

Once in Contact, Always in Contact: Contagious Essence and Conceptions of Purification in American and Hindu Indian Children

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Cultural and age differences in responses to contamination and conceptions of purification were examined in Hindu Indian ($N = 125$) and American ($N = 106$) 4- to 5-year-olds and 8-year-olds, who were provided with stories of juice contaminated by contact with a cockroach, a human hair, and a stranger (via sipping). Children who rejected the juice as being fit to drink were probed to determine whether their rejection was based on material essence (reduced by boiling), association (reduced by color change), or spiritual essence (reduced by sipping by the mother). A majority of 4- to 5-year-olds showed some form of contamination response, as did the great majority of 8-year-olds. Younger children's judgments were often based on spiritual essence or association, whereas material essence was more important for the older children, particularly Americans. However, for many children in both cultures, no purifiers were effective. In keeping with Hindu culture, the Indian children responded significantly more strongly to stranger or cockroach contamination and, with increasing age, viewed contamination as more impervious to any kind of purification.

Following initial demonstrations of sensitivity to food contamination in both adults (Rozin, Millman, & Nemeroff, 1986) and children past the preschool years (Fallon, Rozin, & Pliner, 1984; Rozin, Fallon, & Augustoni-Ziskind, 1985), it is now well established that even young children in Western countries also have substantial contamination sensitivity (see Kalish, 1999, for a review). By the age of 3 years, some children recognize that food or drink that is apparently fresh in appearance may in reality be contaminated. For example, children often say that they would refuse a drink that earlier had been contaminated through contact with a cockroach, even though they realize that another child who had not been informed of the incident of contamination would think that the drink was acceptable (Siegal, 1988; Siegal & Share, 1990). Similarly, some children as young as 3 years of age appreciate that a substance can continue to exist and maintain its inherent properties (e.g., taste or weight) even after it becomes invisible upon dissolving (Au, Sidle, & Rollins, 1993; Rosen & Rozin, 1993). Moreover, in a study with groups of 3- to 4-year-olds and 7- to 8-year-olds, Springer and Belk (1994) showed that some of the preschoolers and most of the older children recognized the need for physical contact between a contaminant (e.g., a bug

and an uncontaminated substance (e.g., juice) in order to make the substance noxious.

Preschoolers also understand that contamination occurs through invisible germ mechanisms (Kalish, 1996a, 1996b) and have some recognition that contamination involves a natural process that cannot be reversed in the way that a physical process affecting inanimate objects can. For example, even 4-year-olds make a distinction between the possibilities of restoring an inanimate object such as a pencil with a broken tip and restoring an animate object such as a rotten peach. They recognize that the pencil can be repaired by gluing on the tip but that the peach cannot be made fresh even through washing and refrigeration (Springer, Nguyen, & Samaniego, 1996).

Yet there is evidence that young children's conceptions of contamination fall short of the Western adult view. For example, some children may view germs as harmful entities that are more like toxins in that they do not reproduce (see Kalish, 1999). Instead of identifying germs as living organisms that multiply, children 4–7 years of age appear to maintain that germs are not alive and do not eat or die and that colds are as likely to be transmitted by poisons or by irritants such as pepper as they are by germs (Solomon & Cassimatis, 1999). Children may also express the views that illness transmission through germs occurs immediately on contact rather than after a period of incubation (Kalish, 1997) and that germs grow like tumors but do not reproduce inside the body (Au, Romo, & DeWitt, 1999). Such findings suggest that some children regard illness as simply due to physical contact with noxious substances rather than as the outcome of microscopic infection by germs. On this basis, it has been concluded that young children may have little understanding of the role of germs as a biological mechanism in the transmission of illness. Conceptual change may involve a progressive "tuning in" to the biological nature of invisible contaminants in which children relinquish the

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notion that contamination simply reflects an immediate contact with noxious substances in favor of the Western culturally received view that contamination results from infection through the transmission of biological organisms.

In this respect, during the time when children may be coming to develop a biological understanding of contamination, their conceptions are likely to be influenced by the *laws of sympathetic magic*, which were originally described as being adhered to by adults in traditional cultures (Frazer, 1890/1959; Mauss, 1902/1972; Tylor, 1871/1974) but which seem to be universal among adults (Rozin & Nemeroff, 1990). One of the laws, the *magical law of contagion* (or *contamination* in the case of negative entities), states that persons or objects that have come into contact with each other continue to exert an influence on each other even after the physical contact has been severed (“once in contact, always in contact”). Any kind of properties might be transmitted, whether these are physical, moral, or psychological in nature and harmful or beneficial in effect. The *source* and the *recipient* of contagion may come into direct or indirect contact (mediated by a *vehicle*), which may be brief or intimate. Transmission of properties occurs through the transmission of *essence*, which is believed to contain the essential properties of the source (Nemeroff & Rozin, 1994, 2000; Rozin & Nemeroff, 1990).

The realm of food and eating is a particularly potent one for investigating the magical law of contagion, because in many cultures it is frequently believed that the properties of a source are conveyed to a recipient via ingestion. The act of eating is a biological necessity embedded in a social framework, and as a result, it has strong social and moral implications for most people in the world. The mouth is the principal incorporative organ. Nothing could be more threatening or intimate than to take something into the self (the body), and this occurs in every act of ingestion. Biology dictates that ingestion is an absolute and frequent necessity, incorporating benefits (e.g., nutrition) as well as risks (e.g., toxic substances). Consequently, as Rozin (1990) noted, ingestion is an act about which people feel strongly, and liking and disliking are terms that naturally apply to food. If a substance is a contaminant, it can prompt individuals to reject an otherwise acceptable food because they perceive the food to have been soiled or made impure by even a trace amount of that substance, whether visible or not. This process can extend to involve associational contamination thinking, in which persons believe that mere proximity between a contaminant and an object can contaminate a previously neutral object (Fallon et al., 1984; Springer & Belk, 1994; for reviews, see Kalish, 1999, and Nemeroff & Rozin, 1994).

Contamination sensitivity is uniquely human, and contamination is a defining feature of disgusting entities (Rozin & Fallon, 1987; Rozin, Haidt, & McCauley, 2000). It is not clear at this time whether sensitivity to contamination originated as an adaptation designed to protect against microbial infection, but many instances of contamination sensitivity in contemporary human adults cannot be explained by a microbial model. For example, it has been shown that American adults hesitate to consume soup that has been stirred by a brand new comb or a new and unused flyswatter (Rozin, Fallon, & Mandell, 1984; Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999; Rozin, Nemeroff, Wane, & Sherrod, 1989) or to drink juice that has been in contact briefly with a dead,

sterilized cockroach (Rozin et al., 1986, 1989). As they possess the knowledge that the possibility of microbial contamination has been eliminated, the main source of thinking that the objects in these cases are contaminated stems from a feeling of disgust or revulsion. Similarly, the Kai of northern New Guinea believe that “everything with which a man comes in contact retains something of his soul stuff” (Frazer, 1890/1959, p. 68). In magical contagion, the nature of the relationship between the source and the recipient determines whether contact has an impact on the recipient’s perceived well-being and what type of impact it will be. According to this law, one’s enemy’s character or evil intent can be absorbed into his clothing and passed on to the next person who comes in contact with the garment (Nemeroff & Rozin, 1989).

Nemeroff and Rozin (1994) proposed that the belief underlying magical contagion, that “contact causes influence,” might be acquired from early cultural experience. According to this analysis, Shweder’s (1977) distinction between intuitive and nonintuitive concepts is useful in understanding the operation of the laws of contagion. Shweder defined *intuitive concepts* as concepts that are available for use without conscious effort or reflection and that are acquired easily, even under highly degraded learning conditions. In contrast, *nonintuitive* concepts require special learning conditions for their acquisition. As these learning conditions are difficult to arrange, nonintuitive concepts are less widely distributed than intuitive ones, both within and across human populations. The broad concept of contamination in terms of transmission of influence via contact can be regarded as an intuitive or prepared, spontaneously occurring concept, helping to delimit what are credible causal mechanisms. It may persist during development and not be completely replaced or suppressed by less intuitive, rival scientific concepts such as digestion or the purification of contaminated liquids through boiling.

Prior research has focused on establishing the existence of contagion in various domains and on describing the major features of its development, from absence in children younger than 3 years of age to full manifestation of adult features some time before age 10. In these contexts, contagion has been shown to have a set of properties roughly indicated in the original works on the subject (Tylor, 1871/1974; Frazer, 1890/1959; Mauss, 1902/1972). Contagion effects tend to be permanent, to be dose insensitive, to require contact, to be capable of transmitting any characteristic of the source, and to be more potent with negative than with positive entities (Rozin, Markwith, & Nemeroff, 1992). Only one study (Nemeroff & Rozin, 1994) has explored, for adults, the nature of the contagious essence (reviewed in Nemeroff & Rozin, 2000). This research indicates the possible operation of three different models of contagion in American adults: an association model (mere association between the contaminant and the source), a material essence model (transfer of physical properties), and a spiritual essence model (transfer of nonmaterial properties). Nemeroff and Rozin showed that some American adults rely principally on a material essence model, others on a spiritual model, and some on both. The technique used by these authors to infer the nature of essence was to determine what transformations were considered to decontaminate a contaminated entity. Associational contamination would be subject to extinction or to a change in the appearance of the source; material essence would be removed or neutralized by washing or boiling. There is no clear neutralizer of spiritual es-

sence, but it was assumed that contact with an opposite-valenced person (e.g., an admired figure) might cancel the effects of a negative spiritual essence.

As cultural factors appear to be the predominant determinants of human food selection (Rozin, 1982; Rozin & Siegal, 2003), it is of prime importance to determine how intuitive concepts of contamination are manifested in children living in different cultures. In this study, we sought to compare American and Hindu Indian children's responses to situations of potential contamination and purification. In Hindu India, food is the major vehicle for maintaining social distinctions and provides an important arena in which to enact basic moral beliefs (Appadurai, 1981). The moral status of food derives from notions of purity and pollution that help define the caste structure. On the one hand, sharing of food has a homogenizing function in that it equalizes the status of sharers and promotes intimacy and solidarity. On the other hand, food has a heterogenizing function. A refusal to share food with members of lower castes serves to establish rank, distance, and segmentation. The basic rule in Hindu India is that higher caste members can give food to members of a lower caste but that one cannot accept food prepared by members of a lower caste (Marriott, 1968). Rule violations are often viewed as disgusting, a threat to the soul and a danger to the spirit, and hence contribute to forms of contamination sensitivity in Hindu Indian children that differ from those of children raised in a Western culture.

Our study thus differs from its predecessors in three ways. First, the sample includes children from India—a third-world culture and one in which contamination and purity constitute a major theme. Second, the range of contaminants is very wide, including entities considered as dangerous, disgusting, and distasteful. Third, the procedures and analysis extend beyond a demonstration of contamination sensitivity and allow an analysis for the first time of the nature of contagious essence as a function of age and culture. We included probes to assess associational, material, and spiritual essence.

We entertained the following hypotheses:

Hypothesis 1: In accordance with prior work on children's developing conceptions of mechanisms underlying contamination (Kalish, 1999), there will be a gradual increase in contamination sensitivity with age.

Hypothesis 2: In both Hindu Indian and American children, the increase in contamination sensitivity with age will be accompanied by a sharper focus of the contamination response on actually dangerous or disgusting contaminants and on the necessity of physical contact.

Hypothesis 3: The nature of contagious essence will become better defined with age and, analogously to the case with adults, will center more on material and spiritual essences.

Hypothesis 4: The progression of contamination sensitivity will be similar in Hindu Indian and American children but with a possible earlier onset in Hindu children as well as a stronger response to interpersonal contagion that is impervious to means of purification, as a consequence of the empha-

sis on purity and pollution in the interpersonal domain in Hindu culture.

Method

Participants

Participants were 125 children (boys and girls) from the eastern Indian state of Orissa from two schools located in the state capital of Bhubaneswar and 106 children (boys and girls) in Philadelphia. In each culture, the children were divided into two age groups: 4- to 5-year-olds ($N = 157$, 82 Indians and 75 Americans) and 8-year-olds ($N = 74$, 43 Indians and 31 Americans). The mean ages of the younger children in the United States and India were 4 years 7 months (range = 4 years to 5 years 11 months) and 4 years 4 months (range = 4 years 1 month to 5 years 10 months), respectively. Comparable figures for the older children in the United States and India were 8 years 3 months (range = 8 years 2 months to 8 years 11 months) and 8 years 8 months (range = 8 years to 8 years 9 months), respectively.

The U.S. sample was drawn largely from a middle-class neighborhood, with the 4- to 5-year-olds attending preschools and the 8-year-olds attending second and third grade in public schools. The ethnic distribution of the 4- to 5-year-olds was 54 Caucasian, 10 Hispanic, 9 African American, and 2 Asian American. For the 8-year-olds, the ethnic distribution was 18 Caucasian, 6 Hispanic, 5 African American, and 2 Asian American. All the children had been born and brought up in the United States.

The Indian children were enrolled in a school located in a middle-class area in Bhubaneswar, the capital city of the eastern Indian state of Orissa. Their native language is Oriya, but the school uses both Oriya and English in instruction. The 4- and 5-year-olds attended preschool and kindergarten classes, and the 8-year-olds attended second- and third-grade classes. The children were predominantly from high (Brahmin) or middle order caste backgrounds, with 60 of the 82 four- to five-year-olds and 34 of the 43 eight-year-olds falling into these classifications. However, the correspondence between caste membership and income is often not strong. Higher caste families may or may not earn more than lower caste families, and government policy promotes education and employment for those in lower castes.

Most Oriya families have persons other than the parents living with the children. At least one grandparent lives with most families and usually has an important role in raising and socializing the children.

Procedure

The procedure was a variant of the approach used by Fallon et al. (1984) and Siegal (1988). Following pilot studies, a picture storybook was constructed, and each child looked at a series of pictures in the storybook and listened to narratives provided by the experimenter. These were about two twin boys or girls (matched to participant gender) who were offered the target, a glass of lemonade (juice), after a variety of treatments to it. The twins differed only in the pattern and color of their shirts. In all cases, one twin said it was okay to drink the juice, and the other said that it was not. The child's task was to indicate which twin was right. The story characters in the pictures were identical from one story to another and between the two cultures except that the complexion of the characters in the Indian story was darker and the mother in the Indian story wore traditional Indian clothing (a sari). The target, the contaminants, and the purifiers were chosen to be appropriate for both India and the United States. Apart from a clean spoon intended as a control, the contaminants were a cockroach (in or near the juice), a tack, a strand of hair, a male stranger (dressed in trousers and a shirt, touching or taking a sip from the juice), and a distasteful food (spinach). Thus we explored four kinds of negative contagious objects or acts in this study. These included things that may cause

illness like germs do (human products such as the hair), things that are dangerous but not considered contagious by adults (the tack), things that are disgusting (the cockroach), and foods that are distasteful either on their own or in combination with juice (the spinach). We also included a uniquely social item, namely, direct contact with another person (the stranger). In addition, we used the cockroach and the stranger in a proximity condition, near the glass or holding the glass, respectively.

The experimenter tested each child individually. She first made some small talk with the children to make them feel comfortable. This was considered necessary because in India there is much importance given to age and hierarchy, and children may be expected to be more restrained or quiet in the presence of an older woman or man whom they do not know very well.

The children were then shown the pictures in the book accompanied by narration from the experimenter. For each contaminant, the following manipulations were depicted in the procedure, which consisted of three parts.

First, to determine whether the children recognized the contaminant objects and regarded them as contaminants, we asked them to name the objects in the pictures and, except in the case of the stranger and the spoon, to agree with one or the other twin, who offered either a “yes” or “no” choice about the acceptability of ingesting each object. The objects depicted were a cockroach (animal disgust contact), a stranger sipping and a hair (interpersonal disgust contact), a tack (danger contact), spinach (distaste contact), a stranger near and a cockroach near (proximity), and a spoon (control contact). Except in the case of the stranger, each object was illustrated as appearing separately on a plate in front of the twins. Then the experimenter provided a verbal description of the contaminant falling into the juice, which was shown in a subsequent pictured scenario. In the case of the “stranger near” situation, the pictures illustrated a stranger who came in and picked up the glass of lemonade but, unlike in the “stranger sipping” situation, did not drink from it. The pictures for the “cockroach near” situation showed a cockroach that remained near the target (a glass of lemonade) but did not enter inside the glass. For each situation, the children were again asked to agree with one of the twins, who provided “yes” and “no” choices about the acceptability of ingesting the juice. To determine whether the children believed that the target was acceptable to drink by itself in the first place, we also showed them a picture of the twins sitting at a table with a glass of lemonade in front of them. All children agreed that it was acceptable for the twins to drink it.

In the second part of the procedure, the children were asked to indicate whether the lemonade remained contaminated when the contaminant (cockroach in or near, hair, tack, spinach, stranger sipping or near) was removed without a trace. Then in the third part, the purifiers were introduced in relation to the specific contaminants of cockroach, stranger, and hair. These took the form of (a) the addition of a color to the previously contaminated juice, (b) boiling and cooling of the previously contaminated juice, and (c) the mother of the twins taking a sip of the previously contaminated juice. In addition, the children were asked whether juice that had not been in previous contact with the contaminants would be drinkable following the addition of each of the three purifiers (color change, boiling, or mother sipping). Children who no longer thought the juice was contaminated after the contaminant had been removed were not given the purification procedures.

During the story, the children were asked if it was okay to drink the juice after a manipulation involving contaminants and purifiers. The children were asked to agree with one of the twins in the story, rather than to answer a series of direct questions, as this procedure may better enable children to express what they know in the presence of an adult who may appear already to have the correct answer, and previous research has shown that children’s responses corresponded closely with their own choices under subsequent direct questioning about what could be ingested (Siegal, 1997, 1999). The sequence of purifiers and contaminants was varied randomly

for each individual child. In the case of the mother sipping, it was made clear that the mother did not know the juice was contaminated.

Ahalya Hejmadi, who is a fluent native speaker of both Oriya and English, interviewed all the participants.

Results

The 4- and 5-year-olds responded similarly across items and so were combined into one group for the purpose of data analysis. With regard to the control items, of the 231 children, only 7 did not accept the juice that had been in contact with the clean spoon, and no more than 4 rejected uncontaminated juice when it was subjected to any of the purifiers (color change, boiling, or mother sipping).

Sensitivity to Contamination: Effects of Age and Culture

The responses of the 4- to 5-year-olds and 8-year-olds in the two cultures for the five contaminants (cockroach, hair, stranger, tack, and spinach) are shown in Table 1. To examine the potentially interactive effects of age and culture, we conducted a series of log-linear analyses on the children’s responses at the $p < .01$ level to control for familywise error in multiple tests. These analyses showed that there were no interactions of age and culture in explaining rejection responses. In each case, the best-fitting model contained main effects of culture and of age. Hence, we used chi-square statistics (equivalent to two-way effects in log-linear analyses) to test separately for effects of culture and of age.

In support of our first hypothesis, there was an overall significant increase in rejection with age for the cockroach, the hair, and the stranger. This held for both the “contaminant in the juice” and the “contaminant out of the juice” conditions, but the effect was more substantial for the “out” conditions, which involved the standard contamination-removal operation. Age effects were significant for the out condition in all three instances, $\chi^2(1, N = 231) > 6.05, ps < .01$. Overall, in the out condition for these instances, the 4- to 5-year-olds averaged 64.5% rejection (vs. 89.5% for the 8-year-olds), which supports the claim that when the third-party query methodology is used, substantial contamination sensitivity can be demonstrated in children in the 4- to 5-year age range (Siegal, 1988).

The spinach contamination sequence depends on the aversive taste properties of spinach or on an aversion to the combination of spinach and juice. The tack contamination sequence is of interest because the threat from the tack may be viewed as physical rather than chemical, so that, for a rational adult, there should be no threat after removal of the tack from the juice (the out condition). In both cases, the principal interest is in the maintenance of a contamination rejection in the out condition. Approximately 30%–40% of children rejected the juice in the out condition for both the spinach and the tack. Hence, a substantial minority of children showed contamination responses for these two contaminants. However, unlike for the true contaminants, for which contamination sensitivity increased with age, there was a decline with age in contamination sensitivity, with the decrease attaining significance in the overall sample for both the “tack in” and “spinach out” conditions, $\chi^2(1, N = 231) > 4.23, ps < .05$. Differences between the children in the two cultures were not significant. This response pattern

Table 1
Percentages of 4–5-Year-Olds and 8-Year-Olds in India and the United States Who Rejected the Juice in Response to Contaminants

Contaminant condition	4–5-year-olds		8-year-olds		Significant differences ^a	
	India (n = 82)	USA (n = 75)	India (n = 43)	USA (n = 31)	Age	Culture (India > U.S.)
Cockroach in	93.9	81.3	100	96.8	6.05**	6.25**
Cockroach out	81.7	60.0	97.7	96.8	19.3***	8.58**
Hair in	78.0	64.0	90.7	83.9	5.91**	4.40*
Hair out	67.0	48.0	83.7	83.9	13.86***	4.63*
Stranger sipping	86.6	68.0	97.7	77.4	3.65*	13.34***
Stranger out	75.6	54.7	97.7	77.4	13.07***	12.89***
Tack in	59.8	46.7	37.2	32.3	6.09**	<i>ns</i>
Tack out	41.5	37.3	32.6	29.0	<i>ns</i>	<i>ns</i>
Spinach in	48.8	56.0	46.5	32.3	<i>ns</i>	<i>ns</i>
Spinach out	42.7	40.0	32.3	32.3	4.23*	<i>ns</i>
Cockroach near	56.0	52.0	44.2	38.7	<i>ns</i>	<i>ns</i>
Stranger near	70.1	46.7	34.9	32.3	12.04***	5.21*

Note. For all significant age differences, except those italicized, 8 years > 4–5 years.

^a One-tailed chi-square test.

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

supports our second and third hypotheses, namely that in both Hindu Indian and American children, the focus of the contamination response on actually dangerous or disgusting contaminants and on the necessity of physical contact sharpens with age, and that the nature of contagious essence becomes better defined with age.

In keeping with our fourth hypothesis about the salience of interpersonal contamination in the Hindu caste system, the Indian children showed significantly stronger contamination effects than their American counterparts for the cockroach, the hair, and, in particular, the stranger, with the strongest effects shown for the stranger sipping, $\chi^2(1, N = 231) = 13.34, p < .001$ and the stranger out, $\chi^2(1, N = 231) = 12.89, p < .001$, conditions. In these cases, the vast majority of Indian children rejected the juice.

The strength of the early onset of contamination sensitivity in the Indian children is illustrated further by the individual response pattern shown in Table 2. Of the 82 Indian 4- to 5-year-olds, 59 (or 72%) rejected all three contaminants (cockroach, hair, and stranger) in the object-in condition, compared with only 33 of the 75 (44%) American 4- to 5-year-olds. This difference was highly significant, $\chi^2(1, N = 157) = 11.93, p < .001$. Selectivity in

contamination sensitivity was also better defined in the Indian children. Of the 15 children in the younger Indian group who accepted the juice containing one of the three contaminants, 8 chose the juice in contact with hair, 4 chose the juice in contact with the stranger, and 3 chose the juice in contact with the cockroach. Sign tests (Siegel, 1956) indicated that juice contaminated by hair was accepted significantly more often than was juice contaminated by a cockroach ($p = .002$). By contrast, of the 22 children in the younger American group who accepted one of the three contaminants, 8 chose the hair, 7 chose the stranger, and 7 chose the cockroach. Sign tests did not reveal any significant differences in contamination sensitivity between the objects.

A similar pattern occurred in the object-out condition. Of the 82 Indian 4- to 5-year-olds, 44 (or 72%) rejected all three contaminants (cockroach, hair, and stranger) in this condition, compared with only 19 of the 75 (44%) younger American children. This difference was significant, $\chi^2(1, N = 157) = 6.35, p < .01$. Of the 18 children in the younger Indian group who accepted juice with only one of the three contaminants, 11 chose the hair, 5 chose the stranger, and 2 chose the cockroach. A sign test indicated that children again accepted juice significantly more often when hair was the contaminant than when the contaminant was a cockroach ($p = .03$). By contrast, of the 21 children in the younger American group who accepted juice with only one of the three contaminants, 7 chose the hair, 5 chose the stranger, and 9 chose the cockroach. Sign tests did not reveal any significant differences in sensitivity to the three contaminants.

The overwhelming majority of Indian 8-year-olds rejected all three contaminants in both the object-in and object-out conditions. The few cases in which a single contaminant was accepted all involved the stranger. Sign tests indicated that the older Indian children accepted juice significantly more often when hair was the contaminant than when the contaminant was a cockroach or a stranger ($ps < .03$). Most of the American 8-year-olds also rejected all three contaminants in both the object-in and object-out

Table 2
Numbers of Children Giving 0, 1, 2, or 3 Rejection Responses to Juice in Contact With Objects of Contamination (Cockroach, Hair, and Stranger) in the Object-In and Object-Out Conditions

Age group and country	n	Object in				Object out			
		0	1	2	3	0	1	2	3
4–5-year-olds									
India	82	2	6	15	59	4	16	18	44
U.S.	75	1	19	22	33	12	22	21	19
8-year-olds									
India	43	0	1	3	39	0	2	5	36
U.S.	31	0	4	5	22	0	4	5	22

conditions. In both conditions, the stranger was the contaminant for 4 of the 5 cases in which a single object was accepted; in the other case, hair was the contaminant. Sign tests did not reveal any significant differences in sensitivity to the three contaminants.

Continued Rejection of Juice Following Contact With Purifiers

The responses of the 4- to 5-year-olds and 8-year-olds in the two cultures to juice that had been treated with purifiers are shown in Table 3. Binomial tests indicated that continued rejection of juice following contact with purifiers did not exceed a chance level (a) for the effects of the mother sipping the juice with the hair or stranger contaminants for the Indian 4- to 5-year-olds, (b) for the effects of the mother sipping the juice with the cockroach and for the effects of any of the three purifiers on juice with the hair and stranger contaminants for the American 4- to 5-year-olds, and (c) for the effects of boiling on juice contaminated by hair for 8-year-olds in both cultures (all $ps > .05$). The 8-year-old Americans also judged the effects of boiling on juice that was in contact with a cockroach or a stranger at a level that did not exceed chance. Again, log-linear analyses at the $p < .01$ level were carried out to examine the potentially interactive effects of age and culture. With one exception (boiling purifies juice contaminated by a stranger, $p = .003$), these analyses showed that there were no interactions of age and culture in responses to purification. Again, analyses were followed up with chi-square statistics as appropriate.

Most children continued to reject the juice when it underwent purification through coloring or through the mother sipping after removal of any of the three contaminants. Consistent with our results on contamination, the rejection rates for juice treated by

these two methods increased with age to nearly 100%, $\chi^2s(1, Ns \geq 153) \geq 10.42, ps < .01$.

However, the case of purification through boiling is complex. With increasing age, boiling was seen to be a significantly greater effective purifier only for the juice that had been contaminated by a hair, with significantly more 8-year-olds than 4- to 5-year-olds accepting the juice following boiling, $\chi^2(1, N = 153) = 9.33, p < .01$. By contrast, significantly more 8-year-olds than 4- to 5-year-olds rejected the cockroach-contaminated juice following boiling, $\chi^2(1, N = 184) = 2.96, p < .05$. In the case of boiling following stranger contamination, significantly more Indian 8-year-olds than 4- to 5-year-olds rejected the juice, $\chi^2(1, N = 104) = 4.62, p < .05$, whereas there was no significant age difference for the American children. In all instances of boiling, the Indian children were significantly more rejecting of the juice than were the American children. For boiling following stranger contamination, the difference was particularly significant between Indian and American 8-year-olds, $\chi^2(1, N = 66) = 13.87, p < .001$. This result attests once more to the importance of interpersonal contagion in Hindu culture—contagion that is impervious to purification. In this connection, it is notable that a third of the American 8-year-olds did accept that boiling could purify juice that had been in contact with a cockroach, compared with fewer than 10% of the Indian children.

Individual response patterns to the purifiers for each of the objects are shown in Table 4. In all cases, most of the children regardless of culture or age rejected juice that had been treated with two of the purifiers or all three.

When the 4- to 5-year-olds judged only one purifier to be effective, this was usually the mother sipping. Of the 18 children in the younger Indian group who accepted juice that had been in

Table 3
Percentages of 4–5-Year-Olds and 8-Year-Olds in India and the United States Continuing to Reject Juice After Purification by Adding Color, Boiling, and the Mother Sipping in Three Instances (Cockroach, Hair, and Stranger) Based on the Numbers of Children Who Had Rejected the Juice After Removal of the Contaminant

Condition	4–5-year-olds		8-year-olds		Significant differences ^a	
	India	U.S.	India	U.S.	Age	Culture (India > U.S.)
Cockroach	(67)	(45)	(42)	(30)		
Color	73.1	73.3	95.2	96.7	10.42**	<i>ns</i>
Boil	71.6	62.2	90.5	66.7	2.96*	4.25*
Mother sips	67.2	51.1	92.9	96.7	24.14***	<i>ns</i>
Hair	(55)	(36)	(36)	(26)		
Color	76.4	63.9	97.2	100	16.63***	<i>ns</i>
Boil	76.4	61.1	50.0	42.3	9.33**	5.52**
Mother sips	47.3	44.4	94.4	96.2	37.32***	<i>ns</i>
Stranger	(62)	(41)	(42)	(24)		
Color	67.7	51.2	92.9	95.8	20.77***	<i>ns</i>
Boil	67.7	51.2	88.1	41.7	<i>ns</i>	12.85***
Mother sips	56.5	46.3	95.2	91.7	36.26***	4.53*

Note. Numbers in parentheses are *ns*. For all significant age differences, except those italicized, 8 years > 4–5 years.

^a One-tailed chi-square test.

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

Table 4
Numbers of Children Giving 0, 1, 2, or 3 Rejection Responses to Purifiers (Coloring, Boiling, and Mother Sipping) in Relation to Juice Previously in Contact with Objects of Contamination (Cockroach, Hair, and Stranger)

Country and contaminant	n	No. of rejection responses			
		0	1	2	3
4-5-year-olds					
India					
Cockroach	67	5	12	18	32
Hair	55	8	11	15	21
Stranger	62	10	13	20	19
U.S.					
Cockroach	45	8	10	12	15
Hair	36	9	4	16	7
Stranger	41	5	18	14	4
8-year-olds					
India					
Cockroach	42	1	3	0	39
Hair	36	0	2	17	17
Stranger	42	1	3	1	37
U.S.					
Cockroach	30	1	0	9	20
Hair	26	0	0	16	10
Stranger	24	0	3	11	10

contact with the cockroach, 4 chose coloring, 5 chose boiling, and 9 chose the mother sipping as effective purifiers. Comparable numbers for the juice contaminated by the hair were 2, 2, and 11 and for the juice contaminated by the stranger were 5, 4, and 11. Sign tests indicated that 4- to 5-year-old Indian children significantly more often accepted juice that had been in contact with hair when the mother sipping was the purifier than when boiling was the purifier ($p = .001$). Moreover, 4- to 5-year-old American children significantly more often accepted juice that had been in contact with a cockroach when the mother sipping was the purifier than when either boiling or coloring was the purifier ($ps < .02$).

However, when the 8-year-olds judged only one purifier to be effective, the overwhelming choice was boiling. Of the 17 Indian 8-year-olds choosing only one effective purifier for juice contaminated by hair, 16 chose boiling and only 1 child chose the mother sipping. Boiling was also the choice for the sole Indian 8-year-old who judged one purification technique to be effective against stranger contamination, as it was for the American 8-year-olds in all instances involving purification of the juice in contact with the cockroach or stranger. Of the 16 American 8-year-olds choosing only one effective purifier for juice contaminated by hair, 15 chose boiling and 1 chose the mother sipping.

Discussion

Our study is an initial step in an examination of cultural influences on the development of conceptions of contamination sensitivity and purification. More information is needed on why children perceive objects to be contaminated and purifiers to be effective or ineffective in eliminating contamination. On the basis

of a perceived indelible material or spiritual essence, children may reject a drink that has been in contact with a contaminant such as a cockroach and regard it to be impervious to any sort of purification, despite having knowledge of germs and a biological understanding of the microscopic nature of contamination. In this respect, their responses are similar to those of many American adults (Nemeroff & Rozin, 1994). Alternatively, some young children may lack a biological understanding that would permit them to acknowledge the effectiveness of boiling in purifying a contaminated substance. Even when children do judge that a purifier would be effective, as in the case of the mother sipping the drink, they may be responding to social pressure or influence rather than seeing the drink as imbued with a positive essence. The purification data were based only on the judgments of those children who judged that a drink had been contaminated, and the numbers who did so were variable across the contamination conditions, ages, and cultures. Further evidence would facilitate the identification of profiles among children who give contamination judgments and resist means of purification across a variety of targets.

Bearing these limitations in mind, we conclude that our hypotheses were for the most part confirmed. We believe we have advanced the understanding of contagion in a developmental context in three ways in this study.

First, we have extended some of the basic original findings in this area, all based on Western or developed cultures, to individuals from a major third-world culture and one in which contagion plays a particularly important role. We found considerable similarity in the development and nature of concepts of contagion in Indian and American children except for the fact that at 4 to 5 years of age, Indian children were closer to adult thinking than were American children and Indian children responded more negatively to the interpersonal contagion effect of contact with a stranger than did American children. We also confirmed the tendency of younger children to treat proximity as sufficient for producing contamination, and we found, as in earlier studies, that this tendency decreased with age—hence the increase in the contact-proximity distinction in the older children.

Second, we have extended the domains in which contagion has been demonstrated in children by including both (a) proximity and contact with an interpersonal contaminant and (b) contact with a dangerous but, to adults, noncontaminating entity (the tack). We found that interpersonal contagion operated in the same way with respect to the conditions of contamination as the contaminants that are usually used (e.g., the cockroach). However, we did not find an age difference in the tack contamination; that is, about the same number of older children as younger children continued to treat the tack as a contaminant after it had been removed from the juice.

Third, for the first time in a developmental study, we explored the child's conception of the nature of contagious essence, using a framework developed by Nemeroff and Rozin (1994) for classifying types of contagious essence for adults. For younger children in both cultures, the "spiritual" purification technique of positive interpersonal contact (the mother sipping) can be potent. It may be that the judgments of purification effectiveness involving the mother sipping reflected a default strategy in which the mother was chosen in the absence of a salient choice of purifier available from personal experience. In this sense, judgments at the chance

level appraising the effectiveness of the mother sipping may be viewed as akin to judgments involving immanent justice—divine or magical retributions for misdeeds—as explanations for physical ailments that are beyond personal experience or are not amenable to a salient alternative (Siegal, 1988).

For older American children generally, as well as for many Indian children in the case of hair contamination, there was a distinct shift to dominance of the “material” purification technique of boiling. However, for many children in both cultures regardless of age, as also for adults (Nemeroff & Rozin, 1994), the contagious essence seemed impervious to purifications such as boiling, which transformed the material nature of the contaminated substance. One likely explanation for this type of response may be that individuals conceive of essence in many instances of contamination as “spiritual,” because data on adults (Nemeroff & Rozin, 1994) suggest that this is the most difficult type of contagion to erase and that it may not be wholly counteracted even through contact with holy or saintly beings or artifacts.

Clearly, Indian children—even at 4–5 years—were more often sensitive than the American children to contaminants. Contamination sensitivity became more indelible with age, so that for contamination through contact with a cockroach or a stranger, Indian 8-year-olds regarded boiling as significantly less effective as a purifier, and as ineffective as adding coloring or the mother sipping, than did Indian 4- to 5-year-olds. This result cannot simply be seen as a response bias, because in the case of the hair, boiling was significantly more likely to be seen as a purifier with age—unlike purification of the juice through coloring or through the mother sipping. By contrast, many American children in both age groups considered boiling to be an effective purifier in the case of the cockroach and the stranger, though only uniquely so (as distinct from purification through coloring and the mother sipping) for the 8-year-olds.

Interpersonal disgust and contagion are a more central aspect of Hindu Indian culture than of Western cultures. Indeed, in the Oriya language of Bhubaneswar, there is a particular word, *aintha* (*jhuta* in Hindi), that refers to the food remaining after someone has consumed some. In this context, any contact with the mouth, either direct (through biting or sipping) or indirect (through the hand or saliva) can render the entire amount of food unacceptable. In our results, stranger contamination was both stronger in Indians and somewhat more indelible. In particular, for Indian 8-year-olds, nothing was effective in removing stranger contamination, whereas boiling was effective for Americans.

The sociopolitical nature of food sharing in India has ancient roots but still is very much evident in modern Hindu Indian practice. Scholars such as Appadurai (1981) and Marriott (1968) have recorded how hierarchy, purity and pollution, and social status between castes and within the family are enacted through food transactions. Many issues of hygiene and food choice that are considered to be personal issues in the United States are taken to be moral issues among many Indians (Shweder, Mahapatra, & Miller, 1987). This may be considered as a case of “universalism without uniformity” (Shweder, 2000, p. 210). In other words, the use of embodied schemata in social life may be a universal psychological and cultural process, yet the particular constellation of bodily and social meanings must be arranged or filled in by each culture. One major source of variation arises from cultural differ-

ences in conceptions of the body. In India (Appadurai, 1981), and among the Hua of New Guinea (Meigs, 1983), people are thought to be linked together along bloodlines in a web of shared bodily fluids or essence, such that pollution incurred by one person spreads to close family members, just as a snakebite in the leg quickly spreads throughout the body. In the West, in contrast, the metaphor of the body as a temple competes with the metaphor of the body as a machine, but it is always either an individual temple or an individual machine. Pollution or contamination incurred by one individual does not threaten anyone else except by direct touch. It is therefore not surprising that moral concerns about interpersonal contact play a greater role in Indian and Hua social life than they do in the United States (Haidt, Rozin, McCauley, & Imada, 1997), as shown by these societies’ conceptions of contamination and purification.

In our analysis of disgust, and contagion as a concomitant of disgust, we have proposed that the response originates with respect to core disgust (animals, food, and excreta), extends to reminders of our animal nature, and extends later to interpersonal contact (Rozin et al., 1999). This sequence, proposed for both cultural evolution and development, is just a proposal; there are few data available. The present data document the early onset of concepts of interpersonal contagion in children but do not speak to the hypothesis that such concepts are preceded by the concept of the contaminating effect of the cockroach. As mentioned above, further developmental studies of the type we have initiated here would contribute to a description and understanding of the development of the concept of contagion. For example, they might clarify the extent to which children’s knowledge of boiling points to the possession of an explanatory understanding of its role in eliminating the microbial nature of contamination. Though this knowledge that boiling is an effective purifier may serve well for elementary predictions, it need not entail an underlying causal understanding. Rather, it may simply serve as a “placeholder” for a causal essence that may not be understood until late childhood or even adulthood (Gelman, 2000; Medin, 1989).

The greater rate of rejection of the contaminated juice by Indian children could conceivably stem from contamination as being more of a practical daily concern for them than for U.S. children. It might be thought that contaminated food or water is more of a real threat in India, in which case a more conservative approach to contamination might result from practical experience rather than cultural beliefs. For our sample of Hindu Indian children, however, food and water were always safe, so it appears that cultural differences are consistent with the Indian emphasis on purity. Within Hindu culture, washing is a generally effective way of ridding the self of pollution. In this context, boiling would be the closest manipulation, and it was generally considered the most successful procedure by the older children. However, although boiling would seem, to adults, to transform material substance, washing is designed to remove it. Nevertheless, many adults as well as children in third-world countries do not appear knowledgeable about the essentials of cleanliness in ensuring the edibility of food. An issue that cries out for further investigation concerns cultural differences in conceptions of purification and hygiene that are fundamental to disease prevention (Curtis & Biran, 2001; Curtis, Cairncross, & Yonli, 2000).

With regard to the developmental course of contamination sensitivity, the shift from spiritual essence (the mother sipping being most potent for younger children) to material essence (boiling being most potent for older children in certain instances) suggests a conceptual change between 5 and 8 years of age that is consistent with a growing awareness of the microscopic nature of contamination, though the nature and extent of such change await careful documentation (Siegal, 2002). Children's conception of contamination, outside of the pure association domain, which appears rather weak in this study, depends on related conceptions, for example, conceptions of dissolving and invisible substances (Au et al., 1993; Rosen & Rozin, 1993). These conceptions come to the fore in a manner that makes some sense of the shift in the 8-year-olds to a material model. However, the boiling manipulation has a second implication for adults: the killing of microorganisms, which is seen as necessary in the sense that very small doses of germs, perhaps harmless in themselves, reproduce massively to cause illness. In view of children's developing biological knowledge, boiling's effectiveness along this dimension for young children is in question. Further research is needed to determine the basis for these judgments. For some children, boiling may be ineffective either because the contaminant itself is not biological in nature or because boiling is insufficient to destroy a potent biological contaminant.

We have argued that the food domain is perhaps the first to show a number of cognitive advances in development, on the grounds that this domain is a particularly important area in which important early decisions have to be made (Rozin, 1996; Siegal, 1995). This amounts to saying that there is an increase in accessibility to conscious awareness as described by Rozin (1976). Although only food contexts were explored in this study, there is evidence in both children and adults for domain-specific knowledge that serves to guide reasoning about food and the intentions of those who offer it (Occhipinti & Siegal, 1994; Siegal & Peterson, 1996). Even though we understand that thorough boiling of a liquid that has been in contact with a cockroach eliminates contamination, we still reject it as undrinkable.

Work with adults (Nemeroff & Rozin, 1994) points to the presence of three operative models and suggests that American adults often hold to two or more. Although it would seem rational to move more and more to a conception of material essence with age, the fact is that spiritual essence remains a major part of adult thinking about contagion. Rather, the Western adult pattern does suggest a tendency to invoke material essence conceptions in cases of contact with illness or germs and spiritual essence conceptions in cases of interpersonal contact with morally questionable people. Though the major innovation in this study was the introduction of procedures to assess the nature of the contagious essence in cognitive development, the present data are not sufficient to reveal whether children use different models for different contaminants or to determine the comparative weighting of contaminants and purifiers in food acceptance. In particular, we did not use a clearly moral interpersonal contaminant, because the stranger's moral status was not specified. The stranger is more likely to be conceived as a moral threat in India than in the United States. Further research is needed to provide clarification of how children conceive of various contaminants and of how this conception influ-

ences their conceptions of purifiers and their models of contagious essence.

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