .05$.

Discussion

Overall, the findings in Study 3 largely replicated those of Study 2. Biases toward the clean child were evident in each of the four tasks. However, these biases emerged less reliably for adults, who (like American adults in Study 2) did not evaluate the clean twin as having more positive traits or fewer negative traits. With the exception of the Trust in Testimony Task, these results tended to emerge similarly across conditions, indicating that attitudes toward dirty individuals are not strongly modulated by the cause of dirtiness. Again, this evidence most strongly supports the General Avoidance Hypothesis.

Because these participants were embedded in a markedly different cultural context than the American participants in Study 2, and in particular one that often exemplifies concerns about purity, it is striking that the results were so similar across these samples. This correspondence suggests that biases against dirty individuals may manifest similarly across societies, even when historical and religious factors strongly emphasize virtues of purification and avoidance of pollution. However, because the Indian participants were all English-speaking (as a second language) and were therefore potentially more exposed to Westernized ideas than the average Indian, this conclusion must remain tentative.

General Discussion

The present research found that a bias against physically unclean and unhygienic people emerges by the age of 5 and persists into adulthood. This general finding is robust; we uncovered converging evidence of biased responding across a wide range of dependent measures and multiple forms of dirtiness. Study 1 found that children and adults consider clean adults to be more likely to possess favorable traits than dirty adults, and adults have particularly strong tendencies to trust information provided by clean adults. Study 2 showed that only children view clean children as possessing more favorable traits than dirty children, but both children and adults selectively trust the testimony of clean children. Additionally, Study 2 uncovered a bias against dirty children in three out of four additional tasks (see Supplementary Materials) and found that this bias is generally constant across different manifestations of dirtiness. Study 3 uncovered similar patterns of results in an Indian sample. Although some measures involved forced choice responses that prevent an interpretation of this bias as either being directed toward clean individuals or against dirty individuals, other measures indicated that both tendencies are at play. Taken as a whole, these findings suggest that people who are perceived to be dirty (e.g., the homeless and sanitation workers) will be frequently mistrusted, marginalized, maligned, and misunderstood from an early age.

Children and adults diverged in the strength of their biases across all three studies. On the whole, the evidence indicates that people more harshly evaluate dirty individuals who more closely approximate their own age. This finding is difficult to interpret from the perspective of the Pathogen Avoidance Hypothesis, as members of one's peer group are not more or less likely to be contagious than members of older or younger cohorts, and weaker biases against dirty individuals from a different age group would be a poor feature of an adaptation for avoiding

harmful pathogens. However, the finding that children were more biased toward children while adults were more biased toward adults is clearly in line with the Social Affiliation Hypothesis. From the perspective that biases against dirty individuals operate to enhance social standing by preventing undesirable affiliative ties, it is less necessary to actively distance oneself from a member of a different age group. Thus, although there were not clear condition differences in Studies 2 or 3, these results help to illuminate potential underpinnings of preferences for clean individuals and disdain for unclean individuals.

In conclusion, these findings indicate that dirty individuals are likely to be stripped of multiple benefits, such as strong social ties and reduced power to effectively transmit cultural beliefs and values, while clean individuals are likely to be admired and trusted as purveyors of cultural wisdom. Gaining a fuller understanding of when and why children begin to develop a disdain for dirtiness carries implications for knowing how to create interventions that could mitigate the discriminatory and sometimes inhumane treatment of individuals who are physically unclean. Depending on the extent to which this early-emerging disdain of physical dirtiness translates into prejudice toward social groups that are figuratively described as “dirty” or “contaminating”, this bias may also have implications for acts of ethnic cleansing and for the treatment of minority groups more broadly.

There is room for substantial optimism for the effectiveness of such interventions. Specific conceptualizations of cleanliness are facilitated by sociocultural constructions that vary substantially across historical time and cultural contexts (Feder, 2015; Speltini & Passini, 2014, 2016). Therefore, views about the dirtiness of marginalized members of society may be highly malleable. As socialization is a major factor in shaping children’s experiences of disgust and beliefs about what is disgusting (Oaten, Stevenson, Wagland, Case, & Repacholi, 2014;

Rottman, Young, & Kelemen, 2017), and the nature of children's social biases (Lane, Conder, & Rottman, 2019; Over & McCall, 2018; Patterson & Bigler, 2006), it is likely that adults can exert a major influence on how children conceptualize and treat people who are dirty. Basic research on the emergence of a disdain for dirty people will be an essential first step in understanding how to combat this bias and the stigmatization it breeds.

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In Sickness and in Filth: Developing a Disdain for Dirty People

Online Supplementary Materials

Method

Participants

Study 2. Participants were randomly assigned to the Sick Condition (Adults: $N = 16$, 12 females; Children: $N = 16$, 8 females, $M_{age} = 7.47$, $SD_{age} = 1.38$), the Enjoy Condition (Adults: $N = 16$, 11 females; Children: $N = 16$, 8 females, $M_{age} = 7.64$, $SD_{age} = 1.84$), or the Spill condition (Adults: $N = 16$, 13 females; Children: $N = 16$, 5 females, $M_{age} = 7.22$, $SD_{age} = 1.35$).

Study 3. Participants were randomly assigned to the Sick Condition (Adults: $N = 17$, 2 females, $M_{age} = 29.06$, $SD_{age} = 4.63$; Children: $N = 17$, 9 females, $M_{age} = 7.27$, $SD_{age} = 1.41$), the Enjoy Condition (Adults: $N = 17$, 5 females, $M_{age} = 33.41$, $SD_{age} = 8.49$; Children: $N = 15$, 5 females, $M_{age} = 7.18$, $SD_{age} = 1.48$), or the Spill condition (Adults: $N = 18$, 3 females, $M_{age} = 30.28$, $SD_{age} = 6.99$; Children: $N = 16$, 9 females, $M_{age} = 7.49$, $SD_{age} = 1.82$).

Additional Measures

Study 2 only. A Drawing Task was administered in order to examine participants' representations of the physical distance that they would place between themselves and each of the twins (Diesendruck & Menahem, 2015; Lane, Conder, & Rottman, 2019). Each participant was given a white legal sheet of paper and a box with colored crayons and asked to draw a self-portrait in a confined space in the middle of the paper. Participants were then asked to draw each of the twins, one at a time (in counterbalanced order), to the left and right of their own image on the same sheet of paper. The distances from the participant's self-portrait to the clean twin and to the dirty twin were measured. Because distance was never

mentioned to participants as a relevant aspect of the task, this can be considered an implicit measure of attitudes.

In an Ambiguous Situations Task (McGlothlin & Killen, 2006), participants were asked to interpret a series of four still frame photographs in which the twins' actions could be interpreted as intentional or unintentional. Two of these photographs portrayed actions that were meant to be disgusting, as they involved consuming either a bowl of pasta or a cup of juice that contained an insect (each of which could be done on purpose or accidentally). The other two photographs involved non-disgusting actions that were either malicious or innocuous (sitting on a toy bear intentionally or accidentally; organizing or disorganizing crayons). For each of these two categories (disgusting vs. non-disgusting), the clean twin performed one of the actions and the dirty twin performed the other action, counterbalanced across participants (see Fig. S3).

Studies 2 and 3. In an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) adapted for use with children (Baron & Banaji, 2006; Dunham, Baron, & Banaji, 2006), a series of smiling and frowning faces were successively paired with a series of photos of the clean and dirty twins in order to measure relative associations between these different pairings. Both the faces and the photos of the twins were varied across trials; in total, there were five smiling faces, five frowning faces, seven photos of dirty twins, and seven photos of clean twins. Across five blocks of trials, the pictures of the twins and/or frowning and smiling faces appeared in the middle of the screen, one at a time. In an initial training stage, participants were asked to press one button in response to photos of the twin wearing a dirty shirt and another button in response to photos of the twin wearing a clean shirt. In a second training stage, participants were asked to press one button in response to frowning faces and another button in response to smiling faces. In a congruent trial stage, participants were asked to press these same buttons, such that one response key was shared for both the

clean twin and smiling faces and another response key was shared for both the dirty twin and frowning faces. In an incongruent trial stage, the dirty twin was instead paired with smiling faces and the clean twin was paired with frowning faces. Between these trial stages, participants were also given another training stage in which the "dirty" and "clean" sides were reversed and they had an opportunity to press different response keys to photographs of the twins. There were ten pictures in each of the training stages and twenty-five pictures in each of the trial stages, and the congruent and incongruent trial stages were counterbalanced across participants (see Fig. S4).

In a Resource Distribution Task, participants were sequentially presented with four desirable items (a fidget spinner, a stuffed animal, a box of candy, a box of new headphones) and four undesirable items (a ginger root, a broken toy, a floppy disk, a crushed soda can). These eight items were given to participants in a random order (see Fig. S5). Participants were then instructed to distribute each of these items to one of the twins, by placing them in buckets that belonged to the twins, or to an empty bucket (see Buttelmann & Böhm, 2014). The advantage of this design is that participants could potentially favor one twin (by giving them more positive resources) without actively disfavoring the other twin (as there was the option to deposit bad resources in a neutral location). At the end of this task, participants were asked to rank the items in order from their least favorite to their most favorite (Sheskin et al., 2016) in order to ensure that our categorization of the items as positive and negative was consistent with participants' valuation of the items.

Results

Study 2

Drawing Task. A difference score was computed by subtracting the distance (in centimeters, from neck to neck) between the participant's self-portrait and their depiction of

the clean twin from the distance between their self-portrait and their drawing of the dirty twin. Thus, higher numbers represented larger relative distances between the participant and the dirty twin. To test whether the difference in distances differed as a function of Condition (Spill vs. Sick vs. Enjoy) or Age Group (Child vs. Adult), we conducted a linear regression. There were no significant effects of either of these factors, bs < |0.53|, ps > .38.

To evaluate whether participants' drawings of the dirty twin were placed farther away from the drawings of themselves as compared to their drawings of the clean twin, a one-sample t-test compared the difference in distances (collapsed across all participants and all conditions) to zero. This test failed to uncover any evidence of a favorable bias toward the clean twin, $t(95) = -0.150$, $p = .881$, $d = 0.015$ (see Fig. S6).

Ambiguous Situations Task. Responses were scored such that attributions of intentionality indicated a bias against one of the twins (1 or -1), while attributions of accidental or innocent behavior indicated no bias (0). Because each pairing of photos (the two disgusting acts and the two potentially malicious acts) included one instance of the clean twin and one instance of the dirty twin, the codings of these pairs were combined for each participant to obtain a score between -1 and 1. To test whether positive evaluations of the clean twin differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), and Item Type (Disgusting vs. Non-Disgusting), we conducted a linear mixed regression model, controlling for the random intercepts of participants. This analysis did not uncover any significant effects, bs < |0.15|, ps > .20.

To evaluate whether participants were less likely to attribute disgusting or malicious intentions to the clean twin than to the dirty twin, a one-sample t-test compared overall tendencies to interpret the ambiguous situations as intentional to chance levels. Because the previous analysis revealed no significant effects, the scores were averaged across Item Type and a single test was conducted, collapsing across conditions and age groups. This t-test

indicated that participants were less likely to interpret the photographs as showing negative intentions when the clean twin was pictured, $t(95) = 2.562$, $p = .012$, $d = 0.262$ (see Fig. S6).

IAT. The overall difference in latency (in milliseconds) between "incongruent" trials (in which the clean twin was paired with frowning faces) and "congruent" trials (in which the clean twin was paired with smiling faces) was calculated for each participant. To test whether the difference in latency differed as a function of Condition (Spill vs. Sick vs. Enjoy) or Age Group (Child vs. Adult), we conducted a linear regression. Neither the Sick condition nor the Enjoy condition produced latencies that significantly differed from the Spill condition, *b*s < 96, *p*s > .32. There was a significant effect of Age Group, $b = -236.53$ ($SE = 78.38$), $p = .003$, such that children had a larger difference in latency than adults. However, rerunning this analysis with average *D* scores (a typical measure of IAT effect size) as the outcome variable, rather than differences in latency, indicated that there were no significant effects of either Condition or Age Group, *b*s < 0.11, *p*s > .29.

To evaluate whether there were stronger implicit associations between the clean twin and positive valence than between the dirty twin and positive valence, one-sample *t*-tests compared the differences in latency to zero. Because the previous analysis revealed a significant effect of Age Group but not Condition on latency differences, the data were averaged across conditions and split by age. These tests indicated that participants were slower to respond in incongruent trials, meaning that there were implicit associations in the predicted direction, for both children, $t(47) = 5.587$, $p < .001$, $d = 0.806$, and adults, $t(47) = 5.569$, $p < .001$, $d = 0.804$ (see Fig. S6). This effect replicated in a one-sample *t*-test using *D* scores as the outcome variable and collapsing across Age Group and Condition, $t(95) = 9.482$, $p < .001$, $d = 0.968$. The average *D* score was 0.541 for children and 0.432 for adults, which are both considered to be moderate effects. Thus, even though children had greater differences in latency overall, the strength of these associations appeared roughly equivalent

across age groups when accounting for the greater variability in children.

Resource Distribution Task. Participants' rankings of the eight resources confirmed that our categorization of the positive and negative resources was fully in line with children's and adults' own assessments. Responses were scored such that giving a positive resource to the clean individual or giving a negative resource to the dirty individual indicated a bias favoring the clean individual (1), while giving a positive resource to the dirty individual or giving a negative resource to the clean individual indicated a bias favoring the dirty individual (-1), and putting a resource in the "Nobody" bucket indicated no bias (0). Thus, as with the previous tasks, positive numbers indicate partiality towards the clean twin and prejudice against the dirty twin. To test whether positive evaluations of the clean twin differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), and Resource Valence (Positive vs. Negative), we conducted a linear mixed regression model, controlling for the random intercepts of participants and questions. There was no significant difference between ratings in the Sick condition and ratings in the Spill condition, $b = -0.090$ ($SE = 0.082$), $p = .278$, but there was a significant difference between ratings in the Enjoy condition and ratings in the Spill condition, $b = 0.211$ ($SE = 0.082$), $p = .012$. There were no significant effects of Age Group or Resource Valence, bs $< |0.12|$, ps $> .09$. The null effect of Resource Valence indicates that favoritism of the clean twin was aligned with derogation of the dirty twin.

We next investigated whether participants were more likely to favor the clean twin when distributing resources. Given that there were no significant effects of Valence or Age Group, we attempted to scale all eight resource distribution items into a single index for both children and adults. However, the internal consistency amongst the items was unacceptable, $\alpha = .278$, and thus the items could not be combined to form a reliable scale. Further investigation indicated that this poor inconsistency was driven entirely by adults, $\alpha = -.722$.

Children distributed the eight items much more consistently, $\alpha = .575$, and this consistency rose to acceptable levels when the box of candy was removed from the analysis, $\alpha = .711$. Therefore, the adults were fully excluded from this analysis, and patterns of distribution for the box of candy were excluded for children. Because a linear mixed regression model with only children and the other seven items still did not reveal any effects of Condition or Resource Valence (*p*s > .10), a single one-sample *t*-test was conducted. This *t*-test indicated that children were substantially more likely to favor the clean twin when distributing resources, $t(47) = 2.970$, $p = .005$, $d = 0.429$ (see Fig. S6).

Differences Between Twins. Two independent coders ($\kappa = .834$) coded the reasons that participants gave for why the twins looked different from each other, and disagreements were resolved through discussion. Overall, 13/16 children and 14/16 adults in the Spill condition, as well as 15/16 children and 14/16 adults in the Enjoy condition, cited either soup or cleanliness as the reason for the difference between the twins, whereas 15/16 children and 13/16 adults in the Sick condition cited vomit or health as the reason for the difference between the twins.

Study 3

IAT. In the Indian sample, the IAT was only administered to child participants. The overall difference in latency (in milliseconds) between "incongruent" trials (in which the clean twin was paired with frowning faces) and "congruent" trials (in which the clean twin was paired with smiling faces) was calculated for each participant. To test whether the difference in latencies differed as a function of Condition (Spill vs. Sick vs. Enjoy), we conducted a linear regression. As in Study 2, there were no significant differences between latencies in the Sick condition and latencies in the Spill condition or between latencies in the Enjoy condition and latencies in the Spill condition, *b*s < 228, *p*s > .31. Rerunning this analysis with average *D* scores rather than differences in latency similarly found no significant effects of Condition,

*b*s < |0.10|, *p*s > .57.

To evaluate whether there were stronger implicit associations between the clean twin and positive valence than between the dirty twin and positive valence, a one-sample *t*-test compared the differences in latency to zero. Because the previous analysis revealed no significant effects, the data were averaged across conditions. This test indicated that participants were slower to respond in incongruent trials, meaning that there were implicit associations in the predicted direction, $t(47) = 9.490$, $p < .001$, $d = 1.370$ (see Fig. S8). This effect replicated in a one-sample *t*-test using *D* scores as the outcome variable and collapsing across Condition, $t(47) = 12.155$, $p < .001$, $d = 1.754$. The average *D* score was 0.793, which is considered a strong effect.

Resource Distribution Task. Responses were scored as in Study 2. To test whether positive evaluations of the clean informant differed as a function of Condition (Spill vs. Sick vs. Enjoy), Age Group (Child vs. Adult), and Resource Valence (Positive vs. Negative), we conducted a linear mixed regression model, controlling for the random intercepts of participants and questions. As in Study 2, there was no significant difference between ratings in the Sick condition and ratings in the Spill condition, $b = 0.078$ ($SE = 0.093$), $p = .405$, and there was a marginally significant difference between ratings in the Enjoy condition and ratings in the Spill condition, $b = 0.188$ ($SE = 0.095$), $p = .051$. Unlike Study 2, there was a significant effect of Age Group, $b = -0.218$ ($SE = 0.077$), $p = .006$, such that children were more likely to favor the clean twin than were adults. There was also no significant effect of Resource Valence, $b = 0.095$ ($SE = 0.135$), $p = .509$, again indicating that favoritism of the clean twin was aligned with derogation of the dirty twin.

We next investigated whether participants were more likely to favor the clean twin when distributing resources. As in Study 2, however, the internal consistency amongst the items was unacceptable, $\alpha = .456$, and thus the items could not be combined to form a reliable

scale. Further investigation indicated that this poor consistency was again driven by adults, $\alpha = .127$. Children distributed the eight items more consistently, $\alpha = .568$, and this consistency rose above a poor level of consistency when the ginger root and headphones were removed from the analysis, $\alpha = .614$. Therefore, the adults were again fully excluded from this analysis, and patterns of distribution for the ginger root and headphones were excluded for children. Because a linear mixed regression model with only children and the other six items did not reveal any effects of Condition or Resource Valence (*p*s > .40), a single one-sample *t*-test was conducted to compare the results to chance. This *t*-test indicated that children were substantially more likely to favor the clean twin when distributing resources, $t(47) = 3.509$, $p = .001$, $d = 0.506$ (see Fig. S8).

Differences Between Twins. Two independent coders ($\kappa = .826$) coded the reasons that participants gave for why the twins looked different from each other, and disagreements were resolved through discussion. Overall, 13/16 children and 18/18 adults in the Spill condition, as well as 12/15 children and 17/17 adults in the Enjoy condition, cited either soup or cleanliness as the reason for the difference between the twins, whereas 14/17 children and 14/17 adults in the Sick condition cited vomit or health as the reason for the difference between the twins.

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Table S1. Items used in the Disgust Scale in Study 1.

1. If somebody gave you a piece of chocolate that was shaped like dog doo, would you eat it?
2. If somebody else in your class got sick and threw up yesterday, would you still play with them during recess?
3. If you accidentally dropped your favorite toy into a dirty toilet, would you reach in to get it back?
4. If you got food from your favorite restaurant and saw that it had a person's hair in it, would you still eat it after you took the hair out?
5. If you were in a swimming pool and somebody peed at the other end of the pool, would you get out of the pool? [R]
6. If you wanted a piece of cake but a stranger had sneezed on it, would you still eat it?
7. If you were stranded on an island and could only eat bugs, would you eat them to survive?
8. If you touched something dirty and were next in line to get a slice of pizza, would you still take it without washing your hands?

Note: Item #1 was adapted from Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences, 16*(5), 701–713. [R] indicates an item that was reverse-scored.

Table S2. Items used in the Disgust Scale in Studies 2 and 3.

1. If a dog licked your popsicle, would you still eat it?
2. When you see blood, do you feel dizzy? [R]
3. *Study 2*: Would you feel gross if you touched raw meat? [R]
   Study 3: Would you watch a TV show that showed people's insides?
4. Would you touch a sandwich with green mold on it?
5. Would you still eat your soup if you saw somebody else's hair in it?
6. Would you sit next to a sweaty kid at lunch?
7. Would you use the toilet even if there was poop still in it?
8. Would you share markers with someone who touched a dead bird?
9. Would you feel sick if you saw a dead animal on the side of the road? [R]
10. Would you still drink out of your juice box even if you saw another kid drink out of it?
11. Do you feel sick if you see someone else throw up? [R]
12. Would you sit next to someone even if they wore the same underwear all week?
13. If your friend gave you a piece of chocolate that was shaped like dog doo, would you eat it?

Note: [R] indicates an item that was reverse-scored.

Fig. S1. Photos of the clean and dirty twins, as presented to male participants in Study 1.

Fig. S2. Photos of the clean and dirty twins, as presented to female participants in Study 2.

Fig. S3. Photos used in the Ambiguous Situations Task. Versions of some of these photos (cropped to include only the person) were also used in the IAT, along with other posed photographs.

Fig. S4. A sample screenshot from an incongruent trial in the IAT.

Fig. S5. The buckets and resources used in the Resource Distribution Task.

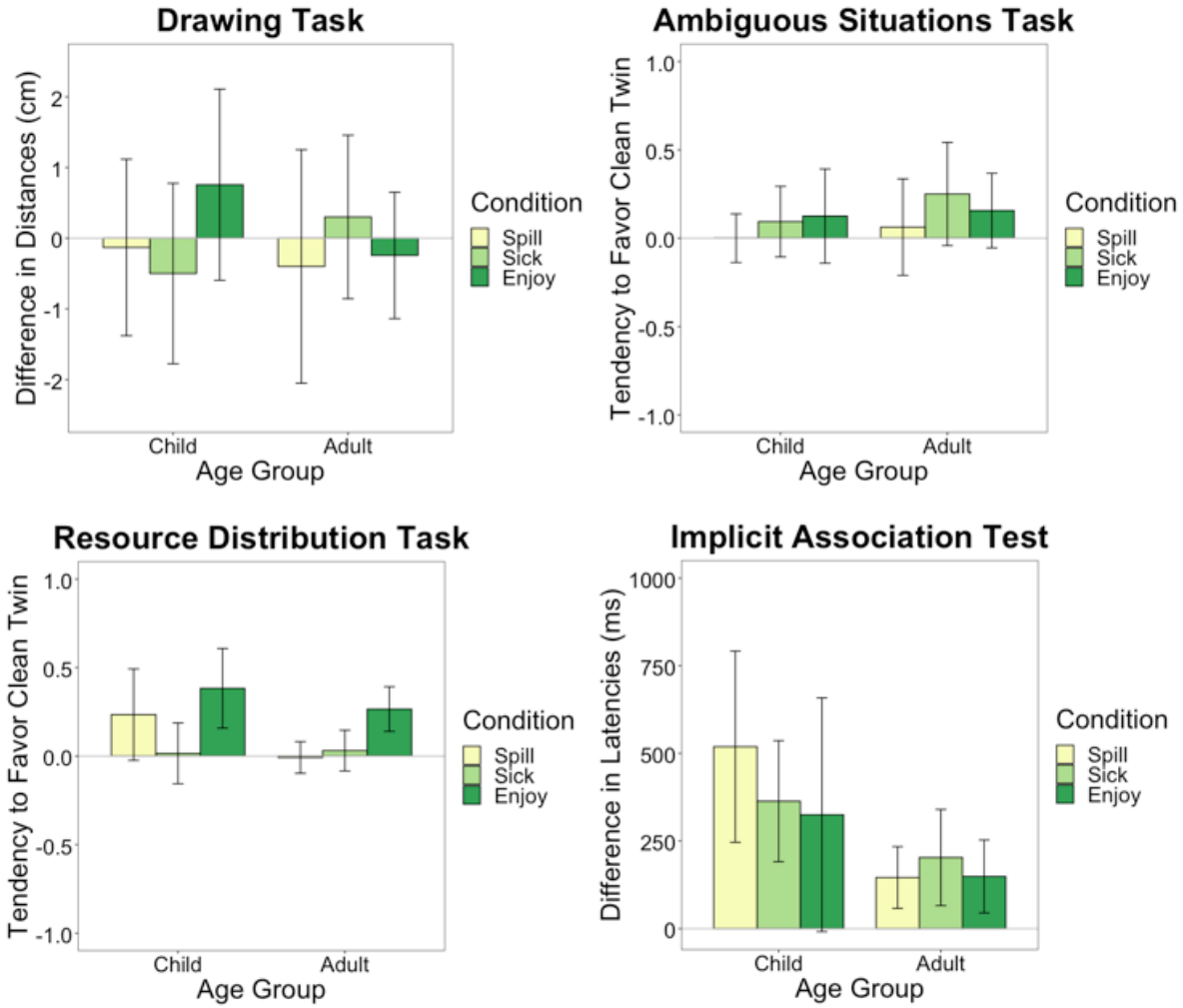

Fig. S6. Overall preferences for the clean twin, as measured by the additional tasks in Study 2, split by Condition and Age Group. For the Drawing Task, higher positive values indicate larger distances between the dirty individual and the self-portrait, compared to the distances between the clean individual and the self-portrait, while negative values indicate the reverse. For the Implicit Association Test, higher values indicate a larger difference in latencies when responding to "incongruent" trials (pairing smiley faces with dirty people) compared to "congruent" trials (pairing frowning faces with dirty people). For the Ambiguous Situations Task and the Resource Distribution Task, negative values indicate tendencies to favor the dirty informant, while positive values indicate tendencies to favor the clean informant (zero indicates a lack of preference). Error bars represent 95% confidence intervals.

Fig. S7. Photos of the clean and dirty twins, as presented to participants in Study 3.

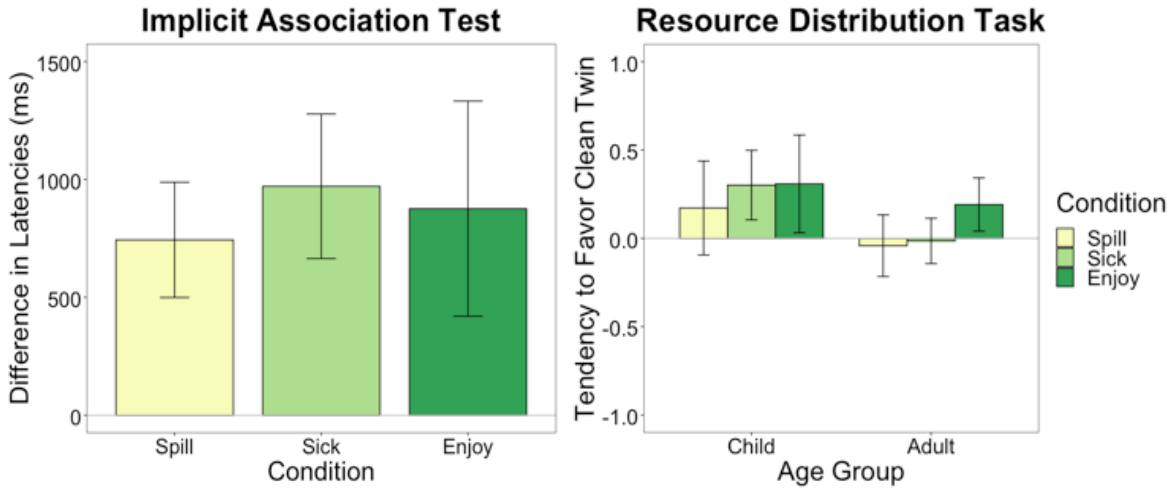

Fig. S8. Overall preferences for the clean twin as measured by the additional tasks in Study 3, split by Condition and Age Group (NB: for the Implicit Association Test, only children were tested). For the Implicit Association Test, higher values indicate a larger difference in latencies when responding to "incongruent" trials (pairing smiley faces with dirty people) compared to "congruent" trials (pairing frowning faces with dirty people). For the Resource Distribution Task, negative values indicate tendencies to favor the dirty informant, while positive values indicate tendencies to favor the clean informant (zero indicates a lack of preference). Error bars represent 95% confidence intervals.