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Koro: a socially-transmitted delusional belief

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Abstract

Introduction: Koro is a delusion whereby a man believes his penis is shrinking into his abdomen and this may result in his death. This socially-transmitted non-neuropsychological delusional belief occurs (in epidemic form) in South-East and South Asia. We investigated whether the two-factor theory of delusion could be applied to epidemic Koro.

Methods: We scrutinised the literature on epidemic Koro to isolate features relevant to the two questions that must be answered to provide a two-factor account: What could initially prompt the Koro delusional hypothesis? Why is this hypothesis adopted as a belief?

Results: We concluded that the Koro hypothesis is usually prompted by the surprising observation of actual penis shrinkage—but only if the man has access to background beliefs about Koro. Whether the hypothesis is then adopted as a belief will depend on individual factors such as prior belief in the Koro concept or limited formal education and sociocultural factors such as deference to culture, to media, or to rumours spread by word of mouth. Social transmission can influence how the first factor works and how the second factor works.

Conclusion: The two-factor theory of delusion can be applied to a socially-transmitted delusion that occurs in epidemic form.

1. Introduction: The *suo-yang* delusion

In the late afternoon of May 21, 2004, a boy in the third grade at a school in the small village of Fuhu (which is in Guangdong Province on the southern coast of China) suddenly felt that his penis was shrinking.

He panicked and ran home to tell his parents. His mother held his penis to prevent any further shrinkage, and his father contacted a local healer, an 80-year-old woman, for emergency treatment. The healer administered to the boy the traditional treatment *aijiu* (known in the West as moxibustion: it consists of burning moxa, made from the mugwort plant, on or close to the skin). The boy's symptoms subsided within ten minutes.

When the school principal learned about this incident two days later, he gathered all the students in the school courtyard and explained to them what had happened. He warned them to be cautious, and to take emergency measures if they experienced similar symptoms.

Later on that same day, four more male students began to complain that their penises were shrinking. They too panicked and went home, and they too received *aijiu* treatment from the local healer.

The next day, sixty more male students experienced the same phenomenon, which made them panic. All except one then received *aijiu* treatment, from the same local healer.

These occurrences attracted the attention of the departments of health and education in the Guangdong region. They immediately took measures aimed at eliminating the atmosphere of panic, through a campaign of public-health education. No further reports of the symptom occurred after this.[1]

At this time, people in Fuhu village already believed in the phenomenon of penis-shrinkage and subsequent retraction into the abdomen, which could ultimately prove fatal. They even had words referring to this phenomenon: *suo-yang* (literally, "shrinkage of yang (penis)"), and *kong-suo* (meaning "panic shrink").

2. *Suo-yang* epidemics in China and beyond

One reason that the Fuhu villagers were familiar with the *suo-yang* phenomenon was that a previous epidemic of the same belief had occurred in the same village in 1963; this involved approximately 50 adults over a period of about 10 days.

This earlier epidemic in Fuhu in turn had taken place one year after an epidemic of the same belief had occurred on nearby Hainan Island, which is just off the southern coast of China, and was (until 1988) part of Guangdong Province. (Because the epidemics that we shall discuss occurred before Hainan became a separate province, we shall use the term "Guangdong Province" to include what is now Hainan Province).

[1] Our account of these events in Fuhu village is drawn from Li (2010).

2.1 *Suo-yang* epidemics in China

According to Mo et al. (1995), official records from Hainan Island mention a *suo-yang* epidemic having occurred there in 1862. Five more such epidemics occurred there or in the adjacent Leizhou Peninsula in the period 1945–1984. All that is known about the 1952, 1962, 1966 and 1974 epidemics comes from the recall of older residents of these regions (Cheng, 1996), but the most recent of these five epidemics has been reported in detail (Mo et al., 1995; Tseng et al., 1988; Tseng et al., 1992).

This epidemic[2] began in August 1984 in Lingao, a village on the north coast of Hainan Island. It spread in an anti-clockwise direction around the coast of the island, from village to village, reaching the village of Dongfang on the western coast in February 1985, after this reaching the south coast, and then eventually reaching the village of Wanning on the east coast around May 1985 (see Tseng et al., 1988, p. 1539, Figure 1). The local health authorities instituted at that point an information campaign targeted at the delusion, which was effective: no further cases were reported after that.

During the period that *suo-yang* was spreading around Hainan Island, there was also an outbreak of the delusion amongst the people of the Leizhou Peninsula, just north of the island, in April–June 1985. This arose in the following way (see Mo et al., 1995, p. 235). A beggar from Leizhou (a place then known as Haikang), a city on the peninsula, had decided to take the ferry to Hainan Island to try begging there. At the ferry, he was warned by someone from Hainan that he risked death by going there; this person described the ongoing *suo-yang* epidemic to the beggar. Frightened by this, the beggar, instead of travelling to the island, returned to Leizhou, where he told people about *suo-yang* and the Hainan Island outbreak. Shortly afterwards people in Leizhou began to report that they had *suo-yang,* and the condition then spread south and north throughout the peninsula, reaching the northernmost part of the peninsula in June 1985.

Here is a case described by Tseng et al. (1988, p. 1541):[3]

> **Case A** One evening in May 1985, a 28-year-old male from Haikang heard the frightening sound of a gong being beaten and the terrifying noises made by the people who were panicking in the nearby neighbourhood. He suddenly became anxious and experienced the sensation that his penis was shrinking. He was seized with panic and shouted loudly for help. Several men in the neighbourhood rushed in and tried to rescue him by forcefully pulling his penis and making loud sounds to chase away the evil ghost that was thought to be affecting him. The panic condition subsided within half an hour. However, his anxiety did not dissipate completely. For
> several evenings he kept his gun beside him when he went to bed to assure himself that the evil would not come close to him.

[2] In many of the Koro epidemics we discuss in this paper, including the 1984/85 Hainan/Leizhou epidemic, there were some female cases. These involved the beliefs that the nipples were retracting into the body and/or the labia were shrinking. Male cases always predominated and no detailed reports of individual female cases exist. For these reasons we do not discuss female cases in our paper.

[3] Most case descriptions have been paraphrased and abbreviated.

More than 3,000 individuals complained of *suo-yang* during the 1984–85 epidemic in Hainan Island and the Leizhou Peninsula. A subsequent *suo-yang* epidemic involving about 300 cases occurred in the area of Leizhou in May 1987.

2.2 *Suo-yang* epidemics outside China

These *suo-yang* epidemics that occurred in one province in southern China are not the only instances of epidemic *suo-yang* to have been reported. Such epidemics have also occurred in countries other than China.

Singapore

Singapore has seen only one *suo-yang* epidemic. It began on 29 October 1967 and lasted for about a month; 469 cases were reported (Koro Study Team, 1969). During the epidemic, some people believed that Koro was caused by eating tainted pork (see Section 5.4).

Here is a case from the Singapore epidemic (Chong, 1968, p. 641):

> **Case B** A 16-year-old Chinese schoolboy rushed into a clinic with his parents shouting for the doctor to attend to him quickly because he had *suo-yang*. The boy looked frightened and pale and he was pulling hard on his penis to prevent the organ from disappearing into his abdomen.
>
> The doctor reassured both parents and patient and provided chlordiazepoxide as a medication. There was no recurrence of the condition.
>
> The boy had heard about *suo-yang* in school. That morning at breakfast he had eaten *cha siu bao* (steamed pork bun). Then he went to urinate and noticed that his penis had shrunk when he had finished. Frightened, he took hold of his penis and rushed to his parents shouting for help.

The Singapore Medical Association and the Singapore Ministry of Health made public announcements on television and in the newspapers stating that *suo-yang* was the result of fear and was not a physical illness, and stressing the harmlessness of pork. An immediate decline in the incidence of cases ensued, and within a month of the initial onset of the epidemic reports of the condition ceased entirely. People resumed eating pork, which they had ceased to do (see Section 5.4).

In 1968, a 'Koro Study team' was formed by interested professionals from several medical units in Singapore to carry out a study of the epidemic. It is of interest to note that the report they subsequently produced (Koro Study Team, 1969), which was published in the *Singapore Medical Journal*, nowhere uses the Chinese term "*suo-yang"*; the delusional condition is instead referred to throughout the report by the Malay term "Koro".[4] Koro has since become the generally-used term for the condition, and is the term we will mainly use from now on in our paper.

[4] According to Ng & Kua (1996, p. 563) "The term 'koro' is thought to derive from the Malay word 'kura' which means 'tortoise'—the symbolic meaning is that the penile retraction is compared with the retraction of the head of the tortoise into its shell."

Thailand

A Koro epidemic occurred in November 1976 in North-eastern Thailand, where within a few days at least 200 patients were treated at local hospitals (Jilek & Jilek Aall, 1977, p. 58). Ultimately, at least 2,000 people were affected by the epidemic (Jilek, 1986, p. 272). Patients recovered after brief symptomatic intervention. During the epidemic, some people believed that Koro was caused by eating food or smoking cigarettes that had been poisoned (see Section 5.4).

India

Six Koro epidemics occurred in India in the period 1968–2015 (Debbarma et al., 2016). Each of the six was associated with at least one of Assam, Tripura and West Bengal, three (adjacent) states in the north-eastern part of India.

The 1982 epidemic occurred in Assam and West Bengal, with a few cases in Meghalaya, to the south of Assam. How did the epidemic spread? Sachdev (1985) said: "An outsider witnessing a case in a village often carried the story, and the example, to his own village. The nature of the spread resembled an epidemic of hysteria" (p. 434). Nandi et al. (1984) described a case of just this kind from West Bengal:

> **Case C** A businessman (Mr K) went to a neighbouring village to collect some outstanding bills. There, he heard about *koro*. He heard that people who had *koro* were panic-stricken and worried that they would die. Mr K hurried back to his own village and went to a tea-stall in the market, where he told people about *koro*. Two people immediately had *koro*, while others left the market to pass the message on—with the result that two more people had *koro*. Mr K then went home and told his family about what had happened and, very shortly, his younger brother had *koro*. (pp. 331–332)

Here is a case from Assam (Sachdev, 1985, p. 435):

> **Case D** While bathing her four-year-old son, a woman noticed that his penis had shrunk slightly. She immediately panicked and called out for her husband.
>
> The boy started to cry and this made the penis retract a little further.
>
> The father held the boy's penis while she wrapped him in a shawl and they rushed for the ferry to take him to the dispensary across the river. A doctor saw the boy and reassured the parents.

The 2010 epidemic occurred in Assam, West Bengal and Tripura in the north-east, and in Kerala in the south-west and Maharashtra in the west—particularly in the city of Mumbai. The movement of migrant labourers (e.g., from Assam to Mumbai) was a factor in the spread of the epidemic. But social transmission does not always require actual physical movement to distant places—as the next two cases illustrate (Roy et al., 2011, p. 683):

Case E A 30-year-old unmarried male carpenter hailing from a remote location of north-eastern India received a mobile phone call from his brother in the evening who told him to be vigilant about a disease in which the penis gets shorter.

Twenty minutes after this call he started to experience twisting body movements and a feeling as if his penis was retracting into his abdomen.

The next morning he was brought to our hospital with extreme anxiety and a feeling that he would die if the penis continued to shrink. He was prescribed a low dose benzodiazepine and was offered supportive therapy. Three days after admission he was relieved of his symptoms and was discharged.

Case F A 23-year-old male also from a remote location of north-eastern India was brought to the casualty department at midnight by his friends and relatives in an anxious and distressed condition. He had calcium hydroxide paste applied to his ear lobules. He reported that he had seen television reports of 'penis retraction disease' and had then felt his penis gradually withdrawing into his abdomen. He also believed that this would ultimately cause obstruction to his intestines and that the chemical applied on his ear lobules could relieve him.

No amount of reassurance could pacify him and he was kept under observation in the psychiatry ward. Thought processes were normal and no perceptual disturbance could be detected. He was prescribed a low dose benzodiazepine, given supportive counselling and discharged. There has been no recurrence of symptoms.

2.3 Non-epidemic Koro

Remarkably, epidemic Koro has never been reported from any country other than the four South Asian countries we discuss above.

However, *individual* cases of Koro have been reported in numerous Western countries. Berrios and Morley (1984) and Chowdhury (2021) review such Western cases. But social transmission of the delusional Koro belief is not seen in these cases; nor do we know of any Western cases where premorbid knowledge of the Koro phenomenon was present. For these reasons, sporadic individual cases of Koro, such as those seen in the West—though these are of great interest—are not relevant to the topic of our paper, which is epidemic Koro as a socially-transmitted delusional belief.

3. Why can one call Koro a delusion?

The latest edition of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*) defines *delusion* thus: "Delusions are fixed beliefs that are not amenable to change in light of conflicting evidence" (American Psychiatric Association, 2013, p.87; see also p. 102 of the recent text revision of *DSM-5*, *DSM-5-TR* (American Psychiatric Association, 2022). As we have noted above, government medical authorities have sometimes used media information campaigns to bring Koro epidemics to a halt. If we were to adhere to the *DSM-5* definition of delusion, it might be interpreted in a very demanding way, so that the term "delusion" would apply only to *permanently* fixed beliefs that are *never*

abandoned in the light of conflicting evidence—and not to the Koro belief, which is sometimes abandoned in response to information provided by a media campaign.[5] But that is not how we use the term "delusion".

The Koro belief is maintained during a period before authoritative health information becomes available in media campaigns. We use the term "delusion" to refer to the belief held during that period and it is crucial for this use of the term that the belief is maintained in the face of evidence against it. If there did exist within one's community a genuine medical condition in which men's penises shrink into their abdomens, with death ensuing after the shrinkage is complete, then one ought to encounter within one's community such men, and such fatalities. This is a prediction that can be derived from the Koro hypothesis. The fact that no such encounters ever occur is therefore evidence that conflicts with the Koro belief—and with any belief in the reality of this condition.[6]

One could not reasonably object to the use of the term "delusion" to refer to the Koro belief on the ground that the belief is held only temporarily. For each of the recognised forms of (monothematic) delusion—Capgras, Cotard, Fregoli, and so on—cases are reported in which the belief in question is maintained for a period of time and then abandoned. (For a detailed example, see Breen et al., 2002 and Coltheart, 2007, p. 1054.) Young (2000) observed: "Often they [delusional beliefs] are only held for a few weeks or even days" (p. 68). The temporary nature of the belief is never taken as a ground for not referring to this belief, while it is maintained, as a delusion.

3.1 Cognitive neuropsychiatry and the *DSM* definition of delusion

There is no reason why cognitive neuropsychiatry should be bound by the *DSM* definition of delusion, and there are good reasons to reject it. The *DSM* is not a scientific document, but a practical manual for clinicians. Just weeks before the most recent version of the *DSM* (*DSM-5*) was published in 2013, the National Institute of Mental Health (NIMH) announced that it would be moving away from funding research based on *DSM* categories. The American Psychiatric Association and NIMH subsequently released a joint statement to the effect that while the *DSM* remains of value for clinical diagnosis, "what may be realistically feasible today for practitioners *is no longer sufficient for researchers*" (https://www.apa.org/monitor/2013/07-08/nimh; our emphasis).

Others have echoed this view, for example:

> despite the facade created by psychiatric textbooks, there is no acceptable (rather than accepted) definition of a delusion. (David, 1999, p. 17)

> definitions such as the ones in the DSM cannot probably be expected to provide necessary and sufficient conditions for the phenomena they aim to define. At best,

[5] A reviewer suggested that the Koro belief is not a delusion because it is not maintained in the face of contrary evidence.

[6] We are not the first to draw attention to this evidence. Mo et al. (1995, p. 243) commented on the "challenging question" why people hold background cultural beliefs about Koro and, specifically, adopt and maintain the Koro belief in Koro epidemics, despite the evidence that "no person has actually died from a *koro* attack".

> they can prove diagnostically useful and guide further research by conveniently delimiting an area of investigation worth pursuing. (Bortolotti, 2022)

A further reason why cognitive neuropsychiatry ought to ignore the *DSM-5* definition of delusion is that within that manual two contradictory definitions are given. The main text offers the definition quoted above; but the Glossary[7] offers a different and conflicting definition: "Delusion: A false belief based on incorrect inference about external reality that is firmly held despite what almost everyone else believes and despite what constitutes incontrovertible and obvious proof or evidence to the contrary" (p. 819).

Numerous aspects of this second definition have been explicitly repudiated by researchers working on the cognitive neuropsychiatry of delusion. As Bortolotti (2022) says:

> Counterexamples are easily found to the DSM definition of delusion: there are delusions that do not satisfy all of the proposed criteria, and there are irrational beliefs that do, even though they are not commonly regarded as delusional. In the passage below, Coltheart summarizes the main problems with the DSM definition:
>
> 1. Couldn't a true belief be a delusion, as long as the believer had no good reason for holding the belief?
> 2. Do delusions really have to be beliefs—might they not instead be imaginings that are mistaken for beliefs by the imaginer?
> 3. Must *all* delusions be based on inference?
> 4. Aren't there delusions that are not about external reality? 'I have no bodily organs' or 'my thoughts are not mine but are inserted into my mind by others' are beliefs expressed by some people with schizophrenia, yet are not about external reality; aren't these nevertheless still delusional beliefs?
> 5. Couldn't a belief held by all members of one's community still be delusional? (Coltheart 2007, p. 1043).

3.2 The Koro belief as a delusion

The Koro belief, "I am suffering from Koro, a dangerous condition that causes penile shrinkage", like other delusional beliefs, is typically temporary. Although the Koro belief is sometimes abandoned in response to authoritative health information provided in media campaigns, it is maintained for a period of time. During this period, the person has access to other evidence that contradicts the Koro belief—as we say, the absence of observation of genuine major shrinking of the penis, let alone the observation of any deaths arising from this. Thus, the Koro belief is a quintessential example of a belief that does not change in light of conflicting evidence. That is why we call the Koro belief a delusion and why we aim to understand it in the explanatory framework provided by the two-factor theory of delusional belief.

[7] We do not find a Glossary in the 2022 text revision of *DSM-5* (*DSM-5-TR*, American Psychiatric Association, 2022).

4. The two-factor theory of delusional belief applied to the explanation of epidemic Koro

The basis of the two-factor explanation of delusional belief (see e.g., Langdon & Coltheart, 2000; Davies et al., 2001; Coltheart & Davies, 2021b) is that any delusional condition can be explained if answers can be found to two questions, which are:

(a) What gave rise to the delusional hypothesis in the first place—what brought this idea to the patient's mind?

and

(b) Given that such hypotheses are not only usually bizarre and implausible, but are also challenged by the patients' families, friends and clinicians, these hypotheses ought to be rejected by the patient; but they are not. Instead, they are adopted and maintained as beliefs. Why?

Any attempt to use the two-factor theory to explain epidemic Koro therefore requires proposing answers to these two questions in relation to epidemic Koro.

We will consider each question in turn.

4.1 First factor: What could bring the Koro delusional hypothesis to mind in the first place?

There are various physiological events which result in genuine (minor and temporary) shrinkage of the penis, including exposure to cold, bathing, colic in children, illness, urination, defecation and ejaculation. Anxiety or fear can have the same effect (Simons, 1985, p. 152).

Many occurrences of Koro have been reported in which some such event that is a normal cause of temporary reduction in penis size preceded the onset of the delusion. Chowdhury (1996) has reviewed such occurrences in relation to four event types; exposure to cold (Table 1), sexual activity (Table 2), urination or defecation (Table 3), and fear/anxiety (Table 4). His review covers 305 cases of Koro in which the onset of the disorder was preceded by one or other of these four types of putatively precipitating event. Of these cases, 267 were epidemic cases from China, Singapore or India.

Additional reports of Koro where one of these prior precipitating events was reported include Gwee (1963), Rin (1963), Yap (1965), Sachdev (1985; see above, Case D) and, especially, Chong (1968), who noted that this appears to have been generally true of the cases in the Singapore epidemic:

> The onset [of the condition] usually followed a normal physiological cause of retraction or shrinking of the organ—for example, after a bath, after passing urine, after illnesses, etc. (p. 641)

So there are many cases where the first factor in the genesis of the Koro delusion can plausibly be supposed to have been the surprising observation of an actual reduction in penis size. We speculate that this is true for most—perhaps all—cases. So this is the answer we propose to the first of the two questions we are considering.

4.1.1 The role of background beliefs about Koro in bringing the Koro hypothesis to mind

We are not suggesting for a moment that, when a man is surprised to find his penis is not as large as he expected it to be, the Koro hypothesis will always come to mind. According to the account of belief formation offered by Coltheart and Davies (2021b), whenever some Surprising Fact (SF) is observed, this automatically triggers an effort to generate some hypothesis that could explain this SF, a hypothesis which may subsequently be adopted as a new belief. A specific information-processing pathway from observation of an SF to a new belief about the world that could explain that SF was proposed by Davies and Coltheart (2020) and Coltheart and Davies (2021a). This was based on the concept of abductive inference first proposed by the American pragmatist philosopher Charles Sanders Peirce (1903/1998) and so we refer to this as a Peircean pathway. Following observation of an SF, the next step in this pathway is the evocation, by the SF, of a hypothesis which could explain the SF. We proposed that the mechanism by which such evocation occurs is associative in nature: some background beliefs that are associatively related to the SF are activated and used as the source of a hypothesis that potentially explains the occurrence of the SF.

In the case of Koro, such a background belief could, for example, be "Koro is—or, at least, there are people in my community who believe that Koro is—a dangerous condition that causes penile shrinkage". But for a person who had no access to such beliefs about Koro, there would be no way in which the experience of one's penis being shorter than expected—which is the relevant SF in the case of Koro—could associatively generate any putative explanation that involved Koro.

4.1.2 Beliefs about Koro in South-East and South Asian countries

Such beliefs are common in various countries of South-East and South Asia. We consider the four countries where Koro epidemics have been well-documented.

China

Suo-yang (the Chinese term for Koro) is known throughout China and the *suo-yang* phenomenon itself has been known in Chinese culture for millennia. Ng and Kua (1996) documented numerous references to the causes and consequences of *suo-yang* in Chinese texts dating from the Han dynasty *(*206 BC–220 AD) to the Qing dynasty (1644–1911). Thus, over the past two millennia, cultural beliefs about the *suo-yang* phenomenon have been widespread in China. In a questionnaire survey reported by Mo et al. (1995; also see Tseng et al., 1992), more than half (53%) of the respondents from Guangdong Province reported awareness of the *suo-yang* phenomenon, and such awareness was also present (though to a lesser degree) in regions far remote from Guangdong: Jilin, in northern China near the Korean border (21% awareness) and Taiwan (37% awareness).

With respect to the 1984–85 epidemic in Hainan Island and the Leizhou Peninsula, 232 individuals from ten villages in Leizhou were surveyed in some detail (see Mo et al., 1995, p. 236) and it was found that all of them had beliefs about *suo-yang* prior to complaining of it (Cheng, 1996, p. 76).

Three different ethnic groups live on Hainan Island. In China overall, the Han are the dominant ethnic group (92%) while the Li and the Miao are minority ethnic groups (each less than 1%);

but the Li and Miao are more common on Hainan Island, where they comprise about 15% of the population. All *suo-yang* cases on the island in the 1984–85 epidemic were Han people (Tseng et al., 1988, p. 1542). This was also true for the 232 cases from Leizhou surveyed by Mo et al. (1995); that is, all were of Han Chinese ethnicity (Cheng, 1996, p. 73).

Why were the Hainanese Li and Miao peoples unaffected? Because in China cultural beliefs referring to Koro are specific to the Han ethnic group. These beliefs are not part of the Li or Miao cultures. Hence even though Li and Miao men, just like Han men, must also encounter the various physiological events which result in genuine (minor and temporary) shrinkage of the penis, the absence in such men of any background beliefs involving Koro will mean that the Koro hypothesis will not be generated in Li or Miao men, and so the Koro delusion will not occur.

Singapore

The 1967 Singapore Koro epidemic affected almost exclusively people of Han Chinese ethnicity. About 75% of the population of Singapore at that time were of Han Chinese descent but 98% of the reported Koro cases were Chinese (Koro Study Team, 1969, p. 236)—almost all from southern China (Ngui, 1969, p. 265). Thus, they would have had some cultural awareness of Koro and "without exception, every case has some idea of Koro either hearing about it previously or told about it at the 'epidemic' before he was affected" (Koro Study Team, 1969, p. 240).

Thailand

The population of Thailand includes a substantial number of people of Chinese descent—currently between 11% and 14% (Draper & Selway, 2019)—but we know of no evidence that beliefs about Koro are part of Thai culture. Suwanlert and Coates (1979) remarked: "although the Chinese comprise 10 percent of the population at risk, not one Chinese case was reported" (p. 65). Thus, it seems relatively unlikely that the 1976 Koro epidemic in Thailand primarily reflected Chinese cultural beliefs. There were, however, rumours circulating "that Vietnamese immigrants had deliberately contaminated food and cigarettes *with a koro-inducing powder*" (Bartholomew, 1994, p. 49; our emphasis). It is somewhat obscure how the Koro concept came to be included in these rumours but Jilek and Jilek-Aall (1977) commented: "It is possible, of course, that the choice of Koro symptoms originally started with a member of the Chinese minority" (p. 59).

India

Writing about the 1982 epidemic, Sachdev (1985) said:

> In view of the emphasis on the traditional Chinese ideas of sex physiology in earlier literature on the syndrome … , one is struck by the similarity of these with some important Indian Ayurvedic concepts. … Concerns about virility and ability to procreate are central to Indian culture. However, Ayurveda records no description similar to koro syndrome. *Shrinkage of the phallus as a sign of imminent death is recorded in Caraka Samhita*[8] *(1977), an authoritative Ayurvedic treatise*, but its reference is clearly to physical causes. (p. 437; our emphasis)

[8] A Sanskrit text on Ayurveda traditional medicine dating back more than two millennia.

In a letter to *The Lancet*, Sachdev and Shukla (1982) described a typical episode:

> tingling in the legs rapidly spreading to the rest of the body … , a feeling of intense heat, psychic and autonomic features of anxiety, and the complaint that the penis or penis and testicles … were going in—all this accompanied by fear of impending death. (p. 1161)

This sounds similar to the Chinese concept of *suo-yang* but it is not clear whether typical cases derived their background beliefs from Indian traditional medicine (Ayurveda).

Ghosh et al. (2013) reported 55 cases of Koro from the area around Kolkata (West Bengal) during the 2010 epidemic, of whom 24 (44%) had a fear of impending death, while the remainder were afraid of 'dissolution' of the male organ. All of the patients had some prior beliefs about the condition (called *disco fever* in that region) including the belief that the condition could be communicated by touch. These beliefs were mostly acquired from neighbours but sometimes from newspapers (Ghosh et al., 2013, p. 11).

In sum, beliefs about a potentially fatal condition in which the penis shrinks completely into the abdomen exist in both Indian and Chinese cultures. We contend that this allows the Koro hypothesis to come to mind in these cultures as a response to the Koro SF (observation of a physiologically normal minor reduction in penis size). In people without cultural beliefs about Koro (e.g., in Thailand) rumours about Koro may have played a similar role in the generation of a hypothesis to explain the Koro SF.

4.2 Second factor: What causes the Koro hypothesis to be adopted as a belief?

We are not suggesting that, at the times of the various Koro epidemics in the four countries we are considering, *everyone* in each of the relevant communities possessed or had access to beliefs about Koro. For those who did not, the SF could not have associatively activated prior background beliefs about Koro, and therefore could not have prompted the Koro delusional hypothesis (Section 4.1.1). But many people in these communities *would* have had beliefs about Koro (Section 4.1.2). In these people, observation of the SF could have evoked hypotheses about Koro being the cause of this SF.

However, even in people for whom the hypothesis, "The explanation of this SF is that I have Koro", did come to mind, this should not have resulted in adoption of the belief, "I am suffering from Koro, a dangerous condition that causes penile shrinkage". Such people will never have observed anyone whose penis has disappeared into his abdomen, let alone someone who has died as a result. These things must be observable if Koro is a genuine phenomenon; and their total absence provides two pieces of disconfirmatory evidence as far as belief in Koro is concerned. Which brings us to the second of our two questions.

4.2.1 Individual differences in susceptibility to Koro

The Koro delusion was fairly widely adopted in epidemics in four countries. Nevertheless, while many people adopted this delusional belief, many others in the same communities did not. In what ways do these two groups of people differ? Two possible second factors can be identified here.

Individuals' prior beliefs about Koro

A questionnaire survey of 214 victims of the 1984–1985 and 1987 *suo-yang* epidemics in Hainan Island and Leizhou Peninsula was carried out by Tseng et al. (1992). Responses to three questions that dealt specifically with beliefs about *suo-yang* were of particular interest:

> The *suo-yang* rumour [legend] exists in the community.
> *Suo-yang* is a dangerous [potentially fatal] condition needing help [emergency care].
> Ghosts [spirits] cause people to have *suo-yang* attacks.
> (Mo et al., 1995, p. 241, Table 17.1; also see Tseng et al., 1992, p. 119)

Responses indicated that *suo-yang* victims believed more strongly than control subjects in the *suo-yang* concept (and this was so even before their attack; see Tseng et al., 1992, p. 119). Tseng et al. (1992) concluded: "This data strongly supports the hypothesis that familiarity with *and belief in* the koro concept … is fundamental for a subject to become the victim of a koro attack" (p. 240, our emphasis).

Level of education

The survey by Mo et al. (1995) of 232 cases of *suo-yang* in Leizhou found that about two thirds of the cases had no more than elementary school education, with only one third proceeding to or beyond middle school (Mo et al., 1995, p. 236). The survey of 214 cases from Hainan Island and the Leizhou Peninsula (Tseng et al., 1992) found that male *suo-yang* victims had fewer years of formal education (7.6 years) than control subjects (11.8 years).

Sex education may be specifically important here. Cheng (1997) suggested that lack of proper sex knowledge was another individual risk factor that interacted with the Koro-superstitious environment. The majority of cases of *suo-yang* were unmarried male adolescents and, as Cheng explained:

> The tendency not to deal with sex issues in an open manner in traditional Chinese culture has left young people deprived of sex knowledge. … [Consequently,] they look for whatever information is available in the environment, and together with the lack of education, they become likely victims of incorrect sex information. (p. 66)

Level of education was also a significant factor in the Koro epidemics in the other three countries. A survey of 31 cases from the 1982 epidemic in Assam, India, found that 42% were illiterate and another 26% had had 5 or fewer years of education (Sachdev, 1985, p. 435, Table 1). In the case of Singapore, a survey of 227 male cases revealed that 58% of them had not received education beyond a primary level (Koro Study Team, 1969, p. 238 Table IV). In the case of Thailand, a survey of 350 cases found that 38% had had less than four years of education (Suwanlert & Coates, 1979, p. 65).

4.2.2 Sociocultural factors

Sociocultural factors are also likely to play a significant causal role in the adoption of the Koro hypothesis as a belief, in at least two ways.

Cultural beliefs
We have said that a surprising observation of penile shrinkage might bring to mind the Koro hypothesis, but only if the person had some background beliefs about Koro (Section 4.1.1). The hypothesis might occur to a man who knew about, but did not fully subscribe to, cultural beliefs about Koro—a man without a prior belief in the reality and dangerousness of Koro. Given that the Koro phenomenon itself has been familiar in Chinese and Indian cultures for millennia, any Chinese or Indian man's suspicion that he might be suffering from this condition will be compatible with, and hence reinforced by, his cultural milieu. Doxastic deference to culture would encourage such a man, after the Koro hypothesis has occurred to him, to adopt it as a belief—rather than evaluating the hypothesis and rejecting it.

Publicity in the media
Koro epidemics have received a great deal of coverage in the mass media—newspapers, radio, television—and, like deference to one's culture, deference to the media is a possible second factor in Koro. If the Koro hypothesis came to a man's mind, acceptance of the hypothesis as a belief would be encouraged by exposure to media reports that treated Koro as a genuine phenomenon. We discuss this further in Section 5.4 below.

5. How is the Koro delusion socially transmitted?

Koro is a socially-transmitted delusional belief but the two-factor account of Koro could be applied to a case that did not result from social transmission—a Case Zero. A man X with some background knowledge or beliefs about Koro might observe some minor penile shrinkage and the Koro delusional hypothesis might come to mind. The man X might adopt this hypothesis as a belief—rather than evaluating and rejecting the hypothesis—as a result of prior beliefs about the reality of Koro, or limited formal education, or both. No social transmission would be involved here. But of course the majority of cases of Koro *are* socially transmitted.

5.1 Social transmission and the two-factor account of Koro
Does the two-factor account of Koro shed any light on the way in which social transmission of the delusion works? Suppose that another man, Y, hears about Case Zero (X) and the Koro delusion is socially transmitted from X to Y. There are two questions here.

First, can hearing about a case of Koro contribute to the Koro delusional hypothesis coming to mind?[9] According to the two-factor account, three things are involved in the Koro hypothesis coming to man Y's mind. There is a surprising fact (SF) of penile shrinkage in Y; this SF is observed by Y; and Y's observation of the SF leads—by an associative process of hypothesis generation—to the Koro hypothesis coming to his mind as a possible explanation for the SF. There are at least two ways in which man Y's having recently heard about Case Zero might contribute to the Koro hypothesis occurring to him. Hearing about a case of Koro might have made Y more vigilant about penile shrinkage. Thus, having recently heard about Case Zero might raise the probability that, if penile shrinkage occurs in Y, it will be observed by Y. Hearing about a case of Koro might also strengthen associative connections and make the Koro hypothesis more salient. Thus, having recently heard about Case Zero might raise

[9] What we say here is intended to apply whether one hears about a case by word-of-mouth, or hears about it on the telephone or on the radio, or reads about it in a newspaper, or via television.

the probability that, if Y observes penile shrinkage in himself, the Koro hypothesis will occur to him.

Second, can hearing about a case of Koro contribute to the Koro delusional hypothesis being adopted as a belief, rather than being evaluated and rejected—that is, can it contribute to a failure of hypothesis evaluation? Hearing about a case of Koro can make one anxious and frightened; it can make one panic. These psychological consequences of hearing about a case will be somewhat contingent on what one already believes about Koro, one's education, one's suggestibility, and so on. We do not suggest that the psychological consequences of hearing about Koro could, by themselves, result in a failure of hypothesis evaluation. We do suggest, nevertheless, that man Y's having recently heard about Case Zero might raise the probability of a failure of hypothesis evaluation. Man Y's being anxious, frightened, and in a panic might make it less likely that he would undertake the cognitively demanding task of critical hypothesis evaluation.

The upshot is that a man's hearing about a case of Koro can influence both how the first factor works and how the second factor works in that man's own case.

5.2 Social transmission in a Koro epidemic

We have considered how the Koro delusion can be socially transmitted to one new case. This has been observed. For example, in Case E (see above, Section 2.2), a man heard about Koro in a phone call from his brother, who advised vigilance. Within twenty minutes, the man began to feel as if his penis was shrinking or retracting. This brought to mind the Koro hypothesis, which he accepted as true. He became anxious and frightened at the prospect of impending death if the shrinkage did not stop.

In a Koro epidemic, there is social transmission to many new cases, creating the potential for exponential growth. In the 1967 Singapore epidemic, just three days after the first dozen or so cases of Koro presented at the Emergency Department of the General Hospital, 97 cases presented on a single day. The Koro Study Team (1969) discussed this steep rise in the number of cases—and the equally steep fall following well publicised authoritative statements about the harmlessness of pork—on the model of infectious diseases. They suggested that the "abrupt and precipitous rise and fall [in Koro cases] indicated that "the spread of rumour [is] also in a geometric progression [like an infectious disease] but far more catching and quicker to take effect" (p. 239).

Commenting on the role of a beggar who brought the Koro epidemic to Haikang on the Leizhou Peninsula in 1985 (see above, Section 2.1), Cheng (1996) commented:

> It is most interesting that news of an epidemic in a neighboring island can trigger another wave of epidemic. Since rumor generates expectation which in turn influences behavior, it appears that any formulation of the epidemic spread of koro cannot ignore the role of *collective anticipation of threat*. (p. 69; emphasis added)

This collective anticipation of threat—people are anxious and frightened, there is an atmosphere of panic—is apparent in accounts of what happened in villages in Guangdong Province during the 1984/85 epidemic:

> Most of the victims described similar patterns of experience. They were already anxious when they heard the news of the spread of koro, and they could sense the atmosphere of panic that already existed in the community. (Tseng et al., 1988, p. 1540)
>
> When a subject claimed that he or she was suffering from a *suoyang* attack, family members, friends, neighbours, and others who happened to be in the surrounding area usually reacted in panic in the belief that the victim needed resuscitation right away. (Mo et al., 1995, p. 237)
>
> The victim believes in koro. Everyone around is frightened. … How the koro victim is identified and rescued appears to be a process involving the entire neighborhood. (Cheng, 1996, pp. 71–72)

In these conditions, "the slightest biological signs of shrinkage can trigger a panic attack. … [K]oro tends to occur when everyone around is nervous about it" (Cheng, 1997, p. 63).

5.3 Social transmission and Koro in children

The outbreak of Koro at the school in Fuhu village began with one boy in third grade and, two days later, the principal addressed all the students in the school courtyard. Li (2010) said: "It is obvious that the reaction of the school principal, as an authority figure, providing a warning message to the schoolchildren, provoked the endemic [*sic*] attack" (p. 104). There was an atmosphere of panic and the children were anxious and frightened. It is reasonable to suppose that the principal's address also resulted in hyper-vigilance about genital shrinkage and that these four features—panic, anxiety, fear, vigilance—played a role in the spread of Koro to 64 other boys.[10]

The Fuhu village outbreak illustrates an additional role for social transmission of information about Koro. People who do not themselves have any beliefs about Koro can learn about Koro from others to whom they disclose their observation of the surprising fact that their penis is shrinking. As Li (2010) pointed out:

> [I]t was not the children themselves, but mainly the adults, their parents or the schoolmaster, in this case, who interpreted and reacted to the occurrence in ways that indicated they believed that the children were suffering from suoyang, were in critical condition, and needed immediate care to save them from potential death. (p. 104)

This was also the case for the Singapore epidemic:

[10] A reviewer asked why, given that the cultural background beliefs about Koro are a stable feature of the community, there are sudden exponential increases in adoption of the Koro delusional belief. In the case of the outbreak of Koro at the Fuhu village school in May 2004, the answer seems clear. Against the stable background of "people's common knowledge of suoyang" (Li, 2010, p. 104), the unique outbreak was triggered by the principal's address warning the children to be cautious about Koro and to take emergency measures if they experienced symptoms.

> It is necessary however to take note of the 6 cases below the age of 5 who could not possibly be receptive to complex cultural ideas to an effective degree. The study showed in fact that in all these cases, the diagnosis was made by the anxious elder relatives—parents etc. Hence they were more victims of the projected fears of other people than true Koro cases. (Koro Study Team, 1969, p. 238)[11]

5.4 Social transmission and publicity in mass media

In Case F (see above, Section 2.2), a man watched a television report about Koro and then felt his penis shrinking or retracting into his abdomen. Mass media—newspapers, radio, television—provide opportunities for social transmission of the Koro delusion on a large scale. Information about Koro transmitted by mass media—like information transmitted in a face-to-face conversation or on the telephone—can contribute both to bringing the Koro hypothesis to mind and to failure to evaluate and reject the hypothesis.

All of the Koro epidemics in India were accompanied by intense and sensationalistic newspaper and television coverage. Many people in India are particularly sensitive to such coverage. We give an example illustrating such sensitivity (see Singhal et al., 1999). In the early hours of the morning of 21 September 1995 in New Delhi, people began to arrive at Hindu temples asking to be allowed to feed milk to statues of the Shiva family in the Hindu pantheon (including Shiva, his consort Parvati, their son Ganesha, and Shiva's bull Nandi), claiming that this milk would be drunk. The news that the gods were drinking milk in the temples spread rapidly via word of mouth and, especially, via the media. It made headlines on 21 September on All India Radio and the TV broadcaster Doordarshan, and also in almost all the major Indian newspapers on 22 and 23 September, which featured such headlines as:

> A Day of Devotional Frenzy;
> Deities 'Drink' Milk in Tonnes;
> Divine Miracle Stuns the World;
> Idols of Shiva Family Accept Milk Offerings; and
> Miracles Claimed in Temples Abroad.

The major temples in every large city in India were soon swarming with crowds so large and unmanageable that police were needed to control them; and milk supplies were rapidly exhausted all across India. Just such powerful and rapid word-of-mouth and mass media coverage was seen for all of the Indian epidemics of Koro (see e.g., Ghosh et al., 2013, p. 9; Kumar et al., 2014, p. 114; Debbarma et al., 2016, p. 5637) and must have contributed to many members of the Indian population having the Koro delusional hypothesis come to mind and to their adoption of this hypothesis as a belief.

The media were also influential in Singapore. Early in 1967, pigs had been vaccinated in a mass campaign to combat swine fever. Rumours subsequently spread that *suo-yang* would result from eating the flesh of vaccinated pigs. These rumours were fuelled by a newspaper report on 29 October 1967 that some people had contracted Koro by eating the flesh of vaccinated pigs, and a subsequent newspaper report that a pig had died of penile retraction

[11] When young children are involved in a Koro epidemic, there may be an element of *folie à deux* or *folie imposée* (see Langdon, 2013, for application of the two-factor theory of delusion to *folie à deux*).

after vaccination. These reports were so widely accepted that there was a virtual standstill in the sale of pork in markets, eating stalls, and restaurants throughout Singapore.

In Thailand, similarly, rumours of poisoning by Vietnamese immigrants "were fanned by sensational media reports" (Mattelaer & Jilek, 2007, p. 1510) and 94% of Koro cases "were convinced that they had been poisoned" (Suwanlert & Coates, 1979, p. 65).

6. Conclusion

We have applied the two-factor theory of delusion to epidemic Koro (*suo-yang*). We propose that the Koro delusional hypothesis, "I am suffering from Koro, a dangerous condition that causes penile shrinkage", is brought to mind by the combination of two elements: observation of the Surprising Fact that one's penis is shorter than expected (the first factor—which has many natural causes), plus pre-existing background beliefs about the Koro phenomenon, beliefs which are associatively activated by this SF (or else contributed by others). We further propose that the adoption of the Koro delusional hypothesis as a new belief (rather than evaluation and rejection of the hypothesis) is stimulated—made more likely—by a number of possible second factors. These include individual factors such as strong prior belief in the Koro concept or limited formal education and sociocultural factors such as doxastic deference to culture, to mass media, or to rumours spread by word of mouth.

The two-factor account of Koro could be applied to a case of Koro that did not result from social transmission; that is, the account does not make social transmission essential to Koro. When—as in most cases of Koro—social transmission is involved, it can contribute both to the Koro hypothesis being brought to mind and to the hypothesis being adopted as a belief. There can be social transmission to a single case but, in epidemic Koro, collective anticipation of threat results in social transmission to many new cases. There is an atmosphere of panic; people are anxious, frightened, and hyper-vigilant about penile shrinkage, and this may lead to exponential growth in the number of cases. In sum, we have, for the first time, applied the two-factor theory of delusion to a socially-transmitted delusion that occurs in epidemic form.

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