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Scientific contagion heuristic: Judgments about the acceptability of water for religious use after potential scientific treatment

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Abstract

We propose the concept of 'scientific contagion' — a mental heuristic through which any form of scientific treatment transfers some essence of 'science' to the processed substance, thereby affecting its nature and social acceptability. This was tested regarding the potential treatment of water from natural sources before it is used for religious purposes, as many such sources have dangerous pollutants. For an ancient natural well having a religious narrative, most participants judged that the acceptability of water would be reduced for religious purposes but not for drinking if local officials scientifically treat the water. That is not the case if religious rituals are conducted on the water instead (Study 1). If water from a "holy river" is processed scientifically, most participants predicted that it would reduce acceptability for religious use while increasing acceptability for drinking (Study 2). Potential scientific treatment without altering the composition of water from a natural spring also decreased acceptability for religious use but there was no effect on acceptability for drinking or on willingness to pay money for the water (Study 3). A follow-up study comparing acceptability for different kinds of water sources — from a holy well, natural spring, and household tap water sourced from either underground wells or rivers found lower acceptability for religious usage compared to drinking after potential scientific treatment for all these waters, but more so for holy and natural waters (Study 4). These studies establish the phenomena of scientific contagion that could have significant social implications and open future directions.

Keywords: contagion, scientific contagion, science versus religion, psychology of water, public health, judgment

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PCM initially ideated the concept with inputs from SM. Both authors were involved in designing the studies. SM analyzed the data. SM drafted the manuscript along with PCM.

1 Introduction

Waters from various natural resources are universally recognized to hold special significance and are used for performing various religious rituals, giving rise to multiple socially constructed meanings of water (Strang, 2004). Water use itself is linked to cultural and religious practices (Smith & Ali, 2006). Millions of people consume water from natural sites with special religious significance — sometimes termed "holy water" or "sacred water" which is associated with heightened judgments in line with narratives that register religious beliefs and obeisance for people who value it. The act of consuming sacred waters for drinking, bathing, and performing religious or purification rituals is inherently religious (Oestigaard, 2017). From the distant past, mythological accounts discuss the divine healing properties of certain waters like the river Ganga in India (Sen, 2019). There are several narratives that augment the sacredness of the water deeming its celestial, sin-absolving nature which has been bestowed as a gift for human salvation[1] In a related vein, people hold beliefs about the healing properties of natural springs without religious narratives but those can at times be quasi-religious. Such narratives indicate that the sacredness of such waters is beyond its usefulness in the pragmatic sense and is attributed to spiritual realms which are beyond the physical usage of the water. Value of these waters transend their instrumental use. It can even be beyond symbolic associations when narratives intermix the water with the divine (for example, narratives suggesting that Gods drank or bathed in it).

Religious use of water abounds across the world. Among Hindus, the concept of ritual dipping at the confluence of holy rivers (Gaṅgā, Yamuna, and Saraswati) in the Indian cities of Haridwar and Allahabad invites millions every year based on the narrative of the holy elixir of immortality (*Amritam)* which fell as drops in these places resulting in the largest gatherings of pilgrims on the earth (Balsari et al., 2016). In Islam, the Zamzam well holds special significance as "holy water" being linked to a narrative about being divinely revealed to an anxious Hagar desperately running between the two hills of Safa and Marwah in search of water for her infant son (Shomar, 2012). Several Muslims have faith in the divine properties of the Zamzam well and pilgrims drink the water during their religious visit to Mecca. Similarly, water from the Jordan River has been important to Christian religious history for rituals and religious purity (De Châtel, 2014). Such narratives are common across various water sites, in turn adding reverence to the belief in its healing, religious, and consecrated properties.

At the same time, there is a looming public health risk in many of these holy waters from religiously famous wells and rivers that have high levels of microorganisms that can cause multiple adverse health issues and hence require scientific processing before

[1]Verses from the ancient Hindu text, the Padma Purana say that: "sins perish just by remembering Gaṅgā. Very heinous sins (perish) by the recital (of her name). Great sin (perishes) by her sight. Hosts of great sins are exhausted by daily bath in the Gaṅgā, and by drinking (her water) daily and by daily offering oblations to the maines into her (stream)". Taken from the English translation of the Padma Purana in the chapter 'In praise of the Gaṅgā' (Bhatt & Deshpande, 2013, p. 801–811). Hindu puranas narrate that Gaṅgā was a celestial river and agreed to plunge down to earth after Bhagiratha's entreaties (Sen, 2019, p. 68).

use. Stagnated water at sites of religious worship can have even bigger risks (Sivasankar & Ramachandramoorthy, 2009). For example, microbiologists found that the holy water fonts from many churches contained bacterial contamination and known human pathogens (Jurado et al., 2002). Many holy springs did not meet the microbiological and chemical requirements of drinking water regulations urging researchers to increase public awareness to perceive holy springs as potential sources of illness (Kirschner et al., 2012). Rivers linked with religious significance have severe contamination including heavy metals which makes them unsuitable for consumption when it flows through plain lands (Jordan river: Ben-Dan et al., 2001; Gaṅgā river: Chaudhary, Mishra & Kumar, 2017; Yamuna river: Haberman, 2006). However, despite the degradation, there is a continued belief in its purity. Peppard (2013) notes the disjuncture between the symbolic identity of rivers due to the narratives connected to religious rites and the material status suffering immense environmental degradation. Satyajit Ray, an Oscar awardee Indian Filmmaker in his 1990 film *Ganashatru* (Inspired by Henrik Ibsen's 1882 play *Enemy of the People*) raised the issues of contamination through water regularly consumed for religious ritual drinking. Even a drop of contaminated water ingested through ritualistic practises is dangerous. Nevertheless, millions of people use these holy and sacred waters to sprinkle them on their lips, take dips, or even consume small portions directly as part of different religious activities.[2]

Most would agree that scientifically treating water at religious sites or water filled from rivers or springs before religious use would be helpful to contain health risks. However, treated water needs to be acceptable for consumption — especially for religious usage by the public. This is not a trivial notion. For decades, researchers have documented the perceived differences between science and religion (Coyne, 2016; Draper, 1875). On one hand, water technology is now sufficiently advanced for treating the water at the source or before use (Bixio et al., 2005) ranging from primary (separation of wastes) to secondary (using microbes to reduce or eliminate unwanted biological elements) to tertiary (using filters) or more advanced procedures (membrane-based processing). On the other hand, psychological barriers to water treatment are largely based on the nuanced psychology of contagion (Callaghan, Moloney & Blair, 2012). Scientific contagion, as we observe, underscores the possibility that water used for sacred purposes is psychologically different from water used for drinking, and that the idea of purity as a criterion for its acceptability for the two may be different.

Considering the intrinsically associated *touch of the sacred* in narratives about holy waters or *merging with the scared* in religious rituals, would any further touch — especially the *touch of science* in the form of scientific treatment, disrupt its acceptability for religious use?

[2]Note that we dissociate between such religious use from drinking where the former is ritualistic that might involve ingestion of small amounts while the later is soley used for ingestion in large amounts as in 'drinking water'.

1.1 Scientific Contagion

The concept of contagion was documented by anthropologists and later by behavioral scientists across different cultures. It is a belief that people, objects, and so forth could acquire an "essence" of a particular source through touch (Rozin, Millman & Nemeroff, 1986). This "essence" can constitute unseen characteristics — "soul stuff" (Frazer 1890/1959). Any physical touch between a source and the target results in a transfer of some essence — properties that could be physical, mental, or moral/spiritual. A wide range of essences that can be contagious include physical attributes, abilities, dispositions, and even intentions. Rozin and Numeroff (2002) enlisted five mental models of contagion: the germ model (through a living invisible entity like bacteria), the residual model (dependent on residuals like sweat), the symbolic interaction model (implied through interaction with an object), associative model (via reminding value of an object) and a spiritual essence model (the source's non-material essence is transferred to the target). The first two are grouped as physical models linked to physical sources and the latter three are grouped as non-physical models linked with interpersonal sources. Some contexts can invoke only the physical models while others invoke only the spiritual model (Numeroff & Rozin, 1994).

The psychological effect of contagion can be seen as an intuitive heuristic (Rozin & Numeroff, 2002) because it is a rapid rule of thumb that is effective under uncertainty. Accordingly, this contagion heuristic might act to protect against possible contamination mediated by our behavioral immune system (Schaller & Park, 2011). Possibly a conceptual system that helped us understand how pathogens infect our bodies through touch got extended into judgments about the transfers of physical and moral essences (Numeroff & Rozin, 1994). This behavioral immune system, consisting of a set of psychological defense mechanisms to promote disease avoidance, is also related to social conservatism that includes religious fundamentalism (Terrizzi, Shook & McDaniel, 2013).

We expand upon the original conceptualization of contagion to introduce a new hypothesis which we term *Scientific Contagion*. Our proposition is that scientific treatment might transfer some essence of science or technology to the processed substance which impacts the very nature of the substance. This transfer need not be physical. It requires expanding the spiritual contagion model that originally proposed a transfer of some essence from people to objects through physical touch to even more abstract transfers where specific processes imbibe or remove certain essences of the substance. This would be more vivid when there are epistemological models which invoke a perceived categorical or moral distinction; such as the public perception of science and religion to be under conflict or as distinct knowledge systems (Ecklund et al., 2016). One idea that is also closely associated with scientific contagion is that of contamination. According to the Oxford English Dictionary, contamination can be defined "as the action or state of making or being made impure by polluting or poisoning". It is pertinent to note that while scientific contagion in our definition does not refer to making the substance physically impure; there is an implicit sense of "polluting" a spiritual essence. However, it does not necessarily hint at the object becoming

non-consumable or inappropriate for any form of usage. Instead, scientific contagion acts like a mental heuristic where we intuitively regard the 'touch' of any 'scientific process or treatment' to potentially desecrate or contaminate the value of the substance. It specifically contaminates the *essence* for which it was understood, respected, and valued, particularly with respect to its sacramental, religious, and ritualistic usage.

The studies below lay forth a picture of this possibility and also highlight how our judgments are affected. This picture in turn points out the complex relationships between science and religion via water that are relevant to public health.

2 Study 1: Judging the effect of potential scientific treatment of a religious water source

2.1 Participants

One hundred and three UG (undergraduate) students enrolled in an undergraduate technology program at a university in New Delhi participated voluntarily (age range = 18–24 years). In response to a demographic question about how important religion is, 10.68% stated it as very important, 35.92% as somewhat important, 39.80% as not too important, and 13.59% as not at all important. The majority were Hindus (87.37%), with some representations of other religions (Muslims: 0.97%, Sikhs: 1.94%, Buddhists: 0.97%, Other: 3.88%, Atheist or Agnostic: 4.85%). In this and follow-up studies, our participants are mainly within the technological community making it a more robust population against scientific contagion and hence function as a strong test for our hypothesis.

2.2 Method

Based on an actual Hindu religious site,[3] the cover story stated '*There is a kund (well) which has some religious stories like, once, the Gods drank water from that kund; which is now celebrated as a festival. The water has been naturally preserved from historical times. It is believed that when required, the kund can quench the thirst of many gods and people. Thousands of believers come to drink water from that kund every year.*'

The processing condition was manipulated between two groups. One group of participants (scientific group, $n = 58$) were told that '*Recently, local authorities are planning to scientifically treat the water of the kund before devotees drink it to reduce possible health issues.*' The other group (ritualistic group, $n = 45$) were told that '*Recently, local authorities are planning to allow some specific pujas (ritualistic worshiping) on the water of the Kund before devotees drink it to reduce possible health issues'*.

[3]The narratives are adopted from real religious sites but no places have been explicitly named. There might not be any real plans of scientifically treating the water by local administrations.

All participants were then asked to make two binary judgments (Yes/No) about whether such processes (scientific treatment or ritualistic worshiping as per the group) would reduce the acceptability of this water (a) for drinking and (b) for religious purposes. Demographic questions were asked at the end.

2.3 Results

A 2x2 contingency table for the judgment regarding reduced acceptability for drinking (Table 1), showed no difference (X^2 (1, 103) = 1.059, p = .304) while there was a significant difference for religious purposes (Table 2) (X^2 (1, 103) = 18.137, p < .001).

Table 1: Count of participants responding to yes versus no regarding reduced acceptability for drinking among the two groups (scientific vs ritualistic).

Condition	Do you think that such [scientific treatment/ritualistic worshiping] would reduce the acceptability of this water for drinking?		
	NO	YES	Total
Scientific group	38	20[a]	58
Ritualistic group	25	20	45

[a] Some participants rated acceptability for drinking as reduced after scientific processing, perhaps because the act of drinking this specific water source has a historically religious narrative entwined with drinking the water in its natural form, which might seem to be affected by scientific treatment.

Table 2: Count of participants responding to yes versus no regarding reduced acceptability for religious purposes among the two groups (scientific vs ritualistic).

Condition	Do you think that such [scientific treatment/ritualistic worshiping] would reduce the acceptability of this water for religious purposes?		
	NO	YES	Total
Scientific group	18	40	58
Ritualistic group	33	12	45

In further analysis, the response on whether processing would reduce acceptability was coded with YES as '1' and NO as '0' for all respondents. This implies a higher mean value when more people judge that acceptability would be reduced (Figure 1). A repeated measures ANOVA with processing condition (ritualistic vs scientific) as a between-subject factor and usage (religious use versus drinking) as a within-subject factor showed a main effect of processing condition (F (1,101) = 5.924, p = .017, η^2 = .026); no main effect of

usage ($F(1,102) = 2.72$, $p = .10$[4]) but a significant interaction between condition and usage, F (1, 101) = 15.302, $p < .001$, $\eta^2 = .068$.

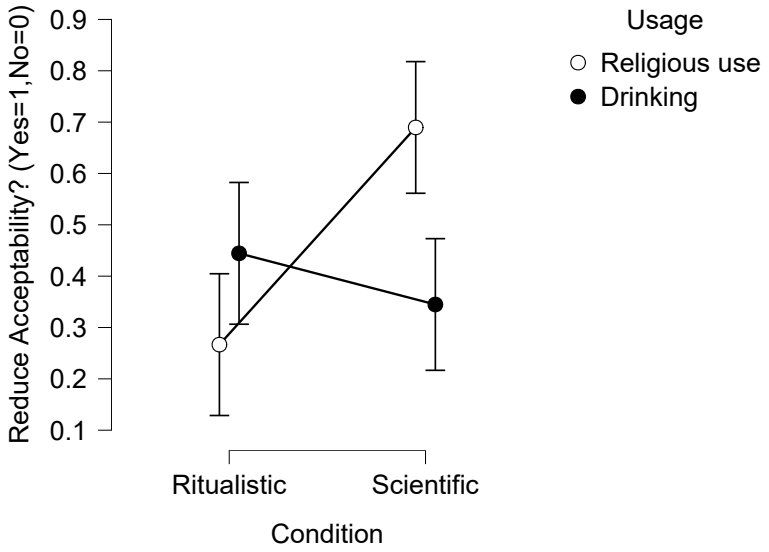

FIGURE 1: Interaction between the type of processing (condition) and usage. Error bars show 95% confidence intervals.

A higher proportion of people judged that acceptability would be reduced for religious use compared to drinking after scientific processing, while no such differences were observed after ritualistic processing. Seen in another way, the reduction in acceptability for religious use is far more salient following scientific processing, compared to ritualistic processing, but there is no such effect in use for drinking. This provides preliminary support for our hypothesis and shows potential scientific treatment can specifically hinder religious acceptability. Additionally, a main effect of the condition shows that more generally, scientific processing (compared to performing religious rituals) is seen to reduce the acceptability of water from a natural source having a religious narrative. Follow-up studies replicate and extend this basic effect to find if indeed scientific processing makes the water psychologically worse for religious usage but not for drinking.

3 Study 2: Judging the effect of potential scientific processing of water from a "holy river"

As rivers are a pertinent source of water for religious use and drinking along with other activities like cleaning. Some of them have deeply religious narratives associated with them that ascribe holiness to the water as outlined earlier but such rivers have been found to contain harmful pathogens (e.g., Ben-Dan et al., 2001; Dwivedi, Mishra & Tripathi,

[4]All main effects are estimated without the interaction term.

2018) that motivate scientific processing. As these rivers travel for hundreds of miles, they potentially impact millions of people, across different locales and religions. This makes it pertinent to test the possibility of scientific contagion for "holy rivers".

3.1 Participants

Three hundred and twenty students (18–22 years; 84.68% Hinduism, 4.37% Islam, 4.06% Jainism, 1.87% Sikhism, 1.25% Christianity, and others) enrolled in a large UG class participated.

3.2 Method

All participants were told '*People often use water from "holy rivers" across the world for various religious purposes / sacred rituals as well as for usual drinking. However, in certain areas, local authorities plan to scientifically process the water collected from the holy rivers before people can use it either for religious purposes or for drinking. According to you, what do you think might be the effects on the "holy water" on its acceptability among the general public?*'.

They had to make binary judgments for two items presented randomly across participants — (a) acceptability for religious use of water from the holy rivers after scientific treatment will: Increase/Decrease and (b) acceptability for drinking water from the holy rivers after scientific treatment will: Increase/Decrease. In the end, they filled basic demographic details.

3.3 Results

A larger proportion of people judged that acceptability for religious use would decrease following scientific processing (decrease = 70.3%, 95% C.I. [65.0% 75.3%] vs increase = 29.7%, 95% C.I. [24.7% 35.0%]; $p < .001$). However, for drinking, the reverse was observed: a larger proportion judged acceptability would increase following scientific processing (decrease = 21.2%, 95% C.I. [16.9% 26.1%] vs increase = 78.7%, 95% C.I. [73.9% 83.1%]; $p < .001$).

On one hand, it is comforting to find that a majority of people judge public acceptability would increase for drinking while at the same time they judge non-acceptability for religious use. These results replicate the effect of scientific contagion and also show that one can delineate its effect on religious use versus drinking.

4 Study 3: Processing water without chemically altering it

The reduced acceptability after scientific treatment may be argued to be due to changes in the composition of the water. However, if acceptability reduces for a chemically identical substance to the source, it eliminates this possible explanation. According to the 'process-sufficient hypothesis' (Rozin, 2006), even if the resulting content is chemically identical (via two processes that cancel out and reach the initial state), the mere act of undergoing a process reduces some of its properties like naturalness. In case of scientific contagion, even if the water remains identical, the narrative of it being scientifically processed should reduce its acceptability for religious use. Additionally, we introduced an additional dependent measure related to money — willingness-to-pay as measures that involve money might not be subject to contagion effects (Rozin, Grant, Weinberg & Parker, 2007). The cover story was applicable to all religions.

4.1 Participants

Two hundred and forty UG students participated voluntarily and completed the study online (age range = 18-24 years, 75.00% Hindus, 2.91% Jains, 2.50% Muslims, 3.33% Sikhs, 13.33% Atheist or Agnostic, and the remaining as other). In response to the question about the importance of religion in their life, 12.08% said religion is very important, 40.00% somewhat important, 31.93% not too important, and 15.54% not at all important.

4.2 Method

The cover story manipulated the narrative among two groups of participants such that about half of them were presented with a religious one: '*There is a natural spring which has some religious associations because of local narratives about ancient legends. People from all religions associate special significance to that water. The water from that natural spring contains no minerals of a specif ic kind.*' while others were presented with a non-religious one: '*There is a natural spring which has some scientific associations because of local narratives about its ancient healing properties. People from all academic and economic backgrounds associate special significance to that water.*' For each half of participants, some of them were told that '*The water from that natural spring contains no minerals of a specific kind*' and others were told that '*The water from that natural spring contains minerals of a specific kind.*' Thus, there were four groups of participants.

After this, all were first asked to rate (a) how acceptable is this water for drinking and (b) how acceptable is this water for religious rituals/activities, both on a scale of 0 (= not at all acceptable) to 100 (= completely acceptable) along with (c)the maximum price they are willing to pay for five liters (5000ml) of that water (within a bounded range of 0 to 300 in local currency). This was the pre-processing acceptability rating.

In the next section, we stated the process used to treat the water adopted from Rozin (2006). For the group of participants, who were told there were no minerals of a special kind, the process was 'add-then-subtract minerals' (PlusMinus) so that through double cancellation, the resulting water was identical to the prior source. Participants were told, '*For the water from the natural spring mentioned in the last page..., a scientific process is done where 0.1% natural minerals are added and then removed. The scientific process does not change the chemical composition of the water.*' For others who were told there were minerals of a special kind,, the cover story was slightly altered to present the process as 'subtract-then-add minerals' (MinusPlus) as follows: '*For the water from the natural spring mentioned in the last page. . . , a scientific process is done where the 0.1% minerals contained in the water are removed and then added back. The scientific process does not change the chemical composition of the water.*' Note that we explicitly stated that the processing does not change the water chemically.[5]

After this information was presented, all participants again rated the acceptability of the water for drinking, and acceptability for religious rituals/activities, followed by their willingness to pay for 5 liters of that water. These were post-processing acceptability ratings. Such a design enabled us to compute pre versus post measures before and after the purported scientific treatment (as in Rozin, 2006). In this way, we manipulated the narrative (religious versus non-religious) and process (PlusMinus versus MinusPlus) between participants in a 2x2 between-subject design (Religious MinusPlus n = 67, Religious PlusMinus n = 60, Non-religious MinusPlus n = 59, Non-religious PlusMinus n = 54).

4.3 Results

A pre-post treatment difference was calculated (Table 3) by subtracting the second time these were asked after processing (post-measures) from the first time the same measures were asked (pre-measures) for all three dependent variables — acceptability for drinking, acceptability for religious purposes, and willingness-to-pay.[6]

A repeated measures ANOVA with pre-post differences in acceptability for drinking versus religious use as two repeated measures[7] and two between subject factors - narrative (religious versus non-religious) and process (PlusMinus versus MinusPlus) was performed. A significant effect was observed for differences in acceptability ($F(1,239) = 54.89$, $p < .001$, $\eta^2 = .18$). There was no effect of narrative ($F(1,238) = .128$, $p = .720$) or of the process ($F(1,238) = .219$, $p = .640$). There was also no interaction of differences in acceptability

[5]Participants might have wondered why a scientific treatment that does not change the water was done at all. It is important to have tested this possibility with reference to chemical composition so that physically the substance remained unaltered while being processed nevertheless. It is possible that there could be legal requirements to process water without making chemical alterations.

[6]Higher positive values thus imply a reduction after scientific processing. A pre-post measure ensures that specific starting references do not matter as we only look at the difference.

[7]We conducted ANOVA on these two ratings as they were on the same scale (0–100). WTP was on a scale of 0–300.

TABLE 3: Pre-post ratings in acceptability for all the four groups of participants.

	Narrative	Process	Difference in acceptability ratings, Mean (SD)
Difference in Drinking	Non-religious	MinusPlus	–4.25 (25.87)
		PlusMinus	0.20 (24.13)
	Religious	MinusPlus	–0.46 (26.26)
		PlusMinus	–3.53 (20.66)
Difference in religious use	Non-religious	MinusPlus	16.59 (29.94)
		PlusMinus	18.94 (33.14)
	Religious	MinusPlus	19.23 (24.31)
		PlusMinus	11.65 (16.15)
Willingness-to-pay	Non-religious	MinusPlus	7.66 (72.93)
		PlusMinus	8.57 (33.48)
	Religious	MinusPlus	7.58 (72.76)
		PlusMinus	–3.50 (35.70)

with narrative (F(1,237) = .206, p = .651) or with process (F(1, 237) = .220, p = .639). No three-way interactions between differences in acceptability, narrative and process emerged (F(1,236) = .05, p = .812). These results show that acceptability selectively reduced only for religious use of the natural spring for both the religious and non-religious narratives (Figure 2). Additionally, the results confirm that the order of processing (add-then-subtract or subtract-then-add) did not matter.

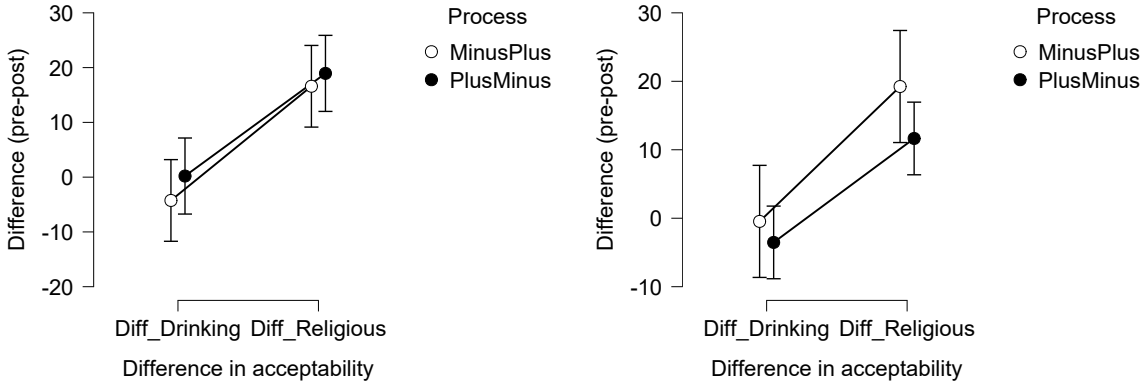

FIGURE 2: Pre-post differences in acceptability for drinking and religious use for the two cover stories (non-religious and religious.)

As there were no effects of narrative or process, paired t-tests on the pre-post differences in acceptability ratings for all the three measures were conducted across all partici-

pants. There was no change in acceptability for drinking ($Mean_{pre}$ = 48.28, SD_{pre} = 29.88 vs$\dot{M}ean_{post}$ = 50.29, SD_{post} = 31.11; $t(239) = -1.28$, $p = .201$, d = –.083). There was a significant reduction for religious rituals/activites ($Mean_{pre}$ = 76.08, SD_{pre} = 29.54 vs. $Mean_{post}$ = 59.45, SD_{post} = 34.73; $t(239) = 8.29$, $p < .001$, d = .535). No significant change was observed for willingness-to-pay ($Mean_{pre}$ = 92.65, SD_{pre} = 69.30 vs $Mean_{post}$ = 87.59, SD_{post} = 71.73; $t(239) = 1.35$, $p = .177$ d = .087).

It is clear that the chemically-identical processed water (reversed) is psychologically different from the original, but only for religious use. These results confirm that both for non-religious and religious narratives, acceptability of water for religious use reduces after scientific treatment. Even without any chance in the composition, it does not help preserve its original acceptability for religious use. There was no effect on economic valuation (willingness to pay) possibly due to money-related measures not being subject to magical contagion (Rozin et al., 2007) or there being no economic implication of the stated scientific process.

Study 4: Judging acceptability for different kinds of waters for religious use and drinking

We compared four kinds of waters based on our prior findings — holy well, natural spring, tap water sourced from underground wells, and tap water sourced from rivers. This tests the hypothesis for waters that are inherently religious, ones that are natural, and those which are mundane. It also serves to de-couple religious/sacred waters from natural waters for testing if scientific contagion impacts both in the same manner.

The scientific contagion hypothesis would predict that after scientific processing, acceptability of water would be worse for religious use compared to drinking and that this effect will be largest for holy water. We were interested in whether the same would hold for water from natural sources, as scientific contagion seems to work even for waters without an explicit religious connotation, as seen before. There was no concrete prediction for tap water but we intended to compare holy and natural water with tap water to be able to consolidate our findings.

4.4 Participants

Three hundred thirty-eight students (18-23 years; 81.95% Hinduism, 4.73% Islam, 2.07% Christianity, 2.36% Jainism, and others) from a large UG class participated.

4.5 Method

Participants were told '*People often use water for various religious purposes / sacred rituals as well as for usual drinking and household cleaning. In some regions, the local*

administration is considering to treat the water scientifically before people can use it. In the scenarios that follow, please answer : According to you, what do you think might be the effects of scientific treatment of waters from various sources on its acceptability among the general public?'

They had to rate how acceptable the water would be according to them on a scale of 1 (= Not acceptable at all) to 10 (= Completely acceptable). Four different water sources were presented on different screens (holy well, natural spring, tap water from underground wells, tap water from rivers) and for each, they had to rate (a) how acceptable would it be for religious use after scientific treatment and (b) how acceptable would it be for drinking after scientific treatment. The order of questions was randomized across participants.

4.6 Results

Acceptability for religious use after scientific processing was lower than acceptability for drinking across all four water sources (Figure 3).

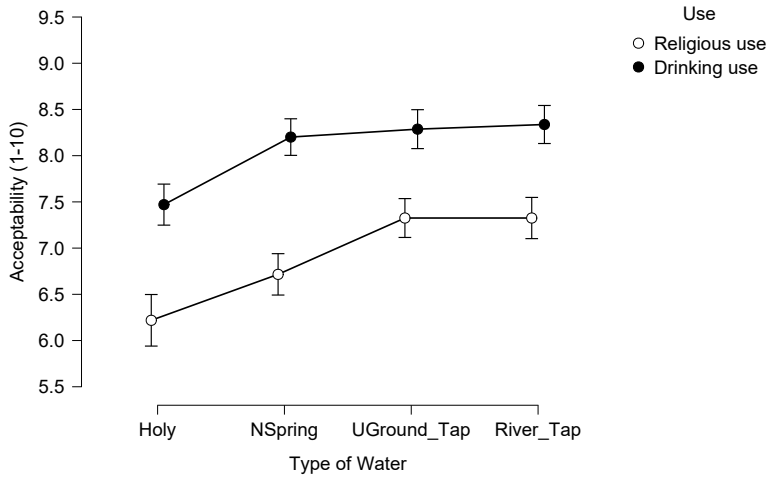

FIGURE 3: Ratings of acceptability for religious use and drinking. Error bars show 95% confidence intervals.

A 4 (water source) x 2(use) within-subject ANOVA showed a main effect of water source ($F(3,1011) = 34.58$, $p < .001$, $\eta^2 = .093$); a main effect of use ($F(1,337) = 80.56$, $p < .001$, $\eta^2 = .193$) and also a significant interaction between water source and use ($F(3,1011) = 4.662$, $p = .003$, $\eta^2 = .003$). Post-hoc tests showed that the acceptability of water after scientific processing from holy well was significantly less than water from natural spring (mean difference = –0.614, $t = –5.554$, d = -.302), underground water served in taps (mean difference = –0.962, $t = –8.669$, d = –0.473), and river water served in taps (mean difference = –0.987, $t = –.8.927$, d = –0.486). Even acceptability for scientifically treated water from natural spring was significantly less than underground water in taps (mean difference = –0.348, $t = –3.148$, d = –0.171) or river water in taps (mean difference = –0.373, t = -3.373, d = –0.183).

Importantly, a post-hoc comparison found a significant difference in acceptability for religious use and drinking across water sources (mean difference = –1.178, 95% C.I. [–1.436 –0.919], SE = .131, t = –8.97, d = –0.488). These results re-confirm that scientific processing results in lower acceptability for religious use compared to drinking, thus underscoring the divergent psychological manifestations of these two uses. This is true for holy and natural waters and to our surprise, even for tap water brought in from natural water sources (underground wells and rivers). In line with the scientific contagion hypothesis, the effect is more pronounced for the former water sources compared to the latter as evidenced by the interaction between the type of water and use.

5 Discussion

Specific water sources having religiously significant narratives are important sites to validate and appropriate as tangible entities of sacramental value. Other natural water sites linked to quasi-religious or even non-religious spiritual narratives or beliefs see a large number of visitors. Such narratives are common across many holy/sacred waters in different religions, but these sites might also benefit from scientific treatment. However, this is a psychological hurdle that public health officials need to overcome as our studies show public acceptability to use treated water for religious purposes is quite low. Based on our proposed scientific contagion heuristic, we predict and empirically show across four studies that communicating potential scientific treatment reduces the acceptability of that water for religious purposes. This occurs when people estimate what might be their own preferences as well as indicate the responses of other people. Additionally, explicitly mentioning that the scientific process does not change the chemical composition of the water is inconsequential. The effect generalizes to natural sources without prior religious narratives. Overall, a scientific procedure could make the water more acceptable for drinking or have no such effect, but make it worse for religious purposes; underscoring that the psychological sense of acceptability vis-a-vis purity for these two uses of water are different.

The related aspect of naturalness is important which is defined as a property that preserves the substance as it is without human intervention/interaction. Hence, it is likely that scientific processes reduce the naturalness of the water (Rozin, 2006), which at times, in turn renders it less suitable for performing religious rituals. This is indeed possible as the religiousness of holy waters are best preserved in their natural form, which can be affected by scientific contagion (Study 2). Even acceptability for natural waters without religious narratives was reduced for religious purposes after scientific treatment (Study 3). Both for "holy" wells and "natural" springs, people rated acceptability for religious use lower in comparison to drinking (Study 4). There may be an intrinsic overlap between the sacredness and naturalness of water when considered for religious practices. Naturalness in itself can also be treated to be moral-like and sacred (Scott, Inbar & Rozin, 2016). In relation to the scientific contagion hypothesis, our findings indicate that people might favor

the purest form of substances for religious rituals, thereby resulting in less acceptability for scientifically processed water in general and also from natural sources with or without religious connotation. This also suggests that judgments about religious use ascribe to a form of originality, that should remain untampered, untouched, or unviolated by any form of scientific treatment.

The current studies also entail some limitations and a need for further explorations. We have tested our hypothesis only on the usage of water. While water is used extensively for religious purposes across cultures, later studies need to gauge the generalizability of scientific contagion for other substances. Moreover, we have compared the usage of water between religious use and drinking, and not with any other ways of using it. In certain contexts, there are also practices involving the ingestion of water in small amounts as a part of religious rituals that might blur the categorical binary between drinking and religious use. In relation to the psychological mechanisms, we need to find mental models among the majority which guide the rejection of scientifically treated substances for religious use. It is also important to study the mental models of the minority who accept scientifically treated water for religious use. Another point to explore is whether it is possible to use scientific processing to improve acceptability of a previously desecrated water. Finally, we have not examined individual differences. The relation between science and religion on which the scientific contagion hypothesis is based can vary across cultures and among individuals. For instance, McPhetres, Jong & Zuckerman (2021) found a small negative correlation between religious beliefs and attitudes toward science across countries but the results depended on the average religiosity of the country. Further, the usage of the substance might moderate the scientific contagion effect. For instance, in Hinduism, unlike many other religions, there is significant usage of water in daily religious practices at home and in places of worship.[8] Hence, later studies need to examine this effect in different countries having different religious majorities, belief systems, and political orientations.

Coming back to the core idea, the question that arises is why do more people think that the acceptability of water would decrease in terms of its religious use after scientific treatment? As per our proposition, scientific contagion transmits some 'essence' of science having downstream effects that enhance or reduce its acceptability. The scientific treatment of water is possibly being taken as a form of contamination rendering "the water" less appropriate for usage in religious activities. The 'touch' of the scientific treatment might have been looked down upon as an action that could desecrate the value of the water and sometimes, its aboriginal sanctity due to an inherent conflict or because of disparate knowledge system boundaries between scientific and religious domains. The affective value specific for religious use questionable. Our studies document evidence that both waters from religious sources and natural sources (without religious narratives) get impacted. Therefore,

[8]Uses of water in religious practices and rituals in Hinduism include pouring water on idols, bathing of deities, consumption of '*charanamrit*' (a sacred water collected after ritualistic bathing of the deities), submergence of idols after ritual worship, and self-purification rituals in marriages, birth ceremonies and death rites.

scientific contagion happens when any scientific activity contaminates the original. In cases where the substance was particularly revered for its religious and sacrilegious usage, the impact is stronger. Scientific contagion thus extends the range of contagion beyond the usual filthy, disease-producing, and moral domains.

Spiritual and religious relationships to water often invoke complex feelings that govern our judgments and acts of its usage across cultures (Strang, 2004). This paper sets the stage for an interdisciplinary dialogue between the psychology of judgment and decision making, the environmental research on water and the symbolic socio-cultural narratives around human engagements. It helps to think in terms of the growing relationship between the symbolic and the material. These complex relations between society, religion, science, and natural resources are of concern to multiple stakeholders spanning social scientists, health professionals, administrative policymakers, and the public at large. Our concept of scientific contagion bears special relevance in expanding such relations with water. This is a matter of critical concern because millions of people across the world possibly use water for their religious or sacred purposes.

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