



Do cultural factors affect causal beliefs? Rational and magical thinking in Britain and Mexico

Eugene Subbotsky^{1*} and Graciela Quinteros²

¹Lancaster University, UK

²Universidad Autónoma Metropolitana, Xochimilco, Mexico

In two experiments, unusual phenomena (spontaneous destruction of objects in an empty wooden box) were demonstrated to adult participants living in rural communities in Mexico. These were accompanied by actions which had no physical link to the destroyed object but could suggest either scientifically based (the effect of an unknown physical device) or non-scientifically based (the effect of a 'magic spell') causal explanations of the event. The results were compared to the results of the matching two experiments from the earlier study made in Britain. The expectation that scientifically based explanations would prevail in British participants' judgments and behaviours, whereas Mexican participants would be more tolerant toward magical explanations, received only partial support. The prevalence of scientific explanations over magical explanations was evident in British participants' verbal judgments but not in Mexican participants' judgments. In their behavioural responses under the low-risk condition, British participants rejected magical explanations more frequently than did Mexican participants. However, when the risk of disregarding the possible causal effect of magic was increased, participants in both samples showed an equal degree of credulity in the possible effect of magic. The data are interpreted in terms of the relationships between scientific and 'folk' representations of causality and object permanence.

During recent decades, interest in the role that cultural factors play in determining the style of an individual's thinking has increased within cultural psychology and anthropology. One of the pioneering studies of the role of culture in the development of cognitive processes was conducted by Alexander Luria (Luria, 1931, 1971, 1976). In this study, cognitive processes of individuals living traditional ways of life in villages of Soviet Central Asia were examined and compared to similar cognitive processes in individuals incorporated in a more Western style of life and education, but living in the same cultural areas. These findings showed that the type of logical reasoning of the traditional

*Requests for reprints should be addressed to Eugene Subbotsky, Psychology Department, Lancaster University, Lancaster LA1 4YF, UK (e-mail: E.Subbotsky@Lancaster.ac.uk).

people differed substantially from that of the individuals involved in the Western type of life. One specific feature that distinguished the 'traditional' type of thinking was that it was short on abstract reasoning and formal categorization. Instead, the traditional thinking was strongly embedded in concrete situations and realities of everyday life. In his explanation of these results, Luria attributed the emergence of formal logical type of thinking primarily to school education.

Luria's results have been replicated in further studies (Cole, Gay, Glick, & Sharp, 1971; Das & Dash, 1990; Scribner, 1977; Tulviste, 1991). One major amendment to Luria's explanation of his results was that the 'traditional' style of thinking is not fundamentally different from the 'Western' style in terms of the cognitive structures involved. Rather, traditional thinkers tend to apply these cognitive structures to different realities and in different contexts than people in Western societies (Cole, 1996; Cole *et al.*, 1971). Recent developmental studies have also shown that the analytic orientation in logical reasoning is not a specific product of school education. Under certain conditions, this orientation can be found even in young children, to whom it comes quite easily and naturally (Harris, 2000). Viewed from a general perspective, these amendments implied that, despite fundamental differences between the roles that scientific and logical reasoning play in 'traditional' and Western cultures, the mental processes of individuals living in these cultures are not fundamentally different.

The studies described highlighted important aspects of cultural factors in cognitive development, yet they were limited in two respects. First, these studies primarily targeted the individuals' verbal reasoning, without contrasting verbal judgments and the individuals' behavioural responses. Clearly, there can be a substantial difference between what people say in a laboratory setting and what they really do in their daily life. As was shown in many studies, behavioural responses in conditions which may involve 'high cost' (i.e. have consequences that are important for the participant's primary needs) reflect more accurately the participants' 'real beliefs' than do the participants' verbal responses, which are sensitive to such factors as social expectations, memory failures, and limited knowledge of one's own needs and beliefs (Thomas, 1971; Wilson & Nisbett, 1978). These studies, with rare exceptions (see Mead, 1932), did not target beliefs in object permanence and physical causality.

Indeed, a major concern in studying the human mind is to establish the extent to which changes in the individual's culture and educational background affect fundamental beliefs about nature.¹ One of these fundamental changes of beliefs occurred in Renaissance Europe when the cultural orientation toward magical and mythical ideology was gradually replaced by the belief in a rational and scientific structure of the world (Losev, 1978). In contrast to traditional archaic societies (and ancient European societies) in which natural objects and elements were endorsed with spiritual powers, modern Western cultures are based on a strong belief in scientific rationality. According to this belief, all natural events are universally based on physical laws and governed by physical causality (see Frazer, 1922; Tambiah, 1990). It is possible to argue, for instance, that the modern beliefs and practices adopted by a culture at the 'above-ground' level (i.e. the belief that everything which occurs in the natural world is based on physical causes and that magic does not exist) completely permeated the mind of an average individual, who therefore becomes a 'miniature reflection' of his or her 'official culture'.

¹ Although in many respects culture and education are different concepts, it is through scientific school education that modern ideas of rationality and physical causal thinking are being most effectively passed to the younger generations, both in Britain and Mexico. That is why, in the context of this paper, education is viewed as an important aspect of culture.

Yet, despite fundamental changes in cultural beliefs about the structure of the world, it can be the case that an average Western individual, at a certain level, remains relatively unaffected by these changes. For instance, the official culture and education can become increasingly dominated by beliefs in the overwhelming power of science and technology, yet many individuals in this culture can still entertain causal beliefs that are incompatible with scientific views. In this case, the individual can only be superficially affected by the changes in culture. On the level of some intuitive beliefs, however, many contemporary Western individuals may not be crucially different from individuals of the earlier historic epochs in their tendency to accept beliefs in magic and the supernatural. This assumption can be given some credit on the basis that the difference between scientific theories and intuitive (or 'folk') theories has been shown to exist in many areas—physics, philosophy, biology and psychology (Boyer, 1994; Carey, 1999; Christensen & Turner, 1993; Keil, 1989; Sperber, 1997). Another way to account for the distinction between the 'official' and the 'underground' representations of the world is to present it as a difference between expert and novice views (Larkin, 1983). It has been argued, for instance, that until the middle of the 18th century, even scientists were unable to distinguish between concepts of heat and temperature (Wiser & Carey, 1983), and the confusion between physical properties of objects and their perceptual qualities is overwhelming among contemporary children and adults (Subbotsky, 1997b). This shows that, in some important respects, contemporary school education fails to create a scientific vision of the world in the students' mind. The question arises of whether this failure also extends from the beliefs about the nature of perceptual qualities to the beliefs about the universal power of physical causality. It is this question that this study aims to examine.

The question concerning the extent to which Western educated individuals can still possess magical causal beliefs is far from being purely academic. In particular, if the growing rationality of Western cultures is accompanied by the growing rationality of the individual's causal beliefs, then the educational system at all levels, as well as more general practices of social and political management, media structures and other social institutions should be increasingly based on rational and scientific foundations. If, however, the development of the individual mind is more complex, with different levels of the mind (i.e. the level of verbal reasoning as contrasted with the level of behavioural responses) being affected by scientific rationality to a different extent, then the mind of a modern individual should be viewed as a pluralistic unity which contains different, even alternative, causal beliefs. The practical implications of this view could be quite substantial. If this view of the mind is correct, then educational and social practices should become more eclectic, taking into account the irrational, as well as the rational, areas of the mind. This would imply, for instance, a greater significance of imaginative pretend play in child development and education, recreation activities based on fantasy (cinemas, art galleries, science fiction, etc.), and social and cultural myths (created by media and lobbies for industrial and political purposes) for the practice of social and political management in contemporary Western societies. This would also explain why beliefs in extraordinary and paranormal phenomena, practices of magic and astrology, and other activities incompatible with scientific views are yet so widely spread among individuals living in the most advanced industrial cultures. Another important implication of this would be in making realistic prognoses of cultural and ethnic conflicts (including international terrorism) that often arise as a result of the under-evaluation of the role that mythical, magical and other modes of irrational thinking play in the mind of modern individuals.

In her fascinating account of witchcraft and magical practices in present-day England, Luhrman (1989) estimates the number of people who practice magic in England at several thousand. These people are usually well-educated middle-class individuals. Among the working class in England, superstitions and magical beliefs are also widespread. According to Gorer (1955), 23% of people with low income believe in ghosts, 53% have visited a fortune-teller, and 51% read horoscopes regularly. A systematic survey conducted in England showed that one person in six believes in ghosts, one in three has been to a fortune teller at least once, one in ten feels that they have lucky days or numbers, or possess lucky mascots, and one in five believes seriously in the influence of the stars (Jahoda, 1969). Naturalistic observations reported by Jahoda (1969) showed that, out of 51 pedestrians passing a ladder positioned over a pavement within a 15-minute period, 14 people walked under the ladder and the rest stepped into the road in order to avoid it. A survey of a representative sample of US counties estimated the number of practising witches to be about 25 000 (Hyman & Vogt, 1967). An estimation of magic believers in the USA gives a number of 80 000 (Adler, 1986). A survey of magical beliefs indicated that the endorsement of at least some magical beliefs among US college students is 64.1%—a finding that undermines the assumption that paranormal beliefs are associated with poor science education (Zusne & Jones, 1989). In experimental psychology, evidence has been presented which shows that even educated adults can follow the laws of magical thinking in their fears and emotional preferences (Rozin, Markwith, & Nemeroff, 1992; Rozin, Markwith, & Ross, 1990; Rozin, Millman, & Nemeroff, 1986). All these data suggest that an individual has a substantial degree of autonomy from the dominant cultural tenets, at least as far as the individual's causal beliefs are concerned.

In the psychological literature, arguments in favour of both 'full penetration' and the 'superficial penetration' scenarios can be found. Thus, in developmental psychology, the mind of a child has been increasingly described as a mind of a 'little scientist'. It has been argued, for instance, that young infants, and even newborns, can 'understand' certain laws that are fundamental for contemporary science and rationality, such as object permanence and physical causality (Bower, 1974, 1989; Gelman & Baillargeon, 1983). In the area of perception, the work of the human perceptual system has been presented as governed by rational laws (Gregory, 1980). In cognitive psychology, the 'computer metaphor' was applied to the individual mind, which presented the mind as a rationally constructed 'virtual machine' (Dennett, 1991; Dowling, 1998; Frawley, 1997; Jackendoff, 1987). Viewed in this way, the mind of an average Western individual is progressively approaching the image of a rationally working device, with any irrationality being viewed as 'remnants of the past'.

As an alternative to this view, an argument has been made that an average Western individual is only superficially affected by the beliefs which are dominant in Western cultures of today. The fact that contemporary educated adults can entertain beliefs similar to those of people living in 'traditional' societies (such as beliefs in magic or 'participation') has been shown in classical works on cultural anthropology (Frazer, 1922; Levy-Bruhl, 1923). The idea of the pluralistic structure of the individual's belief system has been worked out in contemporary writings on cultural psychology (Tulviste, 1991; Wertsch, 1991) and anthropology (Boyer, 1994; Tambiah, 1990). Thus, according to Tambiah (1990), scientific (rational) thinking has its necessary complement in the belief in participation (the belief that individuals or societies are magically 'linked' to certain objects or animals), which is crucial for religious and communicative practices. Multiple studies have shown that beliefs in magic, witchcraft, astrology, palm reading,

and all sorts of 'paranormal phenomena' are still widespread among people living in cultural environments packed with computers and advanced technologies (Bem & Honorton, 1994; Lehman & Mayers, 1985; Zusne, 1985; Zusne & Jones, 1982). The fact that superstition is a part of the ordinary life of the Western individual has become a subject for sociological and psychological analysis (Boyer, 1994; Jahoda, 1969; Vyse, 1997). As an implication of this, it can be assumed that, at some level, Western and non-Western participants cannot be fundamentally different from each other in the extent to which they believe in magical causality.

In order to examine this assumption, in this study participants from Western and non-Western cultures were asked to tackle unusual events which violated the fundamental law of object permanence (a physical object changed without an obvious reason in an apparently empty box). The unusual events were incorporated either in scientific or in magical contexts, and the 'traditional' participants' tendency to handle the events in terms of magic or science was examined and compared with that of Western educated individuals. It was assumed that members of a non-Western community (rural inhabitants of central Mexico) would endorse magical explanations of the phenomenon significantly more frequently than would members of a Western community (university undergraduates in the UK). The assumption was based on the fact that in a Western culture an individual is encouraged (by school education, media, art, interpersonal communication and other cultural impacts) to believe that science is the only way to account for natural events, whereas in a non-Western society the 'pressure' of scientific rationality on an individual is substantially less evident — due to the lack of formal scientific education and the abundance of pre-Christian magical beliefs and superstitions.

In anthropological studies (Boyer, 1994; Frazer, 1922; Jahoda, 1969; Seligman, 1948; Tambiah, 1990), several types of events are usually classified as magical. It is not our intention here to give an exhaustive list of such events, but mentioning some of them seems appropriate. The event is qualified as magical if it involves a direct effect of 'consciousness over matter', like moving or creating physical objects by the sheer effort of will or thought ('thought over matter magic'). Another type of magical events involves a sudden acquisition of feelings or independent movements by a non-animate physical object ('coming to life magic'). A further class of magical events involves violation of object permanence, when a physical object instantly alters its shape, appears 'out of thin air' and disappears without a clear physical mechanism being a reason for this ('non-permanence magic').² Lastly, the widely held belief about certain objects (stones, skulls, mascots) and actions (crossing fingers, tapping on wood) as bringing luck or affecting the flow of natural events can also be considered as magical ('participation or sympathetic magic'). Despite differences between these types of events, they share one common feature: all of them are incompatible with the concept of physical causality. In this study, only the belief in 'thought over matter' will be examined.

It is important not to confuse magical beliefs with the beliefs in the 'almighty power of science', which sometimes appear similar to magical beliefs. Indeed, due to the astonishing achievements of science in the contemporary world, there is the view that

² Permanence of physical objects is not the same as their indestructibility. A physical object (i.e. a glass) can be destroyed by external force (a blow) or by natural wearing with time, or disappear from view in a conventional way, and this would not violate the law of object permanence. If, however, the glass instantly vanishes in full view of an observer, without leaving any traces of parts, and without the possibility of explaining the disappearance in a normal way (including a trick), then the observer becomes a witness of the violation of object permanence.

science can explain virtually everything, if not today, then in the future. This idea is grounded in the fact that many of the achievements of contemporary science (the remote transmission of visual and auditory signals, flying in air and space, etc.), in previous centuries would indeed be viewed as magical (see Nemeroff & Rozin, 2000; Tambiah, 1990). The belief in the potential omnipotence of science has resulted, for instance, in interpreting parapsychological phenomena as physical phenomena whose mechanisms have not yet been discovered by science (Bem & Honorton, 1994). Yet, there is a crucial difference between explanations in terms of 'physical yet unknown' forces and in terms of 'magical forces'.

Although most contemporary magicians believe in parapsychological effects — communicating without speech or sight, moving objects without touch (Luhrman, 1989) — the concept of magical forces cannot be reduced to the natural powers. Magical forces are viewed as a kind of 'spiritual currents', that differ from familiar forces such as gravity or electromagnetic fields. In contrast to natural forces, which operate in a predictable way and devoid of any 'spirituality', magical forces involve some hidden subconscious communication between a person and the world, they are "both part of us, yet universal, and thus link us in a telepathic way to equivalent levels of other peoples' sub-conscious" (Luhrman, 1989, p. 119). Gravity attracts physical objects in a universal mechanical way, while a magic spell implies that a meaningful 'message' is sent to the targeted object or event, with the assumption that there is a hidden capacity in these objects and processes to 'receive' and 'understand' this message in the same way that we can understand language.

The aim of this study was, therefore, to examine the extent to which participants from Western and non-Western communities show their verbal credulity (or scepticism) toward scientific or non-scientific (magical) causal explanations of an unusual phenomenon. One more aim was to find out whether the participants' verbal credulity (or lack of it) was also accompanied by the appropriate actions if some decisions important to the participants had to be made.

The first part of this study was conducted in England with children and educated adult participants (Subbotsky, 2001). In this study, university graduates and 6- and 9-year-old children were shown an unusual phenomenon (an unexpected destruction of an object in an apparently empty box) which was framed either in a scientific (an unknown physical device was switched on and off again) or a magical (the experimenter pronounced a magic spell) causal context. The study indicated that in their verbal judgments, adults (but not children) showed a higher degree of credulity toward scientific explanations than toward magical explanations. However, in their actions, both children and adults showed an equal degree of credulity toward scientific and non-scientific (magical) explanations. This would suggest that scientific education eliminates non-scientific beliefs (like beliefs in magic) from an individual's verbal thinking. Yet, in their behavioural responses, British participants did not show any preference of scientific explanations over non-scientific ones.

Another result of this study was that, in their actions, adult participants showed a very low degree of credulity toward magical explanations of unusual phenomena when the cost of disregarding such explanations was low (possible damage to the participant's driving licence that could result from the experimenter's magic spell). When the cost was high (possible damage to the participant's hands), a significantly larger number of adults behaved in a way that suggested they believed in magical causality.

The point of the current study was to reproduce the experiment conducted earlier in England with participants living in a traditional rural community in Mexico — a cultural

setting that is more tolerant toward magical beliefs than a Western urban cultural setting. Although we are unaware of statistical surveys on magical beliefs and superstitions in Mexico, anthropological and ethnographic studies of Mexican culture and religion do suggest that it has strong adherence to magical beliefs. The widely held belief in *Nahual* (a person who can occasionally turn into an animal) is one of the typical manifestations of truly magical thinking. Unlike religious thinking, magical thinking lacks the idea that a human person is superior to natural things and subordinate only to gods. In the traditional practices of Ancient Mexico, every natural object or event was believed to have an individual will of its own, with which a human person with special powers (a sorcerer) could identify him- or herself. Importantly, it is not that a sorcerer, while imitating rain, is involved in some kind of symbolic activity of ‘pretending to be rain’ (a typical modern rationalistic misinterpretation of magic)—the sorcerer really becomes rain (Sejourne, 1976). The essence of magical thinking is, therefore, the idea that a real metamorphosis of a person into a natural thing (i.e. an animal) can be achieved. This magical way of thinking is still widely spread in contemporary Mexican rural communities, and it coexists with the official Christian religious ideology. Thus, according to Selby (1974), in modern Zapotec communities people believe that they have two souls: the Christian soul and ‘*tono*’—the sole of an animal (a wolf, a snake, etc.). When a person’s death is untimely, it is invariably explained by an accident that happened to the person’s ‘*tono*’. The belief in witchcraft was found to be universal, even among locals who were progressive Protestants, had some education and experience of living in large Mexican cities and in the USA. One of the elements of traditional Mexican magical beliefs is that “certain persons can turn themselves into animals and in this form go about at night doing evil and indecent acts” (Redfield, 1968, pp. 307–308).

If the hypothesis of the ‘deep effect’ of scientific rationality on an individual is true, then the degree of British participants’ credulity toward magical explanations should be significantly lower than that of Mexican participants. If, however, under the same conditions British and Mexican participants showed credulity toward magic to an equal extent, this would mean that, on a certain fundamental level, the mind of a Western individual remains relatively unaffected by scientific rationality.³

EXPERIMENT I (LOW RISK)

Method

Participants and experimenters

Twenty-eight adult participants took part in this experiment, 14 participants in each of two conditions. The samples were of mixed sexes and drawn from small rural communities located in the Morelos district in Mexico, near the city of Cuernavaca. Participants’ mean ages and age ranges for Conditions 1 and 2 were as follows: $M = 41.5$, range 20–72 years; $M = 37$, range 21–56 years. Participants in the British study were students of Lancaster University, in the north-west of England. Their mean ages and age ranges for Conditions 1 and 2 were as follows: $M = 24$, range 18–35 years, and $M = 22.9$, range 18–31 years.

In both British and Mexican studies, the experimenter was an outsider who was well

³ As long as this study targeted only participants from two distinctive communities in Britain and Mexico, the extrapolation of these results over Western and non-Western cultures can only be made with caution.

established in the culture where the experiment was conducted. In Britain, the experimenter was a Russian academic employed by a British university for about 10 years, and in Mexico the experimenter was an Argentinean social worker who had been living in Mexico for more than 10 years.

Materials

A wooden box (15 × 11 × 11 cm) was used for the demonstration of an unusual phenomenon. The box's construction allowed the experimenter to demonstrate a sequence of events that looked like an inexplicable change in a physical object which had been placed inside the box (i.e. a new plastic card placed in the box became cut in three places or badly scratched as if by a sharp nail). A specially constructed lid and a system of magnets hidden in the walls of the box allowed the box to be manipulated (i.e. turned upside down or shaken) without revealing the secret of the trick (the double bottom). A physical device that produced light and sound effects when switched on was also available. The device could be connected or disconnected from the wooden box via a wire. In addition, there were two identical plastic rectangles available. One of them was new and intact, and the other was damaged (cut in three places as if by scissors). Participants were also required to have their valuable documents (voting certificates) available for the experiment.

Procedure

During the recruitment procedure, participants were told that their participation was their free choice and that they could withdraw from the experiment at any time. Each of the participants was tested individually, most of them in their own homes. The instructions were translated, as precisely as possible, from English into Spanish by one of the experimenters, who was a native Spanish speaker and also fluent in English. The instructions were then memorized by the experimenter and presented to a participant in the form of an oral conversation. During the experiment, the experimenter did not take notes; instead, the whole procedure was tape-recorded.

Before the experiment, a participant was given the following introduction:

I am a psychologist, I am studying what people think about why some objects exist and other objects do not exist, OK?

Have you ever heard about Nahual (a folk mythological creature in traditional Mexican culture that can take both human and non human animal shape)? Do you think this creature exists? Why do you think so? And a table — does it exist? Why do you think so?

The reason why the question about the existence of Nahual was asked was dictated by the fact that in the British study the procedure started by asking participants the question about a Centaur — a character embedded in the religion of Ancient Greece and Rome. The Centaur was chosen because (1) it was an example of a mythical creature — half animal and half human — that is a clear product of magical thinking, (2) it was known to the participants (British culture had strong Roman influence), and (3) it was not a part of the official religious ideology.⁴ Like the Centaur in British culture, in

⁴ Indeed, asking participants about the existence of characters that are related to Christian mythology (like angels or ghosts) could interfere with participants' religious persuasions and contaminate the results of the study.

Mexican culture Nahual is a residue of ancient magical beliefs and is a person who can transform himself or herself into an animal (see Introduction).

The experimenter then proceeded with the following questions:

And what is this (a rectangular plastic card was pointed at)? Is this a plastic card? Do you think this plastic card really exists, or does it exist only in your imagination but in reality you don't have anything in your hands? Why do you think that it exists?

How do you assess its condition: is it damaged, broken or in good condition?

Our aim of this introduction was to give the participant a plausible motivation for conducting this experiment, without revealing its real aim but without deceiving the participant. This was dictated by the necessity not to alert the participant that it was his or her beliefs in magic that were under examination, in order to avoid the possibility of participants conforming to the experimenter's expectations. Another aim was to find out the extent to which participants believed in the real existence of a magical creature and in the permanence of real physical objects that were available in their perceptual field.

The introduction was followed by Condition 1 (scientific context) or Condition 2 (magical context). Both conditions consisted of the verbal trial and the action trial.

In the verbal trial of Condition 1, the participant was shown a wooden box with an unknown physical device that could produce sound and light effects. The device was attached to the box via a wire. One of the two plastic cards (the new one) was also available on the table. Another plastic card (the damaged one) was hidden in the box between one of its walls and the flap plate. The participant was asked to make sure that the box was empty, and then place the plastic card inside the box and close the lid.

The experimenter then said: "Look, now I am going to switch this physical device on for some time, OK?"

After this, the experimenter activated the device for a few seconds, switched it off and asked the participant if he or she thought that the card in the box remained the same or had changed. The participant was then asked to open the box and remove the card. On opening the box, the participant found that the plastic card was now damaged (cut in three places). The participant was then asked the following questions: "What is this? Is this the same plastic card that you earlier placed in the box which has become damaged, or is it a different plastic card?" If the participant insisted that it was a different plastic card, he or she was encouraged to search for the original card in the box, and then asked the same questions again.

The rationale for asking these questions was to create the impression in the participant that something unusual had happened: a new plastic card had become slashed inside the box, without being directly affected by other physical objects.

Next, the participant was asked to explain why the effect had happened, and then asked the key question: "And if I told you that this card was damaged by the work of this device when I switched it on, would you believe me or not? Why?" The purpose of this question was to find out whether the participant would be prepared to accept an explanation which was scientifically plausible, albeit not totally clear. Indeed, the device did not have any obvious physical contact with the object inside the box; still, it could be assumed that, in some hidden way (i.e. through some invisible physical fields), the device had affected the card and damaged it.

In the action trial, which followed the verbal trial, the participant was asked to place his or her voting certificate inside the box. This was done because for the participants

their voting certificates were the only official documents they had. They were therefore very valuable, and the loss or damage of these documents would be considered highly undesirable by the participants. The request then followed: "Please open the box and check that your certificate is safe, then close the lid again". The purpose of this manipulation was to rule out the possibility that the box could damage the objects on its own, without the 'aid' of the physical device.

Next, the experimenter said:

Now, I must tell you something. I assure you that if I did not switch this device on now, nothing would happen to your voting certificate. However, if I switch the device on, I cannot give you any guarantee that you are going to get your certificate back in the same condition that you put it in.

So, it is entirely your responsibility to allow me to switch the device on, or to ask me not to do so, OK?

Now, would you allow me to switch this device on, or would you prefer me not to do so?

The purpose of these questions was to find out whether the participant really believed that the accompanying action had affected the object in the box. The positive motivation for allowing the experimenter to reproduce her action was to comply with the experimenter's implicit request to do so ("would you allow me . . .") and a negative motivation was the concern that the reproduction of the accompanying action by the experimenter may destroy the participant's valuable object.

It was assumed that if participants indeed thought that the device might work, then they would ask the experimenter not to activate the device again. The rationale for assuming this was that the cost of losing a valuable document for a participant was much higher than the cost of not complying with the experimenter's implicit request in the condition when the possibility of not complying was open to the participant and embedded in the experimental procedure. If, however, the participant thought that the device had nothing to do with the phenomenon of the plastic card destruction, then he or she would have no reason for not allowing the experimenter to reproduce her manipulation with the device.

After the participant had made his or her decision, the experimenter switched the device on (if she was allowed to do so) for a few seconds, then switched it off and asked the participant the following question: "Do you think that your document is now the same, or has it changed?"

The participant was then asked to open the box and remove the certificate. If the experimenter was allowed to initiate the device, the final follow-up question was as follows: "Were you worried about the possibility of your certificate being damaged? Why were you (not) worried about this?"

If the experimenter was asked not to reproduce the accompanying action, the same follow-up question was slightly modified: "You asked me not to switch the device on because you were worried about the safety of your certificate, or for some other reason?"

The rationale for asking the follow-up question was to find out how the participant would explain his or her decision to allow (or not to allow) the experimenter to activate the device in the condition when the safety of the participant's valuable document was at stake.

In Condition 2 (magical context), the procedure was the same as in Condition 1, except for two differences. First, there was no device available on the table. Second, instead of using the device, the experimenter said: "Now I am going to put a magic spell

on this box". Next, the experimenter closed her eyes and, with the expression of concentration on her face, loudly pronounced the words that sounded like a magic spell: "Ad hashar nor hashylym, ud hashar nar uzdalyk".

The explanation that the experimenter suggested to the participant in the verbal trial of this condition, was as follows: "And if I told you that I can do magic with objects, not just tricks but real magic, and I have just damaged this plastic card by casting my magic spell on the box, would you believe me or not? Why?" The participants' nonverbal credulity toward the effect of the magic spell was tested as in Condition 1, by asking the participants whether they would allow or not allow the experimenter to reproduce her magic spell with the participant's documents in the box.

Scoring and classification criteria

To allow comparison of the results obtained here with those obtained from the British sample, the same scoring and classification criteria were applied.

First, the total numbers of participants who acknowledged the causal effect of the accompanying manipulation in the verbal trial (verbal credulity) and asked the experimenter not to reproduce the manipulation in the action trial (behavioural credulity) were compared with the matching numbers of British participants.

Second, credulity scores were calculated for each participant on the basis of verbal and action trials taken together. A credulity score of 1 was assigned to a participant for any of the following types of behaviour: if he or she (a) acknowledged in the verbal trial that the effect was caused by the accompanying manipulation, (b) gave permission to reproduce the accompanying action in the action trial reluctantly, and (c) acknowledged in the follow-up interview that he or she had some anxiety when giving or not giving the experimenter the permission to reproduce the accompanying action. If the participant asked the experimenter not to reproduce the accompanying action (type d), he or she was assigned a score of 2; the rationale for this was that forbidding the reproduction of the accompanying manipulation was the most important indicator that the participant took seriously the possibility that the manipulation could affect his or her valuable object. As a result, participants' responses were scored on a scale varying from 0 (least credulous participants) to 4 (most credulous participants) (for a summary of scoring patterns see Appendix A).

Third, participants were also classified as believers or non-believers, on the basis of general patterns of their judgments, behaviours and justifications. This was done in order to account for the possible errors in conclusions made on the basis of the two previous methods of assessment. Indeed, a participant may allow the experimenter to proceed with the reproduction of her accompanying action (i.e. the magic spell) not because he or she is sceptical toward magic, but because the participant is credulous and wants to see how the magic spell would work. In this case, the participant may be scored low on the 'scale of credulity', and yet be a believer in magic.

To eliminate the possibility of this kind of error, general patterns of the participants' judgments (verbal trial), behaviours (action trial) and justifications (answers to the follow-up questions) were analysed. The participants who were qualified as credulous toward the effect of the accompanying manipulation came from the following subgroups: consistent believers, curious believers, and inconsistent believers. Consistent believers were those who acknowledged that the accompanying manipulation was the cause of the phenomenon in the verbal trial, and asked the experimenter not to reproduce the manipulation in the action trial. In their answers to the follow-up

questions they did not deny that the effect had been caused by the accompanying manipulation. Curious believers were the participants who acknowledged the effect of the accompanying manipulation in the verbal trial, but allowed the experimenter to reproduce the manipulation in the action trial, justifying this by their curiosity to see how the manipulation would work. In these participants, the motive of curiosity took over the alternative motive — the fear of their valuable object being damaged. Lastly, participants who were sceptical toward the effect of the accompanying manipulation in the verbal trial, yet asked the experimenter not to reproduce the manipulation in the action trial and justified this by their fear of having their valuable object destroyed, were classified as inconsistent believers. In identifying this group of participants, care was taken to ensure that the participants feared the accompanying manipulation *per se*, and had not viewed the manipulation as an irrelevant action used by the experimenter to distract their attention while she initiated some hidden mechanism in the box. Although in their verbal judgments these participants denied that the accompanying manipulation had caused the phenomenon, their behaviours and justification showed that, in fact, they believed in the causal effect of the manipulation.

All other participants were qualified as non-believers (see Appendix B).

Results

Whereas none of the British participants acknowledged that a mythical creature (Centaur) really existed, 13 out of 28 Mexican participants (46%) said that they believed in the existence of Nahual, and two of them claimed they had actually seen the creature.⁵ Even when compared with an average figure for believers in ghosts in England (15% of the population; Jahoda, 1969), the proportion of Mexican believers in the reality of a supernatural character is substantially larger than in England. Yet, as in the British sample, none of Mexican participants doubted the reality of physical objects that were available in their perceptual field (a table and a plastic card); they justified the existence of these objects by referring to their perceptual experience ('I can see it', 'I can touch it', 'I am using it now'), just as the British participants did.

Answering the question about whether the plastic card was still in the box after the box was closed, all but one participant in both conditions said that it was still there. Their justifications showed that the participants were aware of the physical object's permanence ('nothing could happen to it', 'nobody touched the box, so it should still be there', 'it cannot go out of the box by itself', etc.).

However, after the accompanying manipulations were performed, a significantly larger number of Mexican participants said that the object in the box could have changed in the 'device' condition (10 out of 14) than in the 'magic' condition (3 out of 14), $\chi^2(1) = 6.4, p < .01$. This differed from the results of the British study, in which participants did not show any preference in naming the device or the magic spell as a possible cause of the object's change in the box (only 1 participant out of 16 assumed that the object may have changed in the 'device condition', and none out of 16 made this assumption in the 'magic condition').

⁵ The participants' magical beliefs can also be evident from the following episode. One day, after the experimenter had tested a few female participants, a group of men gathered around her, accusing her of the intention to bewitch their children and threatening to punish her for this. At that moment, the community leader arrived and explained to the group that the experimenter was a teacher from the city who was conducting the study that had been agreed with him. After this, the men apologized and even offered the experimenter some small gifts; however, for a moment the experimenter did feel a serious concern about her safety.

Table 1. Numbers (percentages) of participants who acknowledged that the phenomenon had been caused by the experimenter's manipulation (verbal) and asked the experimenter not to reproduce the manipulation (actual) in Experiment 1 of this study (Mexican, total number of participants per condition—14) and in the matching experiment in Britain (British, total number of participants per condition—16)

I (device)		Condition					
		Verbal		Actual		2 (magic)	
Mex.	Brit.	Mex.	Brit.	Mex.	Brit.	Mex.	Brit.
14 (100)	9 (56)	12 (85)	3 (19)	12 (85)	3 (19)	10 (71)	2 (12)

After seeing that the object in the box had actually changed, all Mexican participants showed some surprise in both conditions. Numbers of Mexican and British participants in the verbal trial who acknowledged that the effect had been caused by the accompanying action, and numbers of participants in the action trial who asked the experimenter not to reproduce the accompanying action, are shown in Table 1.

Paired comparisons between conditions by McNemar's *z*-test (Glass & Stanley, 1970) showed only one significant difference: in the verbal trial, British participants acknowledged that the device may have affected the object more often than the magic spell may have done ($z(1) = 2.19, p < .05$). Comparisons using the χ^2 test with Yates' correction for continuity (Ferguson, 1971) showed that for both conditions Mexican participants, in the verbal trial, acknowledged the effect of the accompanying action more frequently than did British participants ($\chi^2(1) = 5.73, p < .01$ and $\chi^2(1) = 10.85, p < .001$ for Conditions 1 and 2, respectively). In the action trial, Mexican participants were more likely than British participants to ask the experimenter not to reproduce the accompanying manipulation ($\chi^2(1) = 10.85, p < .001$ and $\chi^2(1) = 8.48, p < .003$ for Conditions 1 and 2, respectively).

The distribution of credulity scores across Mexican and British participants is presented in Table 2. One-way ANOVAs for culture (Mexican vs. British) were run for each of the conditions, and showed main effects, with $F(1, 28) = 18.15, p < .0002$ for both conditions. This indicated that Mexican participants showed significantly larger mean credulity scores than did British participants.

Numbers of participants in both cultural groups who were classified as believers in the causal role of the accompanying actions on the basis of the general patterns of their judgments, actions and justifications are shown in Table 3. There were no significant differences between conditions. Within conditions, the Mexican sample yielded significantly larger numbers of believers than did the British sample ($\chi^2(1) = 10.85, p < .001$ and $\chi^2(1) = 6.42, p < .01$ for Conditions 1 and 2, respectively).

As the mean ages of Mexican participants in both conditions were significantly greater than those of British participants, the between-age variability of Mexican participants' responses had to be assessed. In order to do that, Mexican participants in both conditions were divided into two groups. The younger group included 13

Table 2. Numbers of participants who received particular scores and mean scores of credulity (standard errors) in Experiment 1 of this study (Mexican, total number of participants per condition—14) and in the matching experiment in Britain (British, total number of participants per condition—16)

Score	Condition			
	1 (device)		2 (magic)	
	Mexican	British	Mexican	British
0	0	5	0	5
1	2	5	2	8
2	0	2	2	1
3	0	1	2	2
4	12	3	8	0
Mean	3.57	1.50	3.14	1.00
SE	(0.29)	(0.38)	(0.31)	(0.24)

Table 3. Numbers of participants who were classified as believers in the effect of the accompanying action on the basis of general patterns of judgments, actions and justifications in Experiment 1 of this study (Mexican, total number of participants per condition—14) and in the matching experiment in Britain (British, total number of participants per condition—16)

	Condition			
	1 (device)		2 (magic)	
	Mexican	British	Mexican	British
	12	3	10	3

participants, with $M = 26.6$ and age ranging from 20 to 32 years, and the older group included 15 participants, with $M = 50.3$ and age ranging from 40 to 72 years. The frequencies of the following participants' responses were compared between the groups by χ^2 test with Yates' correction for continuity: acknowledging that the accompanying manipulation was the cause of the phenomenon (verbal trial), and asking the experimenter not to reproduce the accompanying manipulation when their documents were in the box (action trial). The proportions of participants who were classified as believers in the causal effect of the accompanying actions on the basis of the general patterns of judgments, actions and justifications, were also compared between the groups by χ^2 test, and the mean credulity scores between the groups were compared by one-way ANOVA for age (younger vs. older participants). None of the comparisons showed significant differences between the responses of younger and older Mexican participants.

Discussion

In both studies, the experimenter effect cannot be completely excluded, as long as the experimenter was an outsider to the cultural community in which the experiment was

conducted. Yet it was assumed that if this effect (either as a suppression or an enhancement of magical type responses) did exist, it affected the results of both studies to an approximately equal extent, so the results from both cultural communities were still comparable.

The fact that almost half of Mexican participants believed in the real existence of Nahual confirms the assumption that Mexican culture is generally more tolerant toward magical beliefs than is British culture. However, when discussing the existence of real physical objects that were available in their perceptual field, Mexican participants' answers did not differ from those of British participants: they all believed in the physical objects' permanence, and justified this belief in an appropriate way.

However, before seeing the main phenomenon (the destruction of the plastic card in the box), Mexican participants, unlike British participants, showed a higher degree of credulity toward the possibility that the device may have affected the card than that the magic spell may have done so. This result can be interpreted as an effect of culture: living in the technically unsophisticated environment, Mexican participants may have developed a strong belief in the power of technical devices. It can be assumed that, due to the lack of special education and a limited personal experience with technical artifacts, Mexican participants viewed the unknown technical device in a more global way than did British participants. This means that Mexican participants had a lesser knowledge of the possible mechanisms underlying the work of the device (electricity, wiring, lights, sound producing device, etc.) than did British participants, some of whom were even doing a degree in engineering. As a result, Mexican participants could be less sceptical about the simple device that was used in the experiment and anticipated the causal effect of the device significantly more often than did British participants. These exaggerated expectations with regard to the effect of physical devices can be viewed as a specific feature of the marginality of rural Mexican culture, in which traditional beliefs in magic are tightly bound with the onset of technological civilization (Redfield, 1968; Selby, 1974). This also may have contributed to the fact that the majority of Mexican participants, in their anticipatory judgments, did not think that the magic spell could have affected the physical object in the box.

A possible alternative to this interpretation would be to assume that Mexican participants viewed the device as a sort of magic and not as an unknown piece of technology. This, however, was unlikely, for two reasons. Firstly, the participants were not totally isolated from the world of technology. Some of them had or saw televisions, radios and refrigerators, and they visited nearby cities quite frequently. Secondly, the fact that most participants viewed the effect of the device not as a magical event but rather as a technical effect was also evident from the explanations that they gave to this effect. Like British participants, in their explanations Mexican participants abstained from reference to magical forces. Instead, they simply claimed that the device could do something that would destroy their voting certificates.

To expand on this, it seems plausible to qualify this type of response as phenomenistic rather than magical (see Piaget, 1986; Subbotsky, 1997a; 2000). Indeed, both in Britain and Mexico, ordinary people have access to pieces of technology (products of chemistry and medicine, electronic devices) whose mechanisms of functioning they do not understand. Yet, using these pieces of technology does not imply a belief in magical forces. Although a person may not fully understand, for instance, how a TV or a computer works, the person knows that there are scientists out there who do. As a result, all the person has to do in order to produce a desirable effect is 'to press the right button', which is a phenomenistic, and not magical, type of causal thinking.

However, Mexican participants' sceptical attitude toward everyday magic disappeared as soon as they saw the magic spell to have worked. Both in the verbal trial and in the action trial, Mexican participants showed equal and overwhelming credulity toward the causal effect of the device and the magic spell. In contrast, British participants, having observed the effect of the accompanying action, in the verbal trial (but not in the action trial) proved significantly more credulous toward the effect of the physical device than toward the effect of the magic spell. It seems as if the experience of seeing the change of the plastic card in the box persuaded British participants that the accompanying action did work. This effect was, however, one-sided and increased only the belief in the causal effect of the device, but not of the magic spell. It was also rather superficial, as long as, in the action trial, British participants again showed strong scepticism toward both the device and the magic spell.

Overall, Mexican participants proved to be significantly more credulous toward the causal role of the accompanying actions than did British participants. While they were consistent in their strong belief that the device can affect the object in the box, Mexican participants showed a significant change of attitude as long as the magic spell was concerned. Being rather sceptical toward magic in their anticipatory judgments, Mexican participants were quick to acknowledge the effect of magic as soon as they saw the transformation phenomenon. This reversal from scepticism to acceptance was not, however, observed in British participants. There was a significantly larger number of believers in the effect of the accompanying actions (both with the device and the magic spell) among Mexican participants than among British participants.

One possible way to interpret this difference within conditions is to explain it by the fact that Mexican participants' mean ages were almost a generation greater than those of British participants. This explanation, however, has to be overruled, due to the lack of the between-age variability in Mexican participants. Indeed, if the age was the factor that determined the differences between responses of Mexican and British participants, then the responses of younger Mexican participants (whose mean ages were comparable with those of British participants) would have been similar to those of British participants and different from the responses of older Mexican participants. As long as this was not the case, the 'age related' explanation of the differences within experimental conditions is unlikely.

Overall, the results of this experiment showed that participants from both cultural communities acted in concordance with the systems of beliefs dominant in their cultures. Indeed, British participants, who live in the 'science oriented—magic sceptical' culture, revealed their consistent scepticism toward magic and, at least in the verbal trial, showed preference in accepting the physical causal explanation over the magical one. In contrast, Mexican participants' verbal scepticism toward magic proved to be only superficial. This scepticism disappeared as soon as these participants observed the effect of the magic spell. These results obviously go along with the assumption that in his or her causal beliefs an individual conforms to the beliefs dominant in the official culture.

There is, however, a possibility of an alternative explanation of these results. It could be the case that the British participants' scepticism toward magic was a special effect of the experimental conditions. This effect could have occurred due to the fact that the cost involved in disregarding the potential effect of the accompanying actions for British participants was lower than it was for Mexican participants. Indeed, all that British participants could lose in the action trial was their driving licences, which are easily replaceable. For Mexican participants, however, their voting documents were the only

official documents they possessed, and therefore the voting certificates may have had a significantly greater value for these participants than driving licences had for the British participants. As a result, it may have been easier for British participants to remain sceptical when their documents were put at risk, than it was for Mexican participants. In order to examine this assumption, in Experiment 2, the risk of disregarding the potential destructive effect of the accompanying actions was equalized for both groups of participants. This risk was also generally increased, in order to test whether rational beliefs of British participants were strong enough to withstand the condition in which 'staying rational' becomes rather costly.

EXPERIMENT 2 (HIGH RISK)

Method

Participants

Twenty-eight adult participants were involved in this experiment, 14 participants in each of two conditions. As in the previous experiment, the participants were of mixed sexes and were enrolled from the same rural communities near the city of Cuernavaca. Participants' mean ages and age ranges for Conditions 1 and 2 were as follows: $M = 30.2$, range 17–68 years; $M = 26.5$, range 17–48 years. The mean ages and age ranges of participants in the matching conditions of the British study were $M = 21.3$, range 18–37 years for Condition 1 and $M = 19.6$, range 18–23 years for Condition 2.

Material

The materials were the same as those used in Experiment 1, except that participants' documents were not required and after the transformation the plastic card was not cut but badly scratched instead, as if engraved by some sharp instrument.

Procedure

The procedure in both conditions of this experiment generally followed the procedure of the corresponding conditions in Experiment 1, with three differences. First, in this experiment the basic phenomenon that participants observed was not the plastic card being cut inside the box; instead, a new card was badly scratched. Second, instead of putting their valuable documents in the box, participants were asked to place their hands in the box. Third, in this experiment only one follow-up question was asked: "Did you have any anxiety about your hand being scratched inside the box? Why?"

In order to comply with ethical regulations, it was made clear to the participants that if they decided to take a certain risk, then they would do this on a voluntary basis, and not because they had to. Not only did the participants have the right to withdraw from the experiment, but it was also obvious to them that they could easily avoid any risk at all without using this right. It was a part of the procedure that a participant had to decide whether to allow or not to allow the experimenter to reproduce her accompanying action (the switching on the device or saying a magic spell) when the participant's hand was placed inside the box. All the participant had to do in order to be on the safe side was to ask the experimenter not to reproduce her accompanying actions. In addition, in this study, as in the British study, the participants were asked to sign a letter of consent, in which it was stated that the conditions of the experiment and the risk involved had

been explained to them. In this letter, it was explicitly stated:

I have been fully informed by Dr . . . about the conditions of this experiment and I agree to continue the testing. I am fully aware that whatever happens to my hand during this experiment is entirely my responsibility, and I make Dr . . . free from any responsibility for the consequences of my decision.

This was done in order to minimize the possibility that British participants might have had more knowledge about ethical restrictions placed on experimenting in psychology than Mexican participants, and therefore assumed that the experimenter would not hurt them. By this means, the participants' informed consent was solicited before the experimenter could proceed with the reproduction of the accompanying manipulations. The situation did not involve any deception of participants. After the experiment was over, the participants were debriefed about the aims of the experiment.

Apart from equalizing the price of disregarding the potential effect of the accompanying actions, increasing the risk in this experiment also had an objective of improving the study's methodology: with the risk increased, the participants had even less grounds to believe that the experimenter was prepared to consciously inflict harm to their hands (i.e. by initiating some hidden device). This would rule out the hypothesis that those participants who forbade the experimenter to reproduce her magic spell were bothered not by the spell *per se*, but by the possibility that the spell was used as a distractive manoeuvre in order to create a cover up for some malicious trick. Rather, if a participant asked the experimenter not to reproduce the magic spell, he or she viewed the spell as a potentially harmful force, which, once initiated, would go beyond the experimenter's control and could hurt the participant's hand even despite the experimenter's wishes.

Scoring and classification criteria

Scoring and classification criteria were the same as in Experiment 1.

Results

Participants' answers to questions about the existence of Nahual, and about the existence of real physical objects, were similar to those in Experiment 1. Ten participants said they believed in Nahual, and two of them claimed they personally saw it. Before observing the object's change in the box, all participants showed that they believed in object permanence, seven participants said that the device might have affected the plastic card, and five participants thought that the magic spell may have done so.

Numbers of participants who acknowledged the effect of the accompanying action in the verbal trial, and numbers of those who forbade the experimenter to reproduce his or her accompanying action in the action trial, are shown in Table 4. The paired comparisons between conditions showed that in this experiment, as in Experiment 1, in the verbal trial British participants more frequently acknowledged that the device may have caused the object's destruction than that the magic spell may have done so ($z = 2.14, p < .05$). No other significant differences were found between conditions.

Table 4. Numbers (percentages) of participants who acknowledged that the phenomenon had been caused by the experimenter's manipulation (verbal) and asked the experimenter not to reproduce the manipulation (actual) in Experiment 2 of this study (Mexican, total number of participants per condition—14) and in the matching experiment in Britain (British, total number of participants per condition—16)

		Condition							
		1 (device)		2 (magic)					
		Verbal		Actual		Verbal		Actual	
Mex.	Brit.	Mex.	Brit.	Mex.	Brit.	Mex.	Brit.	Mex.	Brit.
14	11	13	9	11	3	12	8	(100)	(68)
		(93)	(56)	(78)	(19)	(86)	(50)		

Within conditions, in the verbal trial Mexican participants more frequently acknowledged the effect of the magic spell than did British participants ($\chi^2(1) = 8.46, p < .003$). All other differences within conditions proved insignificant.

Participants' credulity scores are shown in Table 5. Two one-way ANOVAs for culture (Mexican vs. British), for each of the conditions, showed main effects, with $F(1, 28) = 8.62, p < .006$, and $F(1, 28) = 6.07, p < .02$, for Conditions 1 and 2, respectively. This indicated that Mexican participants were significantly more credulous toward the effect of both the device and the magic spell than were British participants.

Table 6 shows the numbers of participants who were qualified as believers in the causal effect of the accompanying actions on the basis of general patterns of participants' judgments, actions and justifications. Paired comparisons by χ^2 test with Yates' correction for continuity showed no significant differences either between or within conditions at the 5% level.

Table 5. Numbers of participants who received particular scores and mean scores of credulity (standard errors) in Experiment 2 of this study (Mexican, total number of participants per condition—14) and in the matching experiment in Britain (British, total number of participants per condition—16)

Score	Condition			
	1 (device)		2 (magic)	
	Mexican	British	Mexican	British
0	0	1	0	3
1	0	3	2	1
2	1	3	0	3
3	0	2	3	7
4	13	7	9	2
Mean	3.86	2.69	3.35	2.25
SE	(0.14)	(0.35)	(0.29)	(0.34)

Table 6. Numbers of participants who were classified as believers in the effect of the accompanying action on the basis of general patterns of judgments, actions and justifications in Experiment 2 of this study (Mexican, total number of participants per condition—14) and in the matching experiment in Britain (British, total number of participants per condition—16)

Condition			
1 (device)		2 (magic)	
Mexican	British	Mexican	British
13	9	13	9

Discussion

The hypothesis that a stronger belief of Mexican participants in the causal role of the accompanying actions when compared with that of British participants was caused by the difference in the value of the documents used in Experiment 1 received support in this experiment. When the risk of disregarding the possible effect of the accompanying actions was made identical in both cultural groups and generally increased, participants from both samples showed no difference in the degree of their belief in the effect of the accompanying actions. This follows from the fact that differences within conditions, as measured by the two most reliable indicators of the participants' credulity (the behaviour in the action trial, and the general patterns of judgments, actions and justifications), proved insignificant. Only one measure—credulity scores—showed that Mexican participants were still ahead of British participants. This was mainly due to the fact that, in the verbal trial, Mexican participants acknowledged more frequently the effect of the accompanying actions than did British participants, and in the 'magic' condition this difference was significant.

GENERAL DISCUSSION

Overall, the results of the two experiments presented in this paper are in favour of the assumption that the rationalistic orientation of contemporary Western culture affects the individual mind only to a certain 'depth'. The individual's adherence to the belief in the universal power of physical causality depends on the conditions in which the individual's causal beliefs are tested.

One of these conditions is the mode in which the beliefs are displayed: the individuals' verbal judgments against their behavioural responses. In their verbal judgments, individuals turned out to be more prone to follow values and causal beliefs that are dominant in their societies, than they were in their actions. Thus, in their explanations of the unusual phenomenon, British participants were sceptical toward magic; rather, they believed in the causal role of a physical device (see Tables 1 and 4, verbal trial). In contrast, Mexican participants showed the same (and high) degree of verbal credulity toward both scientific (device) and non-scientific (magic) explanations of the observed phenomenon. The compliance of the individual's verbal causal judgments with the demands and expectations of the 'upper culture' (i.e. with the views which predominate among the educated and powerful representatives of the culture) may explain some results of the previous cross-cultural studies (such as those

conducted by Luria in Central Asia, 1931). In fact, most of these studies were conducted in a verbal mode, while participants' actual behaviour was not the focus of the research.

As the results of this study showed, participants' behavioural responses are related to the demands of the 'upper culture' in a more complex way than are the participants' judgments. As in their judgments, in their behavioural responses British participants showed their adherence to the ideal of scientific rationality. This, however, occurred only when the risk of disregarding alternative beliefs to scientific ones is relatively low. Indeed, when the cost of 'staying rational' in the action trial was low (Experiment 1), the majority of British participants did not change their verbal scepticism toward magic that they had expressed in the verbal trial, whereas most Mexican participants did (see Tables 1 and 3). However, when the cost was increased (Experiment 2), more than half of British participants abandoned their verbal scepticism and showed credulity toward magic in both their actions and in their general patterns of judgments, actions and justifications (see Tables 4 and 6). In this condition, British participants showed credulity toward magical beliefs to the same extent as Mexican participants. It is safe to assume that, at some point within historic and cultural development, British culture was as tolerant toward magical beliefs as is contemporary Mexican culture. If this is the case, then the results of Experiment 2 show that, at some level, magical beliefs remain largely unaffected by the advance of scientific rationality. Indeed, the contemporary Western culture is based on the strong belief in the universal power of physical causality—a belief which is supported by the whole system of education. Yet, an average individual living in this culture, under certain conditions, does not act differently from the individuals who still live in a magic-tolerant culture. This also confirms the idea that the so called 'folk' representations about object permanence and physical causality may strongly deviate from scientific representations (Subbotsky & Trommsdorff, 1992).

The data of this study provide support for the results of previous research that showed the presence of magical thinking in Western individuals. Thus, Nemeroff and Rozin (2000) have accumulated a substantial amount of evidence that sympathetic magical thinking operates in disgust, contagion and other domains of the mind of a contemporary Western person. Usually, mechanisms of magical thinking are triggered in situations of a relatively high cost for the individual, like imagining the possibility of catching a dangerous disease (AIDS, hepatitis). The role of cost in magical thinking can also be seen in the fact that, according to these authors, both in America and non-Western cultures (such as India or New Guinea) the effect of negative contagion is more powerful than that of positive contagion (the belief that you may get some good quality from contacts with positive sources): allegedly, it is of a higher value to keep away from an incurable disease than to enhance one's self through contact with a personification of goodness and holiness.

The potential role of cost in engaging in magical practices has also been highlighted in some developmental studies. Woolley and Phelps (1994) reported that 3- to 5-year-old children were reluctant to explore their magical beliefs if this exploration involved failing to meet a practical request from an adult—which is a relatively high price for a child to pay. Yet, in other studies, children of the same age were shown to be ready to engage in magical actions (Harris, Brown, Marriott, Whittal, & Harmer, 1991; Johnson & Harris, 1994; Rosengren & Hickling, 1994; Subbotsky, 1993). The authors conclude that "when beliefs in magic involved little cost, or conversely, when not believing involved a potentially high cost, adults and children both may appear to entertain magical beliefs"

(Woolley & Phelps, 1994, p. 65). Viewed in the light of this conclusion, the results of the present study can suggest that, at a relatively high cost of not believing in magic, Western and non-Western adult participants are likely to engage in magical practices to an approximately equal extent, whereas when the cost is low, Western participants proved to be significantly more rationalistic and scientifically oriented than non-Western (Mexican) participants.

Coming back to the problem raised in the Introduction, we can conclude that, according to the results of this study, individuals do 'give up' their magical beliefs and practices as long as their official culture becomes dominated by the belief in scientific rationality. Being quite evident in the individuals' verbal responses, this 'surrender' affects the individuals' behaviour only to a certain extent. At a certain level (i.e. in the conditions in which the individual is strongly personally and emotionally involved), the individual can deviate from the beliefs of technological civilization. When acting at this level, a person can retreat into practices (like magic) that are viewed as 'left behind' in history by the person's official culture and education.

Acknowledgements

The authors thank Michael Cole, whose support made this study possible. They are also grateful to Honorine Nocon and Rachel Morse for their careful reading of this manuscript and valuable comments.

References

- Adler, M. (1986). *Drawing down the moon*. Boston: Beacon.
- Bem, D. J., & Honorton, C. (1994). Does Psi exist? Replicable evidence for an anomalous process of information transfer. *Psychological Bulletin*, 115, 1, 4–18.
- Bower, T. G. R. (1974). *Development in infancy*. San Francisco: Freeman.
- Bower, T. G. R. (1989). *The rational infant: Learning in infancy*. New York: Freeman.
- Boyer, P. (1994). *The naturalness of religious ideas. A cognitive theory of religion*. Berkeley, CA: University of California Press.
- Carey, S. (1999). Sources of conceptual change. In E. K. Scholnick, K. Nelson, S. A. Gelman, & P. H. Miller (Eds.), *Conceptual development: Piaget's legacy* (pp. 293–326). Mahwah, NJ: Erlbaum.
- Christensen, S. M., & Turner, D. R. (1933). Introduction. In S. M. Christensen & D. R. Turner (Eds.), *Folk psychology and the philosophy of mind*. Hillsdale, NJ: Erlbaum.
- Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Harvard University Press.
- Cole, M., Gay, J., Glick, J. A., & Sharp, D. W. (1971). *The cultural context of learning and thinking*. New York: Basic Books.
- Das, J. P., & Dash, U. N. (1990). Schooling, literacy and cognitive development. In C. K. Leong & B. S. Randhawa (Eds.), *Understanding literacy and cognition: Theory, research and application*. New York: Plenum.
- Dennett, D. C. (1991). *Consciousness explained*. Boston: Little, Brown and Company.
- Dowling, J. E. (1998). *Creating mind. How the brain works*. New York: W. W. Norton.
- Ferguson, G. A. (1971). *Statistical analysis in psychology and education*. NY: McGraw-Hill.
- Frawley, W. (1997). *Vygotsky and cognitive science. Language and the unification of the social and computational mind*. Cambridge, MA: Harvard University Press.
- Frazer, J. G. (1922). *The golden bough. A study in magic and religion* (3rd. ed.). London: Macmillan.

- Gelman, R., & Baillargeon, R. (1983). A review of some Piagetian concepts. In J. H. Flavell & E. M. Markman (Eds.), *Handbook of child psychology* (Vol. III, pp. 166–230). New York: Wiley.
- Glass, G. K., & Stanley, J. C. (1970). *Statistical methods in education and psychology*. Englewood Cliffs, NJ: Prentice Hall.
- Gregory, R. L. (1980). *The intelligent eye*. London: Weidenfeld and Nicolson.
- Gorer, G. (1955). *Exploring English character*. London: Cresset Press.
- Harris, P., Brown, E., Marriott, C., Whittal, S., & Harmer, S. (1991). Monsters, ghosts and witches: Testing the limits of the fantasy–reality distinction in young children. *British Journal of Developmental Psychology*, 9, 105–123.
- Harris, P. L. (2000). *The work of the imagination*. Malden, MA: Blackwell.
- Hyman, R., & Vogt, E. Z. (1967). Water witching: Magical ritual in contemporary United States. *Psychology Today*, 1, 35–42.
- Jackendoff, R. (1987). *Consciousness and the computational mind*. Cambridge, MA: MIT Press.
- Jahoda, G. (1969). *The psychology of superstition*. London: Penguin.
- Johnson, C., & Harris, P. L. (1994). Magic: Special but not excluded. *British Journal of Developmental Psychology*, 12, 35–52.
- Keil, F. C. (1989). *Concepts, kinds, and cognitive development*. Cambridge, MA: MIT Press.
- Larkin, J. H. (1983). The role of problem representation in physics. In D. Gentner & A. Stevens (Eds.), *Mental models* (pp. 75–98). New York: Academic Press.
- Lehman, A. C., & Mayers, J. E. (1985). *Magic, witchcraft, and religion*. Palo Alto, CA: Mayfield.
- Levy-Bruhl, L. (1923). *Primitive mentality*. Oxford: Clarendon Press.
- Losev, A. F. (1978). *Estetika Vosrozhdenija* (Aesthetics of the Renaissance), Moscow: Mysl.
- Luhrman, T. M. (1989). *Persuasions of the witch's craft: Ritual magic and witchcraft in present-day England*. Oxford: Blackwell.
- Luria, A. R. (1931). Psychological expedition to Central Asia. *Science*, 74, 383–384.
- Luria, A. R. (1971). Toward the problem of the historical nature of psychological processes. *International Journal of Psychology*, 6, 259–272.
- Luria, A. R. (1976). *Cognitive development: Its cultural and social foundations*. Cambridge, MA: Harvard University Press.
- Mead, M. (1932). An investigation of the thought of primitive children, with special reference to animism. *Journal of the Royal Anthropological Institute*, 62, 173–190.
- Nemeroff, C., & Rozin, P. (2000). The makings of the magical mind: The nature and function of sympathetic magical thinking. In K. S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), *Imagining the impossible. Magical, scientific, and religious thinking in children* (pp. 1–34). Cambridge: Cambridge University Press.
- Piaget, J. (1986). *The construction of reality in the child*. New York: Ballantine Books.
- Redfield, R. (1968). *The folk culture of Yucatan*. Chicago: University of Chicago Press.
- Rosengren, K. S., & Hickling, A. K. (1994). Seeing is believing: Children's explanations of commonplace, magical, and extraordinary transformations. *Child Development*, 65, 1605–1626.
- Rozin, P., Markwith, M., & Nemeroff, C. (1992). Magical contagion beliefs and fear of AIDS. *Journal of Applied Social Psychology*, 22, 1081–1092.
- Rozin, P., Markwith, M., & Ross, B. (1990). The sympathetic magical law of similarity, nominal realism, and neglect of negatives in response to negative labels. *Psychological Science*, 1, 383–384.
- Rozin, P., Millman, L., & Nemeroff, C. (1986). Operation of laws of sympathetic magic in disgust and other domains. *Journal of Personality and Social Psychology*, 50, 703–712.
- Scribner, S. (1977). Modes of thinking and ways of speaking: Culture and logic reconsidered. In P. N. Johnson-Laird & P. C. Wason (Eds.), *Thinking: Readings in cognitive science*. Cambridge: Cambridge University Press.
- Sejourne, L. (1976). *Burning water: Thought and religion in Ancient Mexico*. Berkeley, CA: Shambala.
- Selby, H. A. (1974). *Zapotec deviance: The convergence of folk and modern sociology*. Austin, TX: University of Texas Press.

- Seligman, K. (1948). *The history of magic*. New York: Pantheon Books.
- Sperber, D. (1997). Intuitive and reflective beliefs. *Mind and Language*, 12, 67–83.
- Subbotsky, E. V. (1993). *Foundations of the mind: Children's understanding of reality*. Cambridge, MA: Harvard University Press.
- Subbotsky, E. V. (1997a). Explanations of unusual events: Phenomenalistic causal judgments in children and adults. *British Journal of Developmental Psychology*, 15, 13–36.
- Subbotsky, E. V. (1997b). Understanding the distinction between sensations and physical properties of objects by children and adults. *International Journal of Behavioral Development*, 20, 321–347.
- Subbotsky, E. V. (2000). Phenomenalistic perception and rational understanding in the mind of an individual: A fight for dominance. In Rosengren, K. S., Johnson, C. N., & Harris, P. L. (Eds.), *Imagining the impossible. Magical, scientific, and religious thinking in children* (pp. 35–74). Cambridge: Cambridge University Press.
- Subbotsky, E. V. (2001). Causal explanations of events by children and adults: Can alternative causal modes coexist in one mind? *British Journal of Developmental Psychology*, 19, 23–46.
- Subbotsky, E. V., & Trommsdorff, G. (1992). Object permanence in adults: A cross-cultural perspective. *Psychologische Beiträge*, 34, 62–79.
- Tambiah, S. J. (1990). *Magic, science, religion, and the scope of rationality*. Cambridge: Cambridge University Press.
- Thomas, K. (1971). *Attitudes and behaviour*. Baltimore: Penguin Books.
- Tulviste, P. (1991). *The cultural–historical development of verbal thinking*. Commack, NY: Nova Science Publishers.
- Vyse, S. A. (1997). *Believing in magic. The psychology of superstition*. New York: Oxford University Press.
- Wertsch, J. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.
- Wilson, T. D., & Nisbett, R. E. (1978). The accuracy of verbal reports about the effects of stimuli on evaluations and behaviour. *Social Psychology*, 41, 118–131.
- Wiser, M., & Carey, S. (1983). When heat and temperature were one. In D. Gentner & A. Stevens (Eds.), *Mental models* (pp. 75–98). New York: Academic Press.
- Woolley, J. D., & Phelps, K. E. (1994). Young children's practical reasoning about imagination. *British Journal of Developmental Psychology*, 12, 53–67.
- Zusne, L. (1985). Magical thinking and parapsychology. In P. Kurtz (Ed.), *A skeptical handbook of parapsychology* (pp. 668–700). New York: Prometheus Books.
- Zusne, L., & Jones, W. H. (1989). *Anomalistic psychology: A study of extraordinary phenomena of behaviour and experience*. Hillsdale, NJ: Erlbaum.

Received 19 September 2000; revised version received 25 September 2001

Appendix A

Behavioural patterns and total magic credulity scores assigned to participants*

Behavioural pattern	Total credulity score
None of (a), (b), (c), (d)	0
Either (a) or (b)	1
(a) and (b) or (d)	2
(a), (b) and (c) or (d) and (c)	3
(a), (d) and (c)	4

*See 'Scoring and Classification Criteria' section for the definitions of (a), (b), (c) and (d).

Appendix B

Behavioural patterns and classes of participants

Type of behaviour		Believers			Non-believers
		Consistent	Curious	Inconsistent	
<i>Verbal trial</i>					
Acknowledgement that the effect had been caused by the accompanying action	Acknowledged	×	×		
	Not acknowledged			×	×
<i>Action trial</i>					
Permission to reproduce the accompanying action with the participants' valuable object being in the box	Given		×		×
	Not given	×		×	
<i>Follow up interview</i>					
Denial that the effect had been caused by the accompanying action	Denied				×
	Did not deny	×			
Justification of the permission to reproduce the accompanying action	Curiosity		×		
	Lack of belief that the action would work				×
Justification of the request not to reproduce the accompanying action	Fear that it may destroy their valued object	×		×	
	Other type	or	×		

