

Title: Blinded by science? Reasons for thinking twice
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Abstract:

Critical thinking is a key skill promised by many undergraduate programmes, yet few offer specific courses in thinking, nor do university lecturers necessarily think critically or know how to teach critical thinking. This preliminary paper overviews critical thinking in hospitality pedagogy, then uses the literature on fluoridation and astrology to exemplify the discrepancies between observable phenomena and the common view. Empirical data are employed to interrogate the relationship between empiricism and belief, and survey data on contentious beliefs further explore this relationship. The paper concludes that the relationship between scientific evidence and belief is somewhat arbitrary, and advice from friends and personal experience are important influences on thinking and belief. Implications for hospitality and tourism education are addressed.

Keywords: beliefs, critical thinking, education, paranormal, reasoning.

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Critical thinking is a key skill promised by many undergraduate programmes, yet few offer specific courses in thinking, nor do university lecturers necessarily think critically or know how to teach critical thinking. This preliminary paper overviews critical thinking in hospitality pedagogy, then uses the literature on fluoridation and astrology to exemplify the discrepancies between observable phenomena and the common view. Empirical data are employed to interrogate the relationship between empiricism and belief, and survey data on contentious beliefs further explore this relationship. The paper concludes that the relationship between scientific evidence and belief is somewhat arbitrary, and advice from friends and personal experience are important influences on thinking and belief. Implications for hospitality and tourism education are addressed.

Introduction

Using critical thinking, students can learn to differentiate between spurious and genuine ideas by analysing the available information and arriving at a reasoned conclusion, but only if the need to do this is recognized. More commonly, concepts worthy of debate are accepted or rejected according to custom and belief, rather than being evaluated objectively. Many widely held beliefs have no basis in truth, such as (for example) the idea that spinach is high in iron (Sutton 2010), or that food that has touched the floor for less than five seconds is still safe to eat. Regardless of the facts, many beliefs are difficult to substantiate, such as the causal relationship between German Measles vaccinations and autism (Meadows and Mandel 2007), or the existence and nature of God. Discrepancies between scientific evidence and common belief suggest that critical thinking is not as common as university educators might believe it to be (Weissberg 2013), and significantly more challenging and complex than it initially appears.

Literature review

Defining critical thinking

Even though critical thinking is commonly considered a key skill of graduates (e.g. Fahim and Masouleh 2012; Mulnix 2012; Weissberg 2013), there is considerable disagreement about what it is and how it can be developed (Bailin, Case, Coombs,

and Daniels 1999; Fahim and Masouleh 2012; Mulnix 2012). The Foundation for Critical Thinking website (2008) defines critical thinking as ‘self-directed, self-disciplined, self-monitored, and self-corrective thinking’, that entails a ‘commitment to overcome our native egocentrism and sociocentrism’. This might also be expressed as thinking that demands disciplined reasoning and the ability to transcend the cultural and social paradigms that influence how we perceive, experience, and interact with our environment. The website further states that ‘thinking left to itself often gravitates toward prejudice, over-generalization, common fallacies, self-deception, rigidity, and narrowness’, and a tendency to ‘accept whatever was presently believed as more or less eternal truth’. While these views exemplify the pitfalls of uncritical thinking, the literature acknowledges that university educators do not necessarily possess critical thinking skills, or are able to develop these in students (Pithers and Soden 2000; Weissberg 2013). In Mulnix’s (2012: 473) view, a core component of critical thinking is being prepared and able to evaluate evidence that is contrary to a belief. This paper extends this view by suggesting that advanced critical thinking is likely to undermine and disempower beliefs, opening the mind to new ideas, rather than settling into entrenched (and often culturally imposed) beliefs.

Critical thinking for hospitality students

Berger (2008) suggests that critical thinking has been an essential part of hospitality management since the 1980s, but observed that hospitality students are generally more interested in career goals than in learning how to research, and therefore, how to think. However, the development of critical thinking is good preparation for a hospitality career, as is the development of a curriculum that develops reflective practice (Lashley 2007), because problem solving (which involves critical thinking) is an integral part of a hospitality managers’ role (Li, Gray, Lockwood, and Buhalis 2013). In a constructivist approach to education, the focus is more on thinking and the creation of knowledge than on transmitting extant ideas. Hospitality students therefore need to learn to ‘critically reflect on the contents and methods of hospitality management practices by questioning the taken-for-granted assumptions of the hospitality industry’ (Zwaal and Otting 2007: 259).

However, critical thinking is not just required for hospitality management students or critical hospitality and tourism studies (e.g. Fullagar and Wilson 2012; Lashley 2007; Wilson, Small, and Harris 2012), but also for research generally, and various aspects

of work and life. Without the ability to think critically, students will read and believe class material instead of considering, reasoning, and evaluating ideas. As noted, whereas this ability to think critically is held up as the hallmark of a university graduate, it seems academics have been fooling themselves, as this is not the reality. In a study of over 3000 American college (i.e. university) students, Arum and Roska (2011: 204) found that ‘gains in critical thinking, complex reasoning, and writing skills (i.e., general collegiate skills) are either exceedingly small or empirically non-existent for a large proportion of students’.

Topics that challenge the ability to think critically

Finding topics to test and develop critical thinking is not difficult. A review of studies on controversial topics provides support for the premise that beliefs are based not on scientific evidence, but on cultural and other programming. Whereas *The God Delusion* (Dawkins 2008) refutes the existence of God using science, *The Science Delusion* (Shaldrake 2012) asserts that much of science is based on assumptions, rejecting concepts that are neither material nor physical. The simultaneous existence of these conflicting views demonstrates the need for critical thinking to determine whether either of them is correct, or even to just read and understand, without necessarily coming to a certain conclusion (thereby forming a fixed idea, or belief). Research papers on many topics demonstrate the need to think critically, as they often produce contradictory results. The following section overviews debates on the fluoridation of water, and the influence of astrology, as evidence of the need to undertake evaluative research and reasoning.

The fluoride debate

Information is readily available in support of fluoride, but factual information is more difficult to source. The Fluoride Information Network (2013) claims ‘over 50 years of research and experience have shown that fluoridation at optimal levels does not harm people or the environment’ but provides no citations or other support for their claim. Similarly, The New Zealand Ministry of Health (2013) ‘strongly supports water fluoridation as a safe, effective and affordable way to prevent and reduce tooth decay across the whole population’, but offers just one or two citations in support of this claim, and nothing against it.

Some studies claim that fluoride is dangerous and ineffective as a preventer of dental decay. Connett’s (2004) analysis of research on fluoridation reveals an association

between fluoride exposure and reduced intelligence (e.g. Ding et al. 2011; Eswar, Nagesh, and Devaraj 2011; Hong, Cao, Yang, and Wang 2008; Poureslami, Horri, Khoramian, and Garrusi 2011; Seraj, Shahrabi, Falahzade, Falahzade, and Akhondi 2006) that is not mentioned on websites supporting fluoridated water. He also notes associations between fluoride exposure and impaired visual-spatial organization (Calderon, Blenda, Marielena, Letica, Deogracias, and Diaz-Barriga 2000; Li, Yao, Shao, and Wu 2004; Rocha-Amador et al. 2009), and between prenatal fluoride exposure and pre-natal brain damage (Dong, Wan, Zhang, and Liu 1997; Du 1992; He, Cheng, and Liu 2008). Furthermore, a United States (US) National Institutes of Health study found no significant relationship between tooth decay and fluoride intake among children (Warren, Levy, Broffitt, Cavanaugh, Kanellis, and Weber-Gasparoni 2009).

The fluoride debate is important to New Zealand, where half of the population receives fluoridated water (ESR Water Group 2013). In two New Zealand studies (Lee and Dennison 2004; Schluter, Kanagaratnam, Durward, and Mahood 2008), fluoridated water was positively associated with better oral health for children, although Lee and Dennison found differences were greater for Maori and Pacific children and those of low socio-economic status, suggesting perhaps that better oral health practices removed some of the need for fluoridation. Fluoridation was projected to reduce dental caries by 15% in a South African study (Kroon and Van Wyk 2012). Critical thinking is therefore required to determine whether or not it is safe and beneficial to add fluoride to water supplies, and need to consider epiphenomenal factors such as the levels of fluoride already in the soil, the socio-economic status of the local population, and the use of fluoride toothpastes.

The astrology debate

Similar arguments arise over astrology. It is well known that the moon affects tides, but perhaps less well known that it also affects plant growth (e.g. Thun 1963), and that there are more accidents (Thakur and Sharma 1984) and animal emergencies (Harari 2008) at full moon. Churchill Insurance Group (2013) in the United Kingdom (UK) reports 14 per cent more vehicle accidents at full moon than at other times suggesting a relationship between full moon and being accident prone.

Introverts have been found to be more frequently born when Saturn has just risen above the horizon, and extroverts born when Mars or Jupiter has risen (Gauquelin,

Gauquelin, and Eysenck 1979). In another study, the position of the sun at birth was significantly related to sociability (Fuzeau-Braesch 2001). Such studies suggest that the position of the moon, planets, and constellations at the time of birth may affect the behaviour of people, animals, and plants, yet astrology is commonly treated as a superstition. Critical thinking is required to determine whether or not there is a basis for astrological theory, and needs to consider factors such as the effect of the light of a full-moon on animal behaviour (for example), and other time-related influences on personalities, such as generational attributes.

It does seem more common to believe a well-accepted myth than a disputed fact, and some common beliefs have no apparent foundation in fact. For example, nothing could be found to support the notion that swimming after eating is dangerous, even though this is a common belief. The penalties of placing more faith in cultural beliefs than critical thinking are severe. Despite fears of contaminated milk formula in China, only 28 per cent of Chinese mothers breast feed their babies (Pasick and Thomas 2013), even though this is a healthy and safe way to nurture and nourish a baby.

A priori reasoning

It is common to prefer evidence that reinforces current ideas and beliefs (Goldacre 2009), perhaps because so many reputable scientists (e.g. Dawkins 2008) and researchers (McCormick 2011) insist on evidential proof of phenomena. However, Kant (1781) differentiates between empirical (based on direct experience) and a priori knowledge, based on deductive reasoning, offering a valid alternative to the scientific method. In *A Critique of Reason*, he explains that a priori knowledge can be used to extrapolate from the known to the unknown, such as working out that undermining a house will cause it to collapse, even though this phenomenon has never been actually witnessed.

The contradictory content of the literature reviewed indicates that fallacious views are commonplace, and therefore, people are holding erroneous beliefs on a variety of topics. It follows therefore, that university educators may reinforce erroneous views instead of challenging them. For example, it would be unusual to include the potential influence of astrology in discussions about personalities in human resources classes, even though the literature suggests some influence is possible. Avoiding such discussions is likely to reinforce the view that astrology is a superstition, and not worthy of class debate.

This study therefore examines the formulation of beliefs and the relationship between scientific evidence and belief, so results can be used to stimulate the use and teaching of critical thinking in university tourism and hospitality programmes.

Questions arising from the review are:

- 1) Is there a relationship between the validity of an idea and what people believe in?
- 2) What informs beliefs?
- 3) How common is it to hold fallacious views?
- 4) How difficult is it to challenge the common view?
- 5) How can critical thinking be developed?

Methods

Data were collected in Findhorn, Scotland (UK), and Encinitas, California (USA). Findhorn was selected because a local community has been producing (and therefore consuming) organic food since 1994 and is reputed to have New Age (Sutcliffe 2003) and other fringe beliefs. As organic food is an alternative to standard food, but its health benefits difficult to prove, it was reasoned that those interested in organic food may also be more resistant to mainstream beliefs. Encinitas in San Diego is the location of Yogananda's Self-Realization Retreat (teaching meditation and various other yoga practices), and has numerous New Age and activities and shops in the local area, providing another ideal location for data collection. Participants with alternative ideas were specifically recruited to probe the basis of less common beliefs. It was hoped that participants would be able to justify their beliefs, and explain what it would take for them to change these, or even go public with them.

Personal contacts, snowball and convenience sampling in cafes and shops were used to recruit survey participants, some of whom continued on to an in-depth interview.

Questions

Although scientific evidence was sought on homeopathy and vitamin C prior to field work, most questions were selected because of their contentious nature, rather than because they contradicted scientific studies. Participants were asked to agree or disagree with each of the following statements, and advise which sources they trusted for information on astrology and the use of vitamin C to prevent a cold. Statements used were:

1. Plants grow better if you plant the seeds at new moon.
2. After we die, we come back to earth in a new body.
3. The mind is a bigger influence on health and sickness than anything else.
4. A homeopathic dose of Arnica can help prevent swelling if you sprain your ankle.
5. It is possible to use the mind to bend a fork (psychokinetically).
6. Aliens from other planets have landed on earth.
7. Tarot cards can be used to predict events.
8. It is possible to communicate with the spirits of the dead.
9. Vitamin C helps prevent a cold
10. Some people travel to other places out of their bodies.
11. The plastics I throw into recycling bins get recycled.
12. Aluminium causes Alzheimer's disease so aluminium-free deodorants are best.
13. Some houses have ghosts in them.
14. The position of constellations when we are born can influence our lives.

Responses were treated as ordinal data, and scored according to certainty of view, with five being given for 'agree', four for 'probably', three for 'possibly', two for 'unsure', and one for 'don't know'. As no score was given for disagree, the highest scores reflected the highest levels of certainty that a statement was true.

Participants were generally well educated (one had a PhD, five had master's degrees, seven had bachelor's degrees, and one had a professional diploma). There were nine women and six men, aged 28 to 80 years old.

Findings and discussion

This working paper presents preliminary findings from the surveys. As presented in Table 1, participants were more certain about ghosts, astrology, and out of body travel, than they were about the destiny of plastics they threw into their recycling bins. Responses indicated a weak knowledge of scientific facts, demonstrated by the poor responses on the effects of the moon on plant growth. Similarly, because nearly all the statements provoked contradictory responses, by definition, some views had to be incorrect.

The consensus on Out of Body Experiences (OBE) was a surprise finding, as was the certainty of beliefs in ghosts and astrology. Out of Body Experiences are well researched, with strong evidence of their validity (e.g. Blanke, Landis, Spinelli, and

Seeck 2004; Metzinger 2009; Monroe 1971, 1985), yet many people steadfastly refuse to believe that an OBE is possible.

Responses on therapeutic (i.e. not regular) use of vitamin C to prevent a cold were interesting. One participant was unsure, one thought it was possible, and the remaining twelve agreed that taking vitamin C can prevent a cold. Responses on the sources of their beliefs indicated that eleven participants had had the experience of taking vitamin C when they felt a cold coming on, and believed this prevented its occurrence. However, this belief is inconsistent with a large meta-analysis of scientific studies, which did not support therapeutic use of vitamin C (Hemilä and Chalker 2013) unless as a regular supplement. On this topic, participants' personal experiences were in conflict with the results of scientific research.

Score	Belief
75	Out of body travel
70	Homeopathy
70	Ghosts
70	Astrology
69	Communicating with the dead
67	Mind major influence on health
66	Psychokinesis
65	Vitamin C prevents a cold
58	Tarot cards can predict events
53	Aluminium causes Alzheimer's disease
51	Reincarnation
49	Aliens have visited Earth
43	Moon affects plant growth
39	Plastics get recycled

Table 1: Beliefs in contentious ideas

Influences on two beliefs (the efficacy of therapeutic vitamin C and the validity of astrology) revealed the importance of personal experience, reasoning, and advice from friends and family in the formulation of ideas (Table 2). Personal experience was the most trusted source of information, suggesting that unless participants could experience a phenomenon, they were reluctant to believe in it (which may explain disbelief in paranormal phenomena, which only some people experience).

Score	Belief		
	Vitamin C	Astrology	Total
Personal experience	11	10	21
Logic and reasoning	8	10	18
Friends and family	6	8	14
Books	5	8	13
Science	6	6	12
Internet	4	4	8
Teachers	1	7	8
Magazines, papers, television, DVDs	3	4	7
Professional advisor	2	1	3
Historical data	1	2	3
Personal research	3	0	3
Wisdom	1	1	2

Table 2: Influences on beliefs

Conclusions and implications

Inconsistencies within and between the data and literature review provide thought-provoking challenges, and opportunities for further study:

- 1) The relationship between scientific evidence and belief appears to be arbitrary;
- 2) Personal experience and advice from friends and family may be more influential than scientific evidence on the formulation of beliefs; and
- 3) As personal experience is a strong influence on belief, a priori reasoning is unlikely to be used, so resistance to beliefs in phenomena that cannot be experienced will be strong.

A comparative sample of sceptics and mainstream thinkers will be sought to balance the views of those with alternative beliefs, and to test the likelihood that the relationship between beliefs and scientific evidence of phenomena is weak.

Determining the basis of beliefs can help develop critical thinking in students by helping them understand the basis of ideas formed through erroneous information or poor reasoning. The over-arching purpose of this study was to encourage critical thinking for both teachers and students of hospitality and tourism programmes. The study provides useful data and evidence of the need to think critically, and examine all

available evidence before coming to a conclusion, or even just remaining open to new ideas.

Contentious topics similar to those used in this study will be given to hospitality and tourism students to research, using critical thinking to determine whether or not the statements have any basis in truth. Students will be asked to present logical and evidence-based arguments, and explain if they changed their views on any topic, and if so, why. Such an assessment precludes reliance on culturally informed ideas, requiring instead that students critically examine a range of studies before coming to a conclusion. It is hoped that grappling with beliefs that are contrary to cultural and family influences will help students understand the need to think critically.

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