Cognitive Style Predicts Magical Beliefs

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Abstract

Magicians often rely on misdirection to fool their audience. A common way to achieve this is for the magician to provide a plausible and intuitive (but false) account of how an effect is performed in order to prevent spectators from uncovering the truth. We hypothesized that analytical thinkers would be more likely than intuitive thinkers to seek alternative explanations when observing a mental magic effect because generating a coherent explanation requires analytical thought. We found that while intuitive thinkers often espoused explanations for a magic trick similar to one provided by the magician, analytical thinkers tended to generate new explanations that echoed rational principles and relied on physical mechanisms (rather than mental capabilities). This difference was not predicted by differences in numeracy skills or need for cognition.

Keywords: cognitive style**,** misdirection, CRT, dual process theory of reasoning.

Introduction

Renewing a research program as old as scientific psychology itself (Binet, 1894; Triplett, 1900), in the last decade a new research program has emerged that uses illusionism and magical effects to investigate how the mind works (Kuhn, Amlani, & Rensink, 2008; Kuhn & Land, 2006; Kuhn, Olson & Raz, 2016; Macknik, Martinez-Conde, & Blakeslee, 2010; Rensink & Kuhn, 2015). Such efforts have mainly focused on the roles of perception, attention, and visual cognition, though a limited number of studies have examined the relationship between higher-level cognition and illusionism (Danek et al., 2014; Olson et al., 2015; Subbotsky, 2010). Nonetheless, there may be a deep connection between cognitive styles of thinking and the way in which people explain a magical effect.

Ekroll and Wagemans (2016) wrote "[illusionists'] ultimate aim is to design miracles, not mere illusions. That is, the magician's first question is how they can create the illusion of impossibility. Relatedly, the magician's second question is how they can make sure that nobody is able to figure out how it was done. That is, they are essentially aiming to construct a problem that is as difficult to solve as possible, given the fundamental principles of human problem solving" (p. 486). These goals are mainly addressed by using misdirection: the act of manipulating the spectator's attention away from the actual cause of a magic effect (Kuhn et al., 2014). From a psychological point of view, misdirection can be achieved through the manipulation of variables related to at least three different processes: perception, memory and reasoning.

Kuhn et al. (2014) describe the role of perception and memory in detail, but the authors pointed out that misdirection of reasoning and beliefs is loosely defined and harder to describe. However, virtually all areas of illusionism employ techniques based on the dual process theory of thought (Evans & Over, 1996; Sloman, 1996; Stanovich & West, 2000) distinction between analytical (i.e., a slow and effortful form of deliberative thought) versus intuitive (i.e., a fast and effortless form of associative thought) thinking. When a magician interacts directly with a spectator, their actions, dialogue, and other aspects of the performance are aimed at prompting fast, effortless, associative, and nearly-automatic responses. For example, in the classic force, a spectator is asked to pick a card. The choice appears to be at the discretion of the spectator; however, the magician has actually chosen a predetermined card that he "forces" the spectator to pick. The force is obtained by placing the chosen card directly in the hand of the spectator in a way that seems as if it were a random choice. The timing and the naturalness of the magician's movements are crucial factors in getting the participant to "choose" the predetermined card. From a psychological point of view, the success of the force depends on triggering an intuitive-based response—that the participant actually has a choice—and crucially, avoiding an analytical response that could lead the participant to choose a different card (such as one located at the extremities of the fan of cards). The renowned card magic conjuror Roberto Giobbi suggests a series of verbal and non-verbal techniques that stimulate a quick and automatic response (Giobbi, 1995). For example, make a person feel comfortable and then abruptly ask for a card. When this happens in front of an audience, the person may feel pressured to comply quickly or risk embarrassment in front of the public for not having completed such a simple assignment.

Mental magic attempts to create the illusion of impossibility by simulating supernatural mental abilities (e.g., telepathy, clairvoyance, psychokinesis, mediumship, and so on) and, as opposed to more traditional magic areas (such as card magic), sleight-of-hand or object manipulation skills cannot be taken into account as a possible explanation. More recently, given the cultural and educational changes in Western society, supernatural-based explanations have become unrealistic for a general audience—although intuitive thinkers are more likely to hold supernatural (Bouvet & Bonnefon, 2015) and paranormal (Pennycook et al., 2012) beliefs. Instead, the mental magic effects are explained in terms of natural skills, such as the ability to reliably read non-verbal signals, body language and subliminal manipulation of others behaviors by means of psychological suggestion. Even if such abilities are not 100% reliable and in many cases are not sufficient for explaining the observed effect, people generally accept that mental magic is due to highly trained psychological skills. Mentalists will adopt many subtle techniques in order to promote the default, most intuitive or automatic explanation and to avoid promoting alternative explanations. Analytical thinking could help the observer to contemplate alternative hypotheses (such as the use of physical devices or the presence of an accomplice) as well as the weaknesses of the assumed explanation based on the highly developed psychological ability of the mentalist (such as the unreliability of method).

Because magicians rely on intuitive explanations to sell the illusion, individuals prone to analytical thinking may be less susceptible to these tricks. Can individual differences in cognitive style predict the explanations given to a mental magic performance? Adopting a common methodology adopted from the dual process theory literature (Gronchi et al. 2016; Zemla, Steiner, & Sloman, 2016), it is possible to investigate the relation between cognitive style (predisposition to adopt analytical vs intuitive thinking) with the explanation given to a mental magic effect. We seek to establish whether analytical thinking affects the explanations produced by spectators of a magic trick. We predict that observers adopting an analytical cognitive style are more able to inhibit the default, mental power-based explanation suggested by the mentalist.

Experiment

We investigated whether an individual's cognitive style affects judgments about a mental magic effect. Participants watched a video where an expert mentalist performed a prediction effect (predicts a purported "free" choice made by the spectator), and were then prompted to explain the effect they just witnessed. In addition, participants made several judgements, such as whether it was easy to generate an explanation, whether they were surprised by the outcome of the effect, and whether they enjoyed the trick. On a separate day, participants completed an extended version of the cognitive reflection test (CRT; Frederick, 2005) used to measure the cognitive style and other related measures.

Method

Participants 335 freshmen college students (71 male, 29 unknown) enrolled in the Psychology major of the University of Florence were recruited for course credit. The sample mean age (in years) was 19.5 (sd = 2.3), range 18-46 (29 of unknown age).

Materials and procedure Participants completed a Mental Magic Task and four other questionnaires: an extended version of the CRT questionnaire, the Need for Cognition (NFC) questionnaire, an abbreviated Numeracy Scale, and three questions about Science Interest. All materials were presented to participants in Italian and are translated here for the reader.

On day 1 of the experiment, participants completed an extended version of the CRT questionnaire (Toplak, West & Stanovich, 2014; Zemla, Steiner, & Sloman, 2016). The CRT scale is comprised of questions that have a wrong but intuitive answer in addition to a correct answer that requires analytical thinking. For example, one question states: *In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?* The default, intuitive response is 24 days (if 48 days is the time necessary to cover the entire lake, half of 48 should be intuitively the time necessary for covering half the surface). However, if the responder inhibits such response, it is relatively easy to see that every day the patch doubles in size, so on the 47th day the lake was half covered and on the 48th the lily pads will cover the entire surface. So, the inhibition of the most obvious response allows to adopt a deliberation-based form of thinking. The number of correct answers on the CRT measures the degree to which participants engage in analytical thinking and inhibit intuitive responses. Participants completed the 7-item CRT scale in an open-ended format (except for the last item which was a multiple choice question).

On the same day, participants also completed three multiple choice questions about Science Interest inspired by the Science Curiosity Scale (Landrum et al., 2016): 1) *Which of the following do you most like to read?* Possible answers: fiction, science, sports, politics, history, other. 2) *Let's suppose that it's necessary to take a mandatory class (which will not influence your grade; only attendance is necessary). Which of the following topic would you like to take?* Possible answers: Contemporary history, Creative writing, Physics and Astronomy, Cinema and Arts. 3) *Let's suppose that you are travelling for business in an abroad city that you have already visited and known. You have a free afternoon and you have time to do only one of the following activities (free and equally near to your hotel)*: Possible answers: Visiting the science museum, visiting the contemporary art museum, watching a show in a square, relaxing in a park, stay in the hotel to rest. Thus, for each question, there was an answer indicating interest toward science. The scale is intended to avoid socially desirable

responses that may be elicited from other science interest scales.

On day 4, participants completed a six-item numeracy scale (Weller et al., 2013) that evaluates one's competence in solving numerical problems (i.e., basic numerical operations, percentages). Given that CRT also measures numerical abilities as well as of inhibition of the intuitive response, we included the Numeracy Scale in order to exclude the possibility that an effect is due to numeracy and not cognitive style. On the same day, participants also completed the Need for Cognition scale (NFC; Cacioppo & Petty, 1982). The NFC measures the tendency to enjoy and engage in challenging cognitive activities. Indeed, some people have little motivation and tend to avoid effortful cognitive activities whereas other individuals consistently seek opportunities to engage such kind of tasks.

On day 8, participants watched a video about a mentalist's performance. The mentalist is talking with a spectator about free will and the possibility of predicting others' behavior. The mentalist then shows a chessboard with the pieces in the starting position and asks the spectator to choose one of the pieces. The spectator, following the mentalist's directions, announces the chosen piece (a white bishop) and places it in the middle of the chessboard. The mentalist takes the chosen piece in his hands and begins to speculate about the factors that could have influenced the participant's choice: Did the white bishop have a particular significance? Was that particular bishop closer to the spectator compared to other bishops? Finally, the mentalist declares that he knew in advance that the spectator would take that particular piece and then invites the spectator to take another piece. The video ends with the revelation that every other piece besides the white bishop is stuck to the chessboard, so it would appear impossible that the participant could have chosen any other piece. Participants observed the video in a group, but they were also able to re-watch it using a smartphone or tablet. After watching the video, participants were individually asked to provide an explanation for the effect they just saw in an open-ended format. In addition, they answered each of the following questions on a 5-point Likert scale (from "not at all" to "extremely" for questions 1, 2 and 4 and from "strongly disagree" to "strongly agree" for questions 3, 5, 6, 7): 1) How much did you enjoy the effect you just saw? 2) How much did it surprise you? 3) I tried to predict what the magician would do before he did it 4) How confident are you in your explanation? 5) It is easy to think of many alternative explanations for this effect 6) I would like to know how the effect actually works 7) I would like to see other magic effects.

Data Analysis

For each participant, four scores were computed: a CRT score (the number of correct analytical responses out of 7), an NFC score, and a science interest score (giving 1 point for each answer related to science), and a numeracy score.
The open format question ("How do you explain the effect you just saw?"), was coded using two different criteria. The first criterion was based on physical explanation vs mental explanation. Physical explanations often contained reference to a physical device, such as glue or a magnet, but also include trivial solutions such as collusion between the mentalist and the spectator. Mental explanations were based on the possibility of behavior conditioning, the power of gestures, and the possibility of genuinely predicting in advance the spectator's choice (including supernatural powers). A third "other" category included no response, incomplete responses, and explanations not suitable to be categorized in previous terms (such as "I don't know"/"no idea").

A second criterion coded explanations as rational or irrational. Rational explanations included all the physical explanations that are actually feasible in practice, but also included statistical-based reasoning such as the possibility of predicting behavior with high probability on the basis of modal choices (obtained from experience). Irrational explanations were the same as the mental explanations excluding interpretations based on the statistical properties of people's choices (by means of previous empirical observations). Since all reported physical explanations were feasible ways of obtaining the effect, no physical explanations were coded as irrational. Again, an "other" category was included for coding no response, incomplete responses or other explanations not suitably categorized in previous terms. Two independent judges coded each explanation according to the two criteria. A third, independent judge broke any ties (5 out of 335 for the first criterion and 22 out of 335 for the second criterion).

Results

Explanations of the magic effect With regard to the physical/mental dichotomy, the most common explanation (about 70%) was a mental explanation based on the belief that the magician could systematically influence other people choices, such as "the mentalist implicitly and secretly conditioned the choice of the spectator." In several cases, participants added details such as "with gestures", "with his voice", "with his gaze", "with his mind", "with his movements," and so on. Only 13% of participants explained the effect in terms of a physical device (e.g., a special, delayed-effect glue; a magnet-based mechanism) or with a trivial solution (the spectator is an accomplice). The remaining 17% of responses were classified as "other".

With regard to the rational/irrational dichotomy, all of the physical explanations were included in the rational category and the majority of the mental explanations were categorized as "irrational". However, some of the mental explanations were included in the "rational" category. These were explanations based on the belief of influencing other's choice by subtle psychological techniques together with some rational considerations. For example: "The mentalist did a lot of trials before with other people to look for the most chosen piece. When facing the spectator, the mentalist someway suggested with his gaze to take the most likely piece. I think the mentalist has been very lucky." or "The

mentalist knows which piece is generally chosen most often. He exploited such knowledge together with his ability to influence spectator choice. Maybe he was not certain of the final result, but it was the most likely result." According to the rational/irrational dichotomy, the rational explanations were about 20% and the irrational explanations were about 63%. The remaining 17% were classified as "other".

Explanations types and analytical style We evaluated whether CRT scores were correlated with the type of explanation produced (Figures 1 and 2). As predicted, those who generated a physical explanation (compared to a mental explanation) tended to have higher CRT scores, $t(70.1) = 12.89$, $p < .001$. Likewise, participants who wrote a rational explanation had higher CRT scores compared to those who wrote an irrational explanation $t(105.7) = 13.61$, $p < .001$.

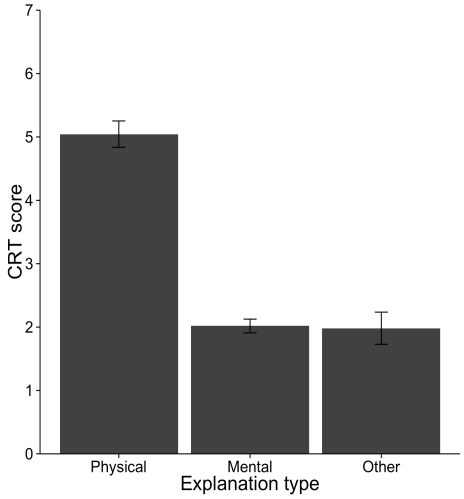

Figure 1: Participants who generated physical explanations typically had higher CRT scores (more analytical).

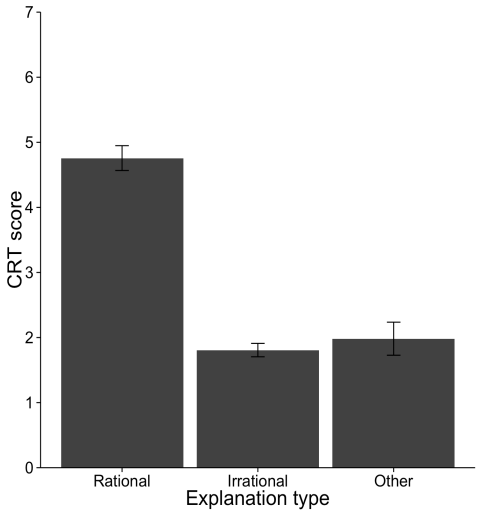

Figure 2: Participants who generated rational explanations typically had higher CRT scores (more analytical).

Explanations types and Numeracy Scale Unlike CRT, numeracy scores did not predict the explanation type that participants generated. Participants who generated physical compared to mental explanations did not differ in numeracy, $t(34.2) = .33$, $p = .74$, nor did participants who generated rational compared to irrational explanations, $t(73.9) = .27$, $p = .79$. This rules out the possibility that the observed CRT-related differences can be due to disparity in numerical ability.

Explanations types and Need for Cognition There were no differences in the NFC score between those who generated physical and mental explanations, $t(33.2) = .11$, $p = .91$, or between those who generated rational/irrational explanations, $t(80.8) = 1.26$, $p = .21$. This rules out the possibility that the observed CRT-related differences can be due to different inclination towards effortful cognitive activities.

Explanations types, science interest and analytical style Participants that wrote a physical explanation had a greater score in Science Interest compared to those that wrote a mental explanation, $t(55.3) = 2.65$, $p = .011$. Similarly, participants who wrote a rational explanation had a greater interest in science, $t(94.97) = 2.36$, $p = .021$. Science Interest was also significantly correlated with the CRT, $r = .35$, $p < .001$.

Explanation types and correlations among the questions of the Mental Magic task We expected that the way in which participants explained the effect would influence their response and enjoyment of the effect. However**,** we found that the type of explanation produced did not predict enjoyment of the effect, the surprise experienced, the attempt to predict the effect, the confidence in the explanation given, the ease of thinking of different explanations, the desire to know how it works, or the desire to see a new effect (all $p > .1$). Similar results were obtained for the rational/irrational dichotomy. However the questions about the Mental Magic effect were correlated among themselves (Figure 3). Having enjoyed the effect correlated with all other variables in the mental magic task except the confidence of the given explanation. The degree of surprise was highly correlated with enjoyment of the trick ($r = .45$), the desire to know how the trick was performed ($r = .33$) and desire to see new magic effects ($r = .34$). Attempts to predict the mentalist's actions during the effect was weakly correlated with the ease of generating an alternative explanation after the effect ($r = .07$), the desire to know how the trick was performed ($r = .14$), and desire to see new magic ($r = .12$). The highest correlation was between the desire to know how the trick was performed and the desire to see new magic ($r = .65$). All correlations reported above were significant with $p < .05$, uncorrected for multiple comparisons.

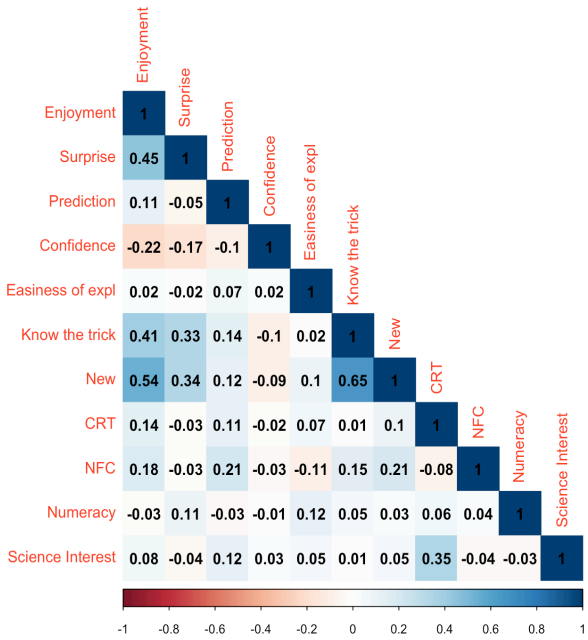

Figure 3: Correlations among the enjoyment of the effect (enjoyment), the surprise experienced (surprise), the attempt to predict the effect (prediction), the confidence in the explanation given (confidence), the easiness of thinking of alternative explanations (ease of explanation), the desire to know how it was performed (know the trick) and the desire to see a new effect (new). Correlations with CRT, NFC, Numeracy skills and Science Interest are also reported.

Analytical style and Mental Magic task questions The CRT was marginally correlated with the interest in seeing new magic (r = .10, p = .08), significantly correlated with attempts to predict how the trick was done (r = .11, p = .004), and significantly correlated with enjoyment of the mental effect (r = .14, p = .01).

NFC and Mental Magic task questions Similarly to CRT, Need for Cognition was correlated with the interest in seeing new magic (r = .21, p = .01), attempts to predict the next move of the mentalist (r = .21, p = .01), and with the enjoyment of the mental effect (r = .18, p = .04). The NFC was also marginally correlated with the interest in how the trick was performed (r = .15, p = .07).

Science Interest and Mental Magic task questions Science Interest was significantly correlated with attempts to predict the actions of the mentalist (r = .12, p = .029).

Discussion

We found that analytical thinking predicts the way people explain a mental magic effect: intuitive thinkers were more inclined to explain a mental magic effect in the same terms suggested by the mentalist (e.g., conditioning the spectator's choice or advanced psychological ability), whereas analytical thinkers were more likely to explain the observed effect by referring to a physical device or trivial tricks (such as collusion, i.e., a previous agreement between the mentalist and the spectator). The same pattern also held when "rational" considerations were taken into account in the categorization of the explanations: analytical thinkers were more inclined to seek an alternative explanation and reject an irrational explanation offered by the mentalist. We also found that these same differences in explanation type were predicted by interest in science, perhaps due to an aversion towards non-scientific (irrational) explanations. Moreover, we observed that such differences between analytical and intuitive thinkers were not due to related constructs such as numeracy skills or need for cognition

Although the explanation that a participant offered did not affect the way they perceived the trick (i.e., it was not correlated with any of the mental magic task questions), analytical style did predict differences. Analytical thinkers were more likely to predict the next step of the performance, suggesting that they were trying to go deeper into the effect not only at the end of the performance but also during the trick itself. This deeper level of engagement may be the reason why analytical thinkers also enjoyed the magic effect more, and expressed more interest in seeing new magic. We also found that being an analytical thinker was associated with an interest in science.

A limit of the present study is its reliance on correlational data. We are planning to further investigate this topic by manipulating the cognitive style to verify whether inducing analytical thinking will prompt participants to generate alternative rational explanations. Moreover, it is important to note that the sample was composed of Italian freshmen psychology students in their first days of college: commonly, those students have high expectations about the capabilities of psychology, including the skills that mentalist's performance suggests. This may explain the bias to provide mental explanations in our sample, although it does not explain the main effect of analytical thinking on explanation type. Another critical aspect is that we employed a single performance that was either interpretable in terms of advanced psychological skills and in physical-device terms in a relatively easy way. In other kinds of performances, it could be more difficult to think of rational/physical device-based explanations.

This work represents a first-step in the psychological investigation of magical effects in cognitive terms going beyond the more common perception and attention-based perspectives. The already existent but still limited literature about high-level cognition and magic may greatly benefit from our understanding of reasoning-based misdirection in terms of dual process theory of thought. In particular, such benefits can go in two opposite directions: psychological studies on cognitive styles (and dual process theory) may employ mental magic effects and magician's misdirection techniques to create unique and innovative experimental settings and, at the same time, conjurors may rely on the dual process theory of thought to improve their performance.

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