**Title:** A Cognitive Account of Manipulative Sympathetic Magic

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## Abstract

Frazer's theory of sympathetic magic has been extremely influential in both anthropology and comparative religion, yet the manipulative aspect has not been adequately theorized. In this paper I formalize sympathetic magical action and offer a naturalistic explanation of manipulative sympathetic magic by attributing it to a combination of environmental regularities (i.e., things that are similar and/or physically proximate tend to co-vary) and human causal cognition (i.e., the tendency to mistake correlation as causation), and supply ample ethnographic and historical evidence for my arguments. In doing so I also specify the variables involved and re-classify sympathetic magic into four distinct types for analytic convenience.


## 1. Introduction

More than a century ago, the pioneering anthropologist James Frazer[1] published his seminal work *The Golden Bough* which would shape the study of comparative religion and cultural anthropology thereafter (Hanegraaff, 1998), and much work in anthropology has been devoted to the discussion of his ideas (Horton, 1993; Mauss, 1902/2001; Tambiah, 1990). In *The Golden Bough*, Frazer (1890, p. 19b) explicitly formulates two principles of magic:

> "First, that like produces like, or that an effect resembles its cause; and second, that things which have once been in contact with each other continue to act on each other at a distance after the physical contact has been severed."

The first principle is referred to as the Law of Similarity and the second the Law of Contact or Contagion, which are collectively termed "sympathetic magic." Although Frazer does not formally define the two laws (for example, he never fully specifies what "act[ing] on each other" means), *The Golden Bough* provides ample ethnographic examples to illustrate these principles.

Frazer's definition of "magic" has been extremely influential and has inspired countless scholarly discussion (Hanegraaff, 1998). We should note, however, that Frazer's theorizing of magic occurred over a century ago and he apparently had a particular agenda in mind when writing *The Golden Bough* (Strenski, 2006). Specifically, Frazer (along with Edward Tylor whom he greatly admired) rejected Christianity and treats magic and religion as separate developmental stages of human societal evolution (Bremmer, 1999). Magic, Frazer contends, is humans' most primitive attempt at manipulating the world, which is to be substituted by religion (belief in an omnipotent deity) and eventually science. Such stagist view of human social and cultural evolution has been widely criticized and now largely rejected in anthropology (Kundt, 2017), but the resulting categorization of magic and religion into different types continue to exert significant influence and is still the subject the much discussion among contemporary researchers (Hanegraaff, 1998). For many, his exclusion of supernatural agency from the category "magic" is problematic, as many of what we normally consider "magic" practices today are directed towards supernatural agents. Here I do not wish to engage in the debate of what the proper definition of "magic" should be, as it is a truly thorny issue (Lindeman & Svedholm, 2012) and beyond

[1] Although Tylor(1871) had already described magic practice in traditional, small scale societies and alluded to some general principles, he never formally proposes sympathetic magic the way Frazer did.

the scope of this paper. Rather, I will focus on the type of magic practices as Frazer defines it, i.e., *sympathetic magic based on the principles of similarity and contagion*.

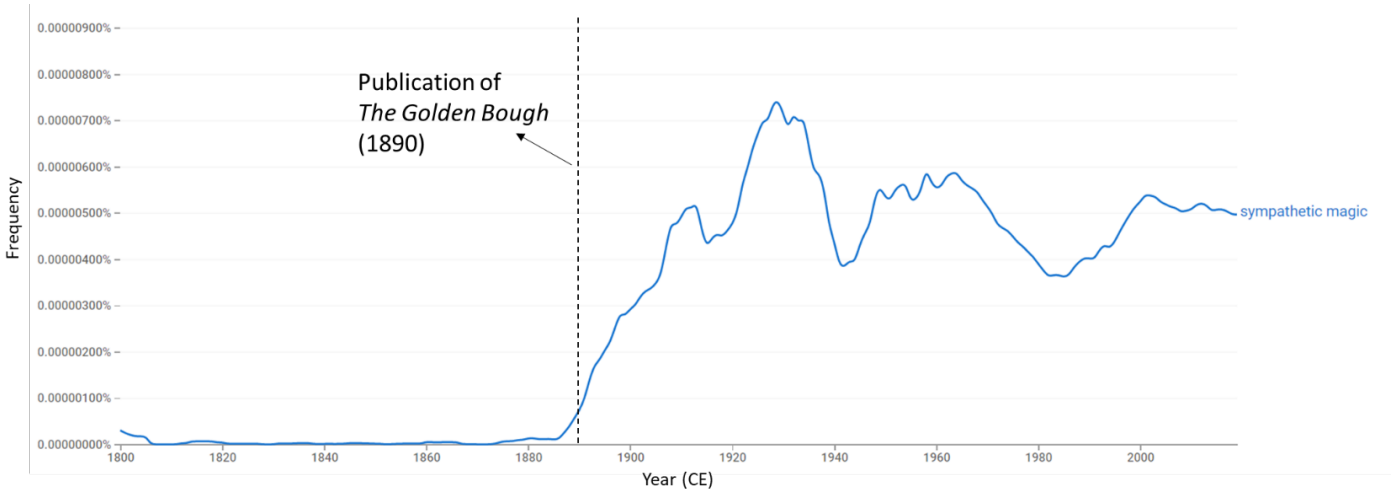


*Figure 1. Frequency of the key phrase "sympathetic magic" from 1800 to 2019 using Google's Ngram Viewer.*

Of course, one may question whether Frazerian sympathetic magic is a "natural kind" at the philosophical level; I suggest, however, that Frazer at the very least identified two analytically useful principles of human thought and action that deserve a serious (re)analysis. Note that the fact that Frazer may have been wrong[2] about the developmental stages of human social evolution does not mean we should abandon the concept of sympathetic magic altogether, and I argue that a fresh theoretical examination of sympathetic magic is important for three reasons. First, while the name of James Frazer has been a "embarrassment" for many anthropologist today (Strenski, 2006, p. 65) and his work not talked about very much, his definition of magic as not involving supernatural agents and thus belonging to a different category from religion has persisted well into the present day, indicating that many researchers likely have found it a useful category to analyze and compare cultural practices. Figure 1 shows the frequency of the phrase "sympathetic magic" in Google's English text corpora (Ngram) from 1800 to 2019, and we can clearly observe a temporal trend here: the frequency of the term "sympathetic magic" has increased dramatically after the publication of *The Golden Bough* in 1890 and remained at rather high levels ever since[3]. Second, cultural practices that derive from such principles have been repeatedly observed in traditional, small-scale societies that lead some early theorists to conclude that sympathetic magic is a universal feature of human societies (Mauss, 1902/2001). Though systematic meta-analysis on the prevalence of sympathetic magic has not been conducted yet, a simple keyword search in Human Relations Area Files (a comprehensive database on human societies and cultures primarily in the form of annotated ethnography) show that a substantial proportion of ethnographic records contain the key phrase "sympathetic magic" (125 out of 359 total cultures in the database). Finally, the psychological intuitions behind sympathetic magic have been shown in contemporary

[2] Today, we know that he was almost certainly wrong about the magic-religion-science developmental stages of human social and cultural evolution based on ethnographic and archeological knowledge accumulated over the past century.
[3] Though it is possible that some of the "sympathetic magic" usage during the 20th century occurred in the context of criticizing it for not being a useful analytic category, it is highly unlikely that such uses of the term could account for such consistent high frequency of its occurrence.

Americans (Hood et al., 2010; Rozin et al., 1986), further suggesting that these principles may be quite fundamental to human cognition.

Note that the majority of the magical practices described in *The Golden Bough* are manipulative; that is, the magician believes that he can produce an effect by imitating it (Similarity) and that whatever he does to an object will affect equally the person with whom the object was once in contact (Contagion). For example, people in Haiti would create voodoo dolls and symbolically insert pins to it in order to inflict harm on whom the doll represents (Armitage, 2015), and the Malays would use the body parts of the intended victim (nails, hair, etc.) to create a figure of the intended victim with wax from a bee's comb, and scorch the figure in order to cause harm to the actual victim (Frazer, 1890). If we focus on the manipulative aspect of sympathetic magic, the two laws can be specified as the following:

> Law of similarity: If two objects A and B are similar in their properties, then a change in A will cause a corresponding change in B.

> Law of contagion: If two objects A and B were once in contact, then a change in A will cause a corresponding change in B, even if A and B are no longer in contact.

To a modern reader, these principles and their associated practices may appear striking, as the modern mechanistic/materialistic worldview does not allow mystical causations (Murdock, 1980), in particular action at a distance without a proper mechanistic explanation[4] (Williamson, 2011). In the classic anthropological literature, the psychological reason for such objectively faulty laws is usually attributed to a mistake in the association of ideas. Mauss (1902/2001) puts it straightforwardly:

> E. B. Tylor and others after him have noticed that these laws are none other than the association of ideas, with one difference, that here the subjective association of ideas leads to the conclusion that there is an objective association of facts, or in other words that the fortuitous connexion between thoughts is equivalent to the causal connexion between things.

Here, Mauss, in summarizing the conclusions of previous thinkers, points out that the laws of similarity and contagion exist because the thoughts of objects that are similar or in contact are naturally associated, and the mistake of the magician (and those who believe in magic) is that they treat this thought association as a real association with causal properties. The most extreme form of such a mistake would of course be to treat the image as *equal* to the real object, and the part as *equal* to the whole. As such, whatever one does to the image affects the real object, and the part affects the whole. Elegant as it seems, this classical account suffers two difficulties. First, in the jargon of evolutionary biology, this classic explanation is "proximate" (Tinbergen, 1963) in that it only tells us *how* people mistake the image/part as the real/whole, but not *why* people would make such cognitive mistake from adaptive/functional perspectives. Second, it is not particularly cognitively difficult to recognize that an image of a person or his body parts and the person himself are different entities, and to my knowledge

[4] It should be pointed out that the phenomenon of quantum entanglement in physics resembles manipulative sympathetic magic principles, where change in one particle may induce change in a different particle at some considerable distance (Popkin, 2018). However, quantum entanglement was discovered in rather late in human history, and it was unlikely that such phenomena (often unobservable to the naked eye) would have influenced the cognitive evolution of our species.

there is no developmental or ethnographic evidence showing that people confuse the identity of objects at such a fundamental level.

More recently, psychologists and cognitive scientists, most notably Paul Rozin and colleagues (Nemeroff & Rozin, 2010; Rozin et al., 1986; Rozin & Nemeroff, 1990, 2012), have sought to show that the psychology that sustains such "magical thinking" also exists in contemporary societies and have provided functional and adaptive rationale for Frazer's sympathetic magic. For example, they find that people in contemporary American societies show disgust to replicas of disgusting objects; in a series of experiments, Rozin et al. (1986) showed that most participants exhibited a preference for a normally shaped piece of fudge over fudge shaped like dog feces. Such effect has been demonstrated at the physiological level: US adults exhibit more electrodermal activity when a photograph of a sentimental object is destroyed despite maintaining that photographs have no physical connection with the real objects (Hood et al., 2010). The explanation offered is that similarity magic is related to the principle of generalization, i.e. treating objects that share some properties as potentially sharing more properties, and the tendency to generalize is usually very useful to the survival of our species (Nemeroff & Rozin, 2010). In a similar vein of argument, Rozin and colleagues suggest that the law of contagion, when conceived as transfer of properties, makes rather good adaptive sense: microbes, for example, do travel from one body to other through physical contact and cause illness, and our disgust towards contaminated food for fear of getting ill either consciously or unconsciously may extend to other domains, indeed anything that we perceive negative. College undergraduates, for example, would strongly prefer to not wear a sweater worn by someone who experienced a misfortune (e.g., an amputated leg) (Rozin et al., 1994).

The above accounts have contributed much to our understanding of the nature and functions of sympathetic magic, but they largely ignore the manipulative aspect, i.e. why would change in one object *cause* change in another object that is/was in physical contact with or similar to it? More recently, Rozin et al. (2018) have attempted to address this question and termed the contagious kind "backward magical contagion". They showed that American Mturkers express discomfort when some of their personal items (e.g. hair, signature photocopy, travel diary) is possessed by a negative third party (rapist or enemy), yet reach no firm conclusions regarding why such phenomenon occurs[5].

In this paper, I aim to show that the manipulative aspect (Paul Rozin's "backward causation") may be explained by a combination of certain regularities of the world (i.e. things that are similar or physically closer tend to co-vary in their properties) and the ordinary human cognitive error of mistaking correlation as causation (Bleske-Rechek et al., 2015; Kida, 2009; Stanovich, 2009). In the rest of the paper, I first formalize the manipulative aspect of sympathetic magic and then provide a verbal argument of how the environment and human cognitive processes collectively produce manipulative sympathetic

[5] Note that to my knowledge this is the only example of experimental evidence showing *manipulative* sympathetic magic in contemporary western societies. However, the fact we usually do not observe such biases in contemporary modern societies does not mean these biases do not exist; rather, they may be triggered in particular social and cultural context and under the appropriate conditions lead to the development of concrete beliefs and practices. As I alluded to in the main text, The prevalent mechanistic worldview in modern societies may have profoundly influenced our intuitions regarding what's possible (manipulative sympathetic magic would be deemed largely impossible); additionally, people's everyday inferences are rarely affected by manipulative sympathetic magical intuitions (similarity and contagion) alone, but rather almost always a result of multiple psychological, social and cultural factors.

magic. In doing so, I also propose two other types of magical principles that have not been formally proposed and have received relatively little attention from researchers, i.e., that physical proximity and similarity may induce each other as a result of the positive spatial autocorrelations in nature, as well as providing relevant ethnographic and historical examples. Finally, I discuss the plausibility and limitations of this account and offer some alternative possibilities.

## 2. Mathematical formulation of Frazer's sympathetic magic

Suppose there are a grid of objects in a two-dimensional space. Each object has two sets of attributes, location $(x, y)$ and properties $(p_1, p_2, p_3, \dots, p_n)$. The distance between any two objects $O_i$ and $O_j$ is thus the standard Euclidean distance:

$$d_{ij} = \sqrt{\left(x_i - x_j\right)^2 + \left(y_i - y_j\right)^2}$$

Define the property similarity between two objects $O_i$, $O_j$ as

$$s_{ij} = \frac{1}{n}\sum_{k=1}^{n}\left|p_{ik} - p_{jk}\right|$$

Now suppose that the properties of objects change over time due to internal or external factors. For example, if we take the objects under consideration to be plants and animals, then they may naturally grow in size with seasons (internal factor) and could be affected by natural events such as fire and disease at particular locations (external factor) as well. Denote object $O_i$'s properties at time $t_1$ as $\left(p_1^{t_1}, p_2^{t_1}, p_3^{t_1} \dots p_n^{t_1}\right)$, $t_2$ as $\left(p_1^{t_2}, p_2^{t_2}, p_3^{t_2} \dots p_n^{t_2}\right)$ and so forth, and create a new variable to represent the property change of $O_i$ from time $t_{q-1}$ to time $t_q$:

$$\Delta O_i^{t_q - t_{q-1}} = \frac{1}{n}\sum_{k=1}^{n}\left|p_{ik}^{t_q} - p_{ik}^{t_{q-1}}\right|$$

Now we create vector to represent the entire sequence of temporal change from time $t_1$ to time $t_q$:

$$O_i^{change} = \left(\Delta O_i^{t_2 - t_1}, \Delta O_i^{t_3 - t_2}, \dots, \Delta O_i^{t_q - t_{q-1}}\right)$$

We are interested in the covariance of the overall temporal change in properties of any two objects $O_i$ and $O_j$, $Cov\left(O_i^{change}, O_j^{change}\right)$, as this variable plays a crucial role in representing the manipulative aspect of sympathetic magic. With the above notations, we can now formally express the law of similarity and the law of contagion as:

Similarity: an increase in $s_{ij}$ causes an increase in $Cov\left(O_i^{change}, O_j^{change}\right)$

Contagion: a decrease in $d_{ij}$ causes an increase in $Cov\left(O_i^{change}, O_j^{change}\right)$

The above formalizations state that making two objects more similar or physically closer will *cause* them to co-vary more regarding their properties. If one intends to induce a certain kind of change in $O_j$ (usually a person), according to these magical principles they only needs to obtain an object $O_i$ that is either in closer contact with $O_j$ or similar to $O_j$ and then manipulate $O_i$. In practice, of course, the physical proximity of $O_i$ and $O_j$ usually occurs some time in past, because if $O_i$ and $O_j$ are physically in contact in present time, one may either directly manipulate $O_j$ (e.g. performing healing rituals directly on the person instead of his bodily parts/clothes) or not wish to perform the manipulation in front of $O_j$ (e.g. induce harm in $O_j$ when $O_j$ is a person).

## 3. The natural environment and human cognition that give rise to manipulative sympathetic magic

Why do people think a change in similarity or physical proximity would have a causal relationship with their co-variation? As alluded to in the introduction, I argue that 1) in the environment where humans live, objects that are physically closer and/or similar do tend to co-vary in their properties, and 2) humans have a strong tendency to detect patterns and establish causality and may mistake correlation as causation (Matute et al., 2015). Because $Cov\left(O_i^{change}, O_j^{change}\right)$ correlates with both $d_{ij}$ and $s_{ij}$, humans may mistakenly believe that change in $d_{ij}$ and $s_{ij}$ will *cause* changes in $Cov\left(O_i^{change}, O_j^{change}\right)$. For example, an increase in $d_{ij}$ would lead to an increase in $Cov\left(O_i^{change}, O_j^{change}\right)$. If $O_i^{change}$ is externally manipulated, the only way for $Cov\left(O_i^{change}, O_j^{change}\right)$ to increase is for $O_j^{change}$ to change in the same direction to an extent such that its change matches the change in $O_i^{change}$ even more.

In plain language, what I am suggesting above is that objects that are physically close or similar in their attributes are more likely to co-vary, and therefore people may believe that by making two things closer or similar they can induce such co-variation, and when people have control over one object, they may mistake correlation as causation again in thinking that manipulating this object will *cause* similar changes in the other object such that the co-variation is increased or maintained. Take the voodoo doll as an illustrative example; we may characterize the procedure as having two separate steps. To induce harm in an enemy, step one is to create a voodoo doll (a symbolic object) that either resembles the enemy in some aspect or made of something that was once physically close to the enemy such as clothes, hair, or fingernails, with the rationale being that creating similarity or physical proximity causes co-variation; step two is to harm the voodoo doll (induce change in the symbolic object), with the rationale being that changing one object causes change in the other object in the same way or direction.

There is a large empirical literature on humans' tendency to mistake correlation for causation in domains such as health (Oh, 2016), finance (Heyns & Vlok, 2014), environmental management (Hilborn, 2016) and scientific research (Rohrer, 2018). Indeed, mistaking correlation for causation is such a rampant phenomenon that researchers have lamented that this cognitive bias "leads us astray practically every day" (Dobelli, 2013, p.110). On the theory front, mechanisms that allows for the evolution of hyper causation detection have been proposed, particularly in the context of superstitions behaviors. Foster & Kokko (2009), for example, discover that natural selection can favor strategies that

lead to errors (assigning causality between two events when there is none) as long as the occasional correct response carries a large fitness benefit. Abbott & Sherratt (2011) models a situation where individuals need to decide whether to exploit (act to maximize fitness given the available information regarding the causal relationship between action and outcome) or to explore (act to generate more information about the true nature of causal relationship) and find that superstitious behaviors (exploiting a non-existent causal relationship) may evolve when the cost of superstition is low relative to the perceived benefits. Given the large literature on this topic I shall not further belabor this point, and will mainly discuss the plausibility and applicability of the first point that objects in contact (more generally, objects in close physical proximity) or objects that are similar tend to co-vary with regard to their attributes.

On the relationship between similarity and co-variation, the human cognitive system tends to categorize objects into different kinds (Harnad, 2017) according to their background theories of the world, and these categories often match pretty well with "natural" kinds in the world, with folk biology being a prime example (Atran, 1999). In the environment where humans live, it is often true that things that are of the same kind 1) change similarly in a temporal fashion (e.g. plant organisms grow with seasons) and 2) respond to external factors in similar ways (e.g. certain infectious disease would cause illness in similar types of animals, such as those of the same species, genus, or family). More generally, because the change induced by external factors on objects often heavily depend on the properties of these objects, those with similar properties would naturally respond in similar ways. Importantly, things of the same kind tend to occur in close proximity and resemble each other in properties. Our cognitive tendency to detect correlations and mistake them as causations, therefore, may pick up such environmental regularities and form the manipulative sympathetic magical intuitions over developmental time. Note that the formation of such heuristic bias need not require actual causation but only perceived causation: for example, observing that domesticated animals (which are physically proximate) falling ill one after another may lead to the impression that the illness of one animal *causes* the illness of another animal[6], and with one more inferential step we get manipulative sympathetic magic: *inducing* illness in one animal *causes* illness in a different animal that is physically proximate.

Before discussing the relationship between physical proximity and co-variation, let us first turn to a related claim that physically closer objects tend to be similar in attributes, or more formally, $d_{ij}$ negatively correlates with $s_{ij}$. To argue for this claim, I draw on the concept of spatial autocorrelation which essentially means that geographically nearby values of a variable tend to depend on one another (Getis, 2010). Although in theory spatial autocorrelations can be both positive and negative, in reality, positive spatial autocorrelations vastly outweigh negative ones (Chun & Griffith, 2018; Griffith, 2019). For example, negative spatial autocorrelation is found in only 8 out of 361 agricultural plant breeding trials (Wu et al., 1998) and 80 out of 2801 US intra-county population density geographic distributions (Griffith et al., 2003). This means that we are more likely to observe nearby objects to be similar than dissimilar; in other words, physical proximity of objects correlates with their similarity. Ethnographically, people also notice the co-localization of things that are of similar properties. The popular Chinese proverb "things find one another according to their kinds" (物以类聚) first appeared in

[6] In fact, of course, such covariation is caused by unobserved variables (pathogens).

*Zhan Guo Ce* (5th-3rd century BCE) and in English there is the familiar saying of "birds of a feather flock together."

Now, since we have already argued for the correlation between $Cov\left(O_i^{change}, O_j^{change}\right)$ and $s_{ij}$ as well as $s_{ij}$ and $d_{ij}$ and if we take these arguments as valid, $Cov\left(O_i^{change}, O_j^{change}\right)$ and $d_{ij}$ are likely to be correlated as well (Lian et al., 2020), especially when the first two correlations are high (Castro Sotos et al., 2009). Of course, we need to bear in mind that strictly speaking the transitivity of correlation is not a mathematical guarantee (Langford et al., 2001). There are also more straightforward reasons why physically proximate objects tend to change together: usually, the extent to which objects are affected by an external factor depends on their proximity to it. For example, in a forest fire, the closer objects are to the center of the fire, the more damage will be incurred (death of living organisms or burning of inanimate objects). The aforementioned example of infectious disease applies here as well: it is a well-known fact in both epidemiology (Lawson et al., 2016) and folk intuition (Singer & Erickson, 2011) that physical proximity is one of the primary factors in predicting who will get infected.

Though people in traditional, small-scale societies rarely theorize their belief systems and everyday practices in explicit terms, in societies with literate tradition we do occasionally find explicit theorizing of the relationship between these variables, especially similarity and covariation. Take the ancient Chinese for example, the Confucian scholar Dong Zhongshu (179-104 BCE) formally proposed the principle that "things of the same kind activate one another" (Dong, 179-104 BCE/2015):

> Now if you pour water on level ground, it will avoid the dry area and run to the wet area, but if you expose two similar pieces of firewood to fire, the fire will avoid the wet piece and go to the dry one. All things avoid what is different from them and follow what is similar to them. Therefore, if *qi* are the same in kind, they will come together; if [musical] tones match, they will respond to each other … This has nothing to do with spirits. Their regularities make them so. A beautiful thing calls forth things that are beautiful in kind; an ugly thing calls forth things that are ugly in kind, for things of the same kind arise in response to each other. For example, when a horse neighs, horses will respond; when an ox lows, oxen will respond.

Bear in mind that Dong's theorization occurred two millennia before Frazer, and it importantly differs from Frazer's writing in that Dong genuinely believes that such a principle is factually correct. Dong's main point here is that things of the same kind (with the same type of *qi*) will "activate" one another, and he supplies his sweeping claim ("all things avoid what is different from them and follow what is similar to them") with some musical and biological examples. Interestingly, some of Dong's examples are factually true: when a horse neighs, other horses will indeed likely respond with neighs either because they are communicating with one another or because they are all responding to some common stimulus. The overall conclusion, however, has a distinctive causal flavor. It is worth noting that Dong's writing has not only since been very influential in the learned circle and was extensively discussed by later scholars, but also was perceived as sensible and intuitive by the lay people and exerted a great influence on their everyday life. For example, the principle of "things of the same kind activate each other" permeates traditional Chinese medicine (Jiang et al., 2018), and his proposed method of rainmaking based on the same principle was practiced as late as the Qing dynasty (1636 – 1911 CE) (Liu, 2013).

## 4. Two additional magical principles: similarity induced closeness and proximity induced resemblance

Although in both Frazer's original formulation and subsequent treatment of sympathetic magic similarity and contagion/proximity are treated as distinctive types of magic, as the above analysis have shown, there is a deeper connection between similarity and proximity in that they themselves are correlated as well. This suggests that the human tendency of mistaking correlation as causation should in theory produce two other types of magical principles:

> Similarity induced closeness: Making two objects more similar will cause them to be physically closer.

> Proximity induced resemblance: Making two objects physically closer will cause them to be similar.

To be fair, in *The Golden Bough*, Frazer does provide some "similarity induced closeness" examples, but he groups them under the same "like produced like" category and does not offer additional explanations (Frazer, 1890):

> The Indians of British Columbia live largely upon the fish which abound in the seas and rivers. If the fish do not come in due season, and the Indians are hungry, a Nootka wizard will make an image of a swimming fish and put it into the water in the direction from which the fish generally appear. This ceremony, accompanied by a prayer to the fish to come, will cause them to arrive at once.

In this case, the indigenous people are not manipulating the image fish in the sense of causing it to change in its properties; rather they simply place it at a certain location hoping that real fish will also appear in that location. Later in the text Frazer uses the more explicit language of "attraction" (Frazer, 1890):

> The Toradjas of Central Celebes believe that things of the same sort attract each other by means of their indwelling spirits or vital ether. Hence they hang up the jawbones of deer and wild pigs in their houses, in order that the spirits which animate these bones may draw the living creatures of the same kind into the path of the hunter.

This "things of the same kind attract each other" idea deserves a special attention, because it was explicitly theorized in other cultures. Wang Chong (27CE – 97CE), a skeptic thinker of Eastern Han dynasty of China, made a very similar point on fake fish attracting real fish:

> The fisherman carved wood into a fish-shape and painted the fish with red lacquer. When the wooden fish floats against the water and stirs it, fish [in the water] think it is real and swim towards it to meet it. (*Lunheng, chapter 47*)

Here, Wang Chong's comments on wooden fish attracting real fish occurs in a larger context where he defends the thesis that one can "seek to obtain something using something that is similar" (以类求之). In medieval Europe, thinkers such as Girolamo Fracastoro also believed that the attraction and repulsion

of two bodies takes place on the basis of their similarity and dissimilarity respectively (Nejeschleba, 2006).

The other type of magic, proximity induced resemblance, is simply the reversing of the causal arrow of similarity induced closeness. To reiterate, it states that by making two things closer they will become more similar. In a sense, this is same the type of contagious magic that Paul Rozin and colleagues discussed where they focus on the psychological discomfort of the participants when the negative properties of some objects "diffuse" into other objects that they have to interact with. Ethnographically, this magic principle mostly manifests itself in the negative form, that is, if one contacts or comes into close proximity with something perceived to be negative, they will "acquire" the negativity which will lead to some kind of misfortune and therefore such contacts should be avoided. I shall note a positive use of such magical principle from my own fieldwork experience with the Yi. The Yi in Liangshan area will sometimes diagnose the location and nature of the illness of a patient by using a chicken to sweep over the patient's body and then sacrifice the chicken by drowning it in water. After the chicken is dead a dissection is performed and it is believed that abnormalities found in the chicken body correspond to pathologies (usually hidden) in the patient. For example, a broken bone in the chicken wing would signify a broken bone in the patient's arm. The local people would jokingly tell me that this method is the "X-ray of the Yi" (Hong, unpublished)[7].

The kinds of magical principles discussed so far can be shown in a simple diagram (Figure 1). Unlike previous accounts of sympathetic magic, this graphical representation of the four principles clearly illustrates the different variables involved and the direction of causality. Note that we don't see causal arrows going from covariation to similarity of physical proximity because when it is possible to induce covariation in both objects we presumably have both of them at hand, and to induce similarity it would be much easier to change one so that it looks more like the other; and to induce proximity they could simply be placed by each other. Therefore, in practice we almost always see the causal arrow going towards rather than from covariation.

[7] There are very few informants who think that in performing this ritual the illness is transmitted to the chicken as well (therefore the patient is healed after such transfer). However, most people seem to think that it only diagnoses rather than cures, and additional healing procedures (usually in the form of propitiating the aggressive ancestral spirits and sending them away) need to be performed to cure the patient.

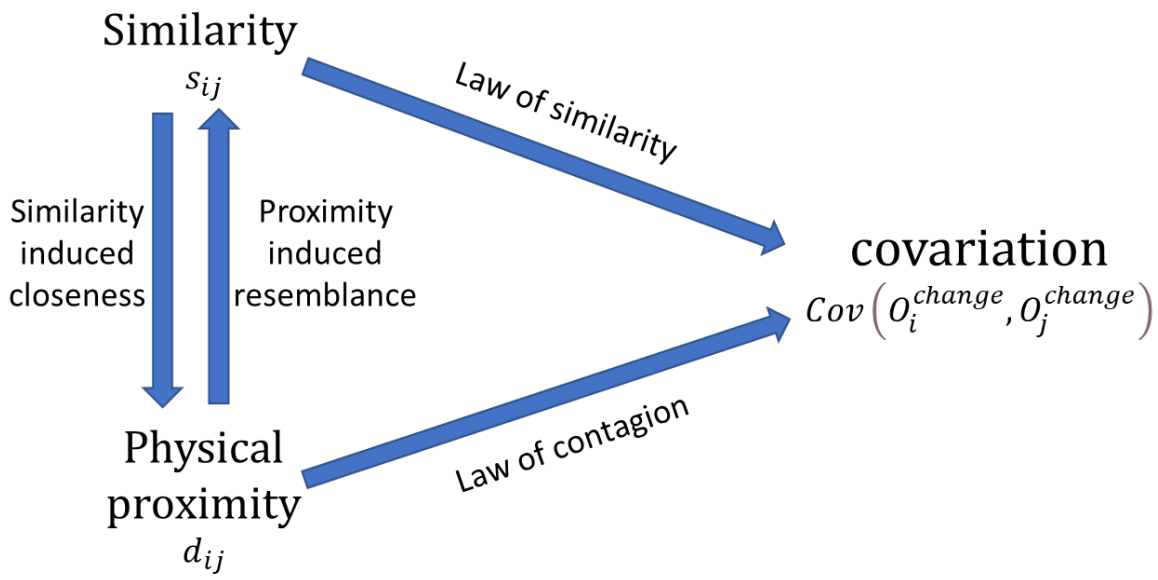


*Figure 2. Types of magical principles due to a combination of environmental regularities (correlation amongst similarity, proximity, and co-variation) and human cognitive tendency (mistaking correlation as causation) .*

## 5. Discussion

In this paper, I have argued that the intuitive plausibility of manipulative sympathetic magic is a result of the regularities in the environment (the correlation between physical proximity, similarity, and covariation) and a by-product of human causal cognition (mistaking correlation as causation), Again, this paper does not attempt a general theory of magic (broadly defined); practices directed towards supernatural entities, for example, clearly have rather different underlying psychological mechanisms such as agency detection (Andersen, 2019), intuitive dualism (Bloom, 2007), and mentalizing (Barrett, 2004; Guthrie, 1995). Like beliefs in god which has been suggested by some[8] to be evolutionary by-products (Boyer & Bergstrom, 2008), I argue that manipulative sympathetic magic is also best viewed as a by-product of human cognitive evolution and does not serve adaptive functions. Cultural evolution, however, may shape the performative aspects of magic in ways that fit our genetically evolved (Singh, 2017) or culturally transmitted intuitions (Hong, forthcoming). In reality, the above four sympathetic magic principles are almost always used in combination with a number of other features to increase the intuitive plausibility of magical practices. Among the Yi in Southwest China, for example, when diagnosing causes of illness shamans (called *suni*) would use both sympathetic magic (rubbing an egg against one's body, dropping the egg yolk into a bowl with water and examining the patterns) and an animistic agent (a benevolent spirit which is said to attach itself to the shaman) in order to identify the causative ancestral ghost (Hong, submitted). Therefore, it may be difficult to pinpoint these magical principles from actual ethnographic observations.

Although the present account provides a novel way of understanding the nature and function of manipulative sympathetic magic, it nonetheless presents a few challenges. Below I address these difficulties and discuss some alternative explanations.

[8] For a discussion on the adaptationist-byproduct debate on the evolution of religion, see Sosis (2009).

### 5.1. What counts as "being similar"?

In the context of sympathetic magic, similarity serves as an important explanans and as such an independent account of how humans perceive similarity is crucial. Yet, the notion of similarity is in fact a very difficult concept both philosophically and psychologically (Goodman, 1972/2012; Tversky, 1977). Traditionally, similarity is often invoked in the discussion of categorization (Goldstone, 1994) and analogical reasoning (Gentner & Markman, 1997) where much effort has been devoted to understanding the specific features and relational structures that make two entities similar. However, human similarity judgements are highly dependent on context, and require not only selection of relevant features but some weighing of their relative importance. People with different backgrounds will not only pay attention to different features but also weigh them differently when deciding the extent to which two objects are similar (Goodman, 1972/2012). Experimental evidence shows that similarity judgement of human subjects often exhibit substantial flexibility and is susceptible to context manipulation: for example, *raccoon* and *snake* were judged to be less similar when no explicit context was provided than when a context was created by placing the word *pets* above the comparison (Barsalou, 1982). Additionally, human subjects often judge similarity between objects in an asymmetrical manner: for example, North Korea is typically judged to be more similar to China than China is to North Korea (Tversky & Gati, 1982). To address these theoretical issues and empirical observations, many models have been proposed on how exactly humans process sensory input information and categorize objects into different groups (Decock & Douven, 2011; Medin, 1989; Verguts et al., 2004).

More recently, advances in brain science and cognitive neuroscience have shed considerable light on cognitive mechanisms of similarity perception, such as deep convolutional neural networks where sophisticated computational models of brain representations are developed to mimic human similarity judgement and categorization (He et al., 2015; Simonyan & Zisserman, 2015). Data driven approaches have also help reveal the underlying dimensions of human similarity judgement: Hebart et al. (2020), for example, identified 49 meaningful dimensions (e.g. *animals*, *colorful*, *circular*, *fire*) using a comprehensive dataset of real-world images and over one million triad responses generated by online workers.

In the mathematical formulation in Section 2, I essentially used a simplified version of the geometric model of similarity which is known to be subject to a number of problems (Decock & Douven, 2011). This is for illustrative purpose only, and I make no strong claims about the human psychological reality of similarity computation and/or categorization. As far as my argument is concerned, the ways humans judge similarity for the purpose of manipulative sympathetic magic need only roughly match similarity of objects in nature regarding their tendency to change in a synchronized manner. In practice, of course, we may observe objects used to activate or influence each other that are "similar" only in a very minimal sense by most accounts (Mauss 1902/2001). This is because during cultural evolutionary time humans may culturally construct theories that group certain objects together for purposes (in cognitive science, this is sometimes referred to as the "theory theory," see (Gopnik, 2008; Murphy & Medin, 1985)) that has nothing to do with sympathetic magic. Once these objects are recognized as belonging to the same kind, however, they may then be (mis)used for manipulative sympathetic magic. For example, dragons and rain by most naturalistic accounts (and to most westerners) have very little in common, yet in traditional Chinese culture these two types of objects share some fundamental properties and therefore are believed to be of the same kind. As such,

traditional Chinese rainmaking activities frequently involve the use of dragon image (Hong, forthcoming).

### 5.2. Is contact the same as physical proximity?

So far in the paper I have been using "contact" and "physical proximity" more or less interchangeably. Both Frazer himself and subsequent scholars, however, emphasize "contact" as an essential component of sympathetic magic (hence the name "law of contagion"). In an obvious sense, the most physically proximate two objects can be is actual contact, yet for sympathetic magic to work, the two objects need only be recognized as belonging to the same system by virtue of physical proximity. Neuroscientific work in "systematizing mechanism" shows that the human brain may focus on one detail (the input) and observes what happens to the input when it is manipulated by just one factor (the operation), and logs the result of the transformation of the input by the operation (the output) (Baron-Cohen et al., 2003), and such cognitive process likely leads humans to see lawful, potentially causal patterns (Baron-Cohen & Lombardo, 2017). In proximity induced resemblance, proximity itself is often sufficient to induce change; for example, in rural Ghana in the 1940s, the potency of certain medicine is believed to be spoiled by the proximity of a menstruous woman in the house (Field, 1970). Similarly, the war scouts of the Kpelle people in Western Africa in the early 20$^{th}$ century would carry "magic bananas" which would indicate the proximity of the enemy through sympathetic response (it would be too late to wait for contact!) (Westerman & Schütze, 1921). In South Asia, the Telugu believe that auspicious influences can be transmitted by both touch *and* proximity (my emphasis) (Tapper, 1987). Regarding manipulative magic depending on the principle of contagion, it is true that most practices recorded ethnographically and historically do involve contact at least in the folk sense. I suggest that this is because amongst the many objects that are physically proximate to the focal object, the ones that actually are in contact with the focal object are much more cognitively salient (and more likely to be recognized as belonging to the same system) and may enjoy an advantage during cultural transmission (Claidière & Sperber, 2007; Sperber, 1996).

### 5.3. What about the transfer of essence?

In both classical anthropological accounts and later work on magic, one explanation of the law of contagion that frequently emerges in literature is the transfer of essence or vital properties through contact. To be sure, my account does not involve any transfer of properties, and I offer two arguments regarding the relevance the "transfer of essence" idea. First, it may be a result of an extremely common human thinking habit, *post hoc* rationalization (Cushman, 2019) of the intuition that objects that are in contact/physically proximate influence each other. In other words, the mechanism that people come up with to justify their intuitions may not explain why they have such intuitions in the first place. Second, while transfer of essence does offer a plausible mechanism for proximity induced resemblance, it does not really explain manipulative magic, at least not in any straightforward way. Why would objects that share the same essence causally co-vary? One possibility is that once the essence of an object is transferred to another object, the two objects become *similar* and we are back at the puzzle of manipulative magic based on similarity. Sørensen (2007), in his extensive treatment of magic from cognitive perspectives, proposes that the transfer of essence establishes a kind of "essence link" such that the objects involved may sympathetically respond to each other. This account unfortunately still begs further questions: why would contact establish an essence link, and why does the essence link

make the two objects respond to each other's change in similar ways[9]? As a result, it feels more of a re-description of the phenomenon rather than a genuinely explanation.

### 5.4. The possibility of false generalization

The present account does not rule out an important alternative explanation: false generalization based on few examples. The idea is that in nature there are indeed cases where things activate each other at a distance. Dong, for example, in illustrating of principle of "things of the same kind activate one another", uses the phenomenon of sympathetic resonance in musical instruments with strings: "Pluck the note *gong*, and other *gong* notes will respond to it; pluck the note *shang*, and other *shang* notes will respond to it[10]." Indeed, many early Chinese writers used the actual observation that if one string of an instrument is plucked, a similarly tuned string on a nearby instrument will vibrate (Schliesser, 2015). Western scholars such as Plotinus (204 – 270 CE) and Francis Bacon (1561 – 1626 CE) also noticed the sympathetic resonance of strings in musical instruments (Schliesser, 2015). Plotinus, in particular, uses sympathetic vibration in music to argue for the efficacy of prayers (Gurtler, 2015):

> But the sun, or another heavenly body, does not hear his prayer. And that which he prays for comes about because one part is in sympathetic connection with another, just as in one tense string…when one string is plucked, another has a kind of sense of this by its concord and the fact that it is tune to the same scale. But if the vibration can even pass from one lyre to another in so far as a sympathy exists, then there is also one single harmony in the All…

Plotinus here jumps from the existence of sympathetic resonance between strings to "one single harmony in All", a quite hasty generalization. We now know through modern acoustics and physics that such sympathetic resonance occurs when the natural oscillatory periods of sonorous vibrators are harmonically related and the vibrations are isochronous (Schliesser, 2015), and is a rather specific case and thus would be a poor foundation to construct grand generalizations.

The most typical natural example of sympathetic action, of course, is magnetism. This phenomenon has attracted much theorizing from scholars and thinkers across cultures and historical times. In the same paragraph where Wang Chong makes the case the fake fish can attract real fish, he also uses magnetism to justify "like activates like": "sea turtle shells, after being rubbed, may attract small and light items; magnet stones can attract needles made of iron. This is because they are all really of the same kind, not different kinds." (*Lunheng, chapter 47*) In the western tradition, magnetic attraction was similarly used to illustrate the principles (or at least the plausibility) of sympathetic influence (Nejeschleba, 2006; Pollitt, 2019), including many notable enlightenment scientists such as Margaret Cavendish, Anne Conway, and Gottfried Leibniz (Meyns, 2018).

Aside from music and magnetism, miscellaneous cases can also be grouped together under the same category "sympathy". Aristotle, for example, when discussing the idea of sympathy, starts with yawn contagion[11] ("Why do men generally themselves yawn when they see others yawn?") yet he also

[9] Presumably, "essence link" could be defined this way, but this would not add to our understanding of the phenomenon.
[10] Both *gong* and *shang* are notes of traditional Chinese pentatonic scales.
[11] Note that unlike the previous two examples of cosmic harmony where different events/entities are linked via a mechanistic pattern (under the implicit assumption of the fundamental patterns in the physical universe), the yawning case is based on social perception of empathy that is also observed in other primates (Anderson et al., 2004).

includes the urge to urinate when people are close to a river and the contagious spread of disease (Barnes, 2014).

All of this is to say that there are indeed cases where change in one object (spontaneous or manipulated) induces change in other objects, and such cases were often used to infer some general law of sympathetic action. Of course, pre-modern theorizing of sympathetic action in literate societies is not exactly the same as Frazerian sympathetic magic, but they do share the underlying logic that things (usually of the same kind) can influences each other in some way. The key difference is perhaps that the enlightenment thinkers do not believe one can create deep similarity by means of superficial resemblance. A voodoo doll, for example, would be an image and only an image in the eyes of an enlightenment thinker, and as such would not be categorized as belonging to the same kind as the real person.

I suggest that both mechanisms (mistaking correlation amongst similarity, proximity, and covariation as causation and false generalization) contribute to the phenomenon of manipulative sympathetic magic, though their relative importance may depend on the specific historical and cultural contexts. The limitation of the false generalization account may be that it does not address the manipulative aspect of magical actions as much as the correlation-causation account, as there is nothing intrinsic in this account that requires change in one object leading to change in another object *in the same direction*. In medieval theorizing of sympathetic actions, for example, sympathy is often discussed in conjunction with antipathy, and manipulation of objects mainly affects the presence or absence of their sympathetic power (e.g., garlic deprives magnets of their attractive power (Sander, 2019)) rather than the corresponding change in objects that are in sympathetic relationships with them. In any case, it is perhaps not surprising that more than one cognitive and cultural mechanisms sustain a phenomenon as rich and prevalent in human societies as sympathetic magic. Nonetheless, we should keep in mind that the principles of manipulative sympathetic magic do not account for *all* magic/superstitious practices in a broad sense: as already mentioned, practices such as deity worship clearly requires quite different psychological bases from those require for sympathetic magic. This paper also only addresses the evolved intuition aspect[12] of magic practices as it explains why cultural practices with certain forms are more successful than others (Miton et al., 2015). Obviously people must have encountered numerous empirical failures when attempting to use any magic (in fact, one of the proposed defining features of magic is that it doesn't work, see Lindeman & Svedholm (2012)), yet empirical failures can be easily explained away and rarely fundamentally challenge the validity of culturally accepted practices[13] (Hong, forthcoming; Hong, forthcoming).

[12] More precisely, the present paper only accounts for evolved intuition regarding sympathetic magical actions: i.e., why we find similarity and contagion as attractive causal principles. For other work that looks at the evolved aspect of magical thinking, see Legare & Souza (2012), Singh (2017) and Boyer (2020).

[13] Keith Thomas, the celebrated historian of medieval magic comments that "…once their initial premises are accepted, no subsequent discovery will shake the believer's faith, for he can explain it away in terms of the existing system. Neither will his convictions be weakened by the failure of some accepted ritual to accomplish its desired end, for this too can be accounted for…The reaction against magic could thus never come from the cumulative resentment of disappointed clients. It had to arise from outside of the system altogether." (Thomas, 1971/2003)

## 6. Conclusion

In this paper, I formalize Frazer's classic account of magic and argue that the puzzling practice of sympathetic magic can be explained by a combination of environmental regularities and the human tendency to mistake correlative patterns as causality. I draw from a rich source of ethnographic and historical record in support of the plausibility of the account and at the same time suggest that a full understanding of sympathetic magic may require taking into consideration multiple mechanisms.


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