



# Why People Trust Something Other than Science

## Cases of Acupuncture and Four Pillars of Destiny in Korea

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### Abstract

In modern society, people are expected to make scientific decisions and rational actions over a range of personal and social problems. There have been a number of studies on students' and adults' decision-making over socio-scientific issues under the name of scientific literacy. In this study, we investigated the social and cultural backgrounds of Korean people's actions and trust over their personal problems (e.g. health, career choice), by conducting in-depth interviews with ten Korean adults on their experience related to acupuncture and Four Pillars of Destiny (FPD), two representative examples of unorthodox sciences. The analysis of the data reveals that their actions concerning acupuncture and FPD are influenced by socio-cultural factors (esp. family culture, social system) and by their understandings of the nature of science. In addition, we found that there are a different set of reasons and varying degrees of people's trust between acupuncture and FPD. Based on the results, we discussed the needs to introduce wider concepts of the nature of science and of the scopes of science education.

## 1 Introduction

The idea that science should be our dominant source of authority about empirical matters - about matters of fact - is one that has prevailed in Western countries since the Enlightenment, but it can no longer be sustained without an argument. *Should*

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we trust science? If so, on what grounds and to what extent? What is the appropriate basis for trust in science, if any? (Oreskes, 2019, p.15)

Issues of modern society are often, in their nature, scientific because to understand and find the solutions of them require substantial scientific data, knowledge and reasoning. Big issues, such as climate change, air pollution, nuclear plants, renewable energy, micro-plastic wastes and COVID-19 are just few examples of them. For the past four decades, dealing with these issues in relation to science education has been echoed under the name of STS(E) (science, technology and society (environment)) (e.g. Ziman, 1980; Solomon, 1993; Solomon & Aikenhead, 1994; Yager, 1996) and SSI (socio-scientific issues) education across the world (e.g. Sadler, 2009, 2011; Bencze et al., 2020). These issues have been caused by human civilization and are being accelerated by modern sciences and technologies. To find the solutions, serious scientific investigations, decision-making and actions are required. Thus, it is important to listen to what scientists and their investigations claim (Oreskes, 2019).

People are also often expected to be scientific in order to make appropriate decisions for issues related to personal routine (such as what, when and how to do something, eat, travel and buy). These personal issues may also relate to health (e.g. vaccination, therapy, nutritional supplements), safety (e.g. driving, travel, information security) and life (e.g. education, job, business). To avoid ill-informed and inefficient decision-making, people need to take “the scientific” approach, despite that many other important personal issues are not to do with science. The remaining question is, what is meant by “the scientific” (e.g. Bingle & Gaskell, 1994; Alters, 1997; Holbrook & Rannikmae, 2007)?

“To-be-scientific” is at the core of scientific literacy, which has long been the ultimate goal of school science education. For instance, the *National Science Education Standards (NSES)* (NRC, 1996) of the USA, in relation to the goals of science education, claimed that “Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. ... A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it” (p. 22). Based on a historical review on the meanings of scientific literacy from the 1950s to 1990s, DeBoer (2000) summarized nine goals of science teaching, and among them included “Teaching students to be informed citizens” and “Preparing citizens who are sympathetic to science”. Despite its diverse and continuously changing meanings, the concept of scientific literacy has been also regarded as a core of science for adults, i.e. citizen science and the public understanding/awareness/participation of science (e.g. Irwin, 1995; Popli, 1999; Laugksch, 2000; Miller, 2001). Science-related data processing and decision-making have been regarded as essential components of school science education. For example, the NSES identified four major goals for science education, among which the second goal was to “use appropriate scientific processes and principles in making personal decisions” and the third goal was to “engage intelligently in public discourse and debate about matters of scientific and technological concerns” (recited in Yager, 2000, pp. 327–328). Meanwhile, in relation to scientific literacy, there has been a series of arguments concerning the different visions on science education. While Vision I refers to the products and processes of science itself, Vision II is concerned with science-related situations that students are likely to encounter as citizens (Roberts, 2007; Haglund & Hultén, 2017). According to Aikenhead (2007), while Vision I aims to enculturate students into a scientific discipline, Vision II aims to enculturate students into their local, national and global communities. On top of these, he claimed another one, the Vision III, for less Eurocentric and more pluralistic perspectives in science education, by raising a fundamental question

“Which science should be drawn upon in school science to make sense of human situations or events related to understanding natural phenomena?” (p. 68). Thus, it can be said that “to-be-scientific” towards the issues mentioned above is more to do with Vision II.

The idea of Vision II is also well reflected in the recent conceptual framework of Korean science education known as KSES (Korean Science Education Standards for the Next Generation), in which a new model of scientific literacy, ToSL (Tree of Science Literacy), has been proposed (Song et al., 2018; Kim & Song, 2019). Under its mission of fostering “creative and cooperative people equipped with scientific literacy”, KSES defines scientific literacy as “the attitudes and abilities as democratic citizens to participate in and act for solving personal as well as social problems using science-related competencies and knowledge” (Song et al., 2018, p.73). The ToSL model consists of three interwoven and mutually complementary dimensions (i.e. competence, knowledge and participation and action). In this model, “scientific thinking” and “information processing and decision-making” are included as two of the five areas of the competence dimension; “science and society” and “science and technology for a sustainable society” are included as two of the six areas of the knowledge dimension, and “enjoying scientific culture” is included as one of the five areas in the participation and action dimension. In KSES, special attention is given to the concepts of science education for “participation and action” and “lifelong learning”. We believe that these are linked with the ideas of Vision II as well as those of “to-be-scientific”.

In their study to set rational goals for science education, Longbottom and Butler (1999) raised the question of “what sort of science education should we have and what should its goals be?” (p.486) and argued that we should reject both positivism (e.g. scientific claims based on empirical data cannot be false) and postmodernist positions (e.g. science is simply a social construct). Responding to the question, they proposed the three aims of science education, as “rational” goals as they claim: (1) “children should understand that scientists are successful in developing understanding of the world even though they do not have a fail-safe method, but that science is fallible”; (2) “children should acknowledge scientific knowledge as the best we have, and therefore accept that it is rational to trust in expert knowledge”; (3) “children should adopt many of the critical and creative attributes of scientists” (pp.486–487).

When people are expected to make scientific decisions and actions, they often recourse to something other than science. It is widely known that many do not trust scientific claims and sometimes even rely heavily on pseudo-scientific or anti-scientific claims (e.g. Lewandowsky & Oberauer, 2016; Lobato & Zimmerman, 2018). Despite the exclusive status and authority of science, even data and empirical matters are questioned by people (Oreskes, 2019), and people’s understanding of science is constantly influenced by the worldview and culture to which the people belong (e.g. Aikenhead & Jedge, 1999). This is a rather common phenomenon across the world, and Korean society is not an exception. Then, why do people not trust science and rely on something else?

In the Korean tradition and culture, there have been various forms of unorthodox science (that is to be introduced later in this paper) which are still commonly practiced as popular social activities. They cannot be easily judged by the dichotomous demarcation of traditional philosophy of science (science vs. non-science), because they are different to a varying degree in terms of their worldviews, explanation systems and methods of accumulating and verifying knowledge. Considering the socio-cultural context of Korea, the traditional demarcation as well as post-modern approaches denying the demarcation are both de-contextualized approaches. Unfortunately, there have been little in-depth studies, based

on empirical evidence, showing why and how Korean people tend to trust alternatives to science in their everyday life.

We use the term “unorthodox sciences” to refer to science-related practices that do not pertain to well-established mainstream sciences. Unorthodox sciences can be either pseudoscience or fringe science. Pseudoscience refers to something that is not science but is inappropriately characterized or perceived as science. Fringe science refers to something that is an established field of study but departs significantly from mainstream sciences. We selected acupuncture and the Four Pillars of Destiny (*Saju* in Korean, hereafter FPD), which are both heavily based on the ideology of Feng Shui, as examples representing fringe science and pseudoscience respectively (Matthews, 2019).

Thus, in this study, we conducted a qualitative study based on in-depth interviews with adults who have had personal experiences of acupuncture and FPD. We asked them why and how they first experienced and formulated trust on acupuncture and FPD. By analysing the data, we attempted to identify the cultural factors and the kinds of personal experiences that impacted their trust towards acupuncture and FPD and examine if there are different levels and reasons of trust towards acupuncture and FPD.

## 2 Research Backgrounds

### 2.1 Trust, Science and Pseudoscience

What is trust? What does it mean “to put trust in science”? Sztompka (1999) argued that trust is an action of “bet[ting] about the future, contingent actions of others” (p. 25). Trust is basically of twofolds: that of the object and that of the content. That is, when we trust something, we trust somebody’s certain action and thus the logic of trust would be “A trust B to do X” (Hardin, 2002: 9, recited from Sztompka, 2007). The issue of “science and trust” has been occasionally studied in science studies and science education (e.g. Kolstø, 2001; Carolan, 2006; Carlisle et al., 2010; Whyte & Crease, 2010; Achterberg et al., 2017). For example, Carlisle et al. (2010) conducted a study with a similar idea. To understand the psychology on competing claims, they tested the influence of the credibility of sources of the claims and the content of the claims (or simply source credibility hypothesis and content hypothesis). The source credibility hypothesis suggests that people tend to place heavier trust on the claims made by experts representing organizations that they normally agree to than those made by experts representing organizations that they do not. The content hypothesis describes that people have a higher tendency to accept claims which support their existing views (like core values or prior beliefs) than claims which do not. For the case of offshore oil drilling in California, the participants confirmed the content hypothesis instead of the source credibility hypothesis. The source of the claims did not appear to have significance over people’s trust towards the claims.

Other studies have argued that the attitudes of the general public towards science in particular (i.e. controversial scientific research) should be distinguished from that of science in general (i.e. science in abstract) (e.g. Michael, 1992; Bak, 2001). While people tend to consider science-in-general to be black boxed, objective and disconnected to themselves, people treat science-in-particular as a part of a society and may form strong connections to their own lives. Thus, their attitudes towards science-in-particular are likely to be less affected by the years of schooling and the levels of scientific knowledge

than their attitudes towards science-in-general (e.g. Bak, 2001). Meanwhile, Sztompka (2007) argued that when we consider science as an object of trust, there are four different aspects of science to be trusted including scientific knowledge, scientific method, actions of researchers and the scientific community.

The demarcation problem between science and non-science has long been central to the philosophy of science. Throughout history, there have been rise and fall of theories and models attempting to answer this problem, and these include David Hume's empiricism based on human sensory experience, Ernst Mach's philosophical phenomenology, Karl Popper's falsificationism, Quine's naturalism, Thomas Kuhn's theory of scientific revolution, Imre Lakatos' model of research programmes, Larry Laudan's model of research tradition, Paul Feyerabend's epistemological anarchism and Edinburgh School's strong programme. The criteria and beliefs on demarcation, which once were strengthened through logical positivism, have been weakened by constructivism and postmodernism. However, it still remains the central issue in the debate of science vs. pseudoscience (e.g. Matthews, 2019; Hansson, 2009; Bunge, 1991).

For this ongoing debate, several promising positions have been proposed. Carl Hempel proposed a list of seven conditions for a good scientific theory, and these are precise, preferably quantitative, predictions; testable consequences and good agreement with experimental tests; consistency with currently accepted theories; broad scope; prediction of novel phenomena; simplicity; fruitfulness (Hempel, 1983; recited from Matthews, 2019, p. 274). Bunge (2001) suggested ten features of a mature science, which includes a community of trained inquirers; philosophical background supporting the free search for truth; real events and processes as the domain of investigation; formal background with current best logical and mathematical theories; specific background with up-to-date and well-confirmed data, hypotheses and theories; being a quest for laws; knowledge fund with up-to-date and testable theories, hypotheses and data; aims or goals of the discovery of laws or confirmed hypotheses; methods with scrutable, checkable and justifiable procedures and significant overlap with other scientific fields of inquiry (Bunge, 2001, pp. 170–171; recited from Matthews, 2019, pp. 278–279).

Pseudoscience is criticized for lacking the above conditions and features. Some scholars argue that pseudoscience, in general, has its own distinctive characteristics. For example, Kim (2004) said that pseudoscience does not allow the possibility of falsification and does not admit human errors and incompleteness, while not admitting this nature of science but trying to use scientific methods and claims. Hansson (2009; recited from Matthews, 2019, p. 279) provided a list of characteristics of pseudoscientific belief and practice, and these characteristics are overdependence on authority figures; unrepeatable experiments; data selectivity or cherry-picking of evidence; unwillingness to seriously test claims and predictions; confirmation bias and no seeking of disconfirmation and explanation changes without systematic consideration.

On the other hand, Hecht (2018) claimed that, like science, "pseudoscientific beliefs are always as random or indefensible as they might seem ...[and] if pseudoscience is a historically contingent phenomenon, then so is science itself" (p. 4). Hecht argued that the histories of science and pseudoscience are not only inseparable but also often strongly bound together, as shown in the cases of alchemy, physiognomy and evolutionary psychology. From the two generations of science studies, there is no timeless agreement that defines the scientific enterprise, and thus, the demarcation of pseudoscience from science is not easy. Nonetheless, unlike scientific ideas which are mostly communicated within the professional scientific community and via formal science education and informal media, non-scientific and pseudoscientific ideas are communicated through media and informal sources,

such as family members, friends and social media (e.g. Lobato & Zimmerman, 2018). Therefore, this makes pseudoscience cultural and social to the point that it is difficult to be changed.

Acupuncture and FPD, the two topics of this study, are typical examples of which are frequently considered to be pseudoscientific. Despite much debate over the effectiveness of acupuncture (e.g. Matthews, 2019), there have been only a few in-depth studies which investigated people's experience and attitudes towards acupuncture in Korea and across the world (e.g. Beinfeld & Korngold, 1991; Lee & Park, 2000). The situation is similar for FPD. The experience and attitudes towards FPD of Koreans have been often studied but only through the method of survey (e.g. Kim, 2005; Park, 2014).

## 2.2 Cultural Backgrounds of Acupuncture and Four Pillars of Destiny (FPD) in Korea

Both acupuncture and FPD are strongly based on the idea of “Yin-Yang and Five Elements”, which has been a part of the East Asian view of life, nature and the world. Originating from ancient China at least 3000 years ago, this idea has been engrained in the traditional cultures of East Asia, including Korea and Japan. One of the most representative examples of this cultural embeddedness in Korea is the national flag of South Korea, *Taegeukgi* (pronounced the-guk-key).

The elements of the flag symbolize the dual forces of nature. The red and blue circle in the middle of the flag is called *taegeuk* in Korean (t'ai chi in Chinese) ... The circle is divided into two parts ... The upper, red part represents the forces of yang (yang in Chinese as well), and the lower, blue part represents the forces of um (yin in Chinese) (<https://asiasociety.org/education/taegeuk>).

Since acupuncture and FPD have been very popular among the general public in Korean society, numerous books and articles have been published for the general readers. However, these books and articles usually serve introductory purposes for lay people and are hardly academic or scholastic. Hence, in this section, we provide the historical and cultural backgrounds of acupuncture and FPD in Korean society based on a brief literature review on related research papers and academic writings from the RISS (Research Information Sharing Service) (<http://www.riss.kr/index.do>) system that is run by KERIS (Korea Education and Research Information Service). Our review was tightly limited to the history, philosophy and cultural backgrounds of, the people's attitudes and activities towards, and the arguments concerning the scientific nature of acupuncture and FPD.

### 2.2.1 Acupuncture

There are myriads of traditional medicines around the world. These medicines have been developed in and thus reflect the socio-cultural contexts and environment of the originating countries. Some are still being actively practiced and recognized as clinical treatments (Kang et al., 2009). In Korea, the traditional Korean medicine (hereafter TKM) has long been in place as its traditional medicine. TKM is known to be first developed during the Gojoseon Kingdom period, which lasted until BC 108, and was practiced in the forms of acupuncture and herbal therapy. Then, TKM underwent a gradual development through active interactions with China throughout the Three Kingdoms and Koryo Dynasty periods (BC 1C–AD 14C). During the Chosun Dynasty (1392–1910), TKM branched out into an independent medicine system, distinct from Chinese medicine. This was largely made

possible by two important developments: the publication of “Donguibogam” (translated *Principles and Practice of Eastern Medicine*) in 1610 and the development of the theory of “Sasang Constitutional Medicine” in 1894 (The Association of Korean Medicine, 2020).

The basic framework of TKM can be summarized with its three methods: herbal therapy, mind-body training and body surface stimulation therapy (Jeon, 2004). Acupuncture is a kind of body surface stimulation therapy, which involves penetrating thin and solid metal needles (often with electric stimulation) into the hands, feet and skin of other parts of the body (Choi et al., 2010; NIH, 2020; MedlinePlus, 2020). Acupuncture has been regarded as an important and effective treatment with faster effects than herbal treatment (Bak, 2008). The tradition of Korean acupuncture has a long history dating back to ancient times. During the Chosun Dynasty, there were training and qualification systems for practitioners of acupuncture, separate from those of general TKM doctors (Bak, 2008). Traditional acupuncture embodies the Yin and Yang theory, which is the essential foundation of East Asian ideas (Chang et al., 2016).

Nowadays, acupuncture is also used widely in Western countries like the USA, the UK, Germany and Australia (Choi et al., 2010). However, there is a clear difference between Korea and those countries in terms of the legal status of who can practice acupuncture. While Eastern medicine, including acupuncture, in the West usually holds the status of alternative medicine, TKM in Korea shares the legal status of conventional medicine with Western medicine (Bae, 2004). In Korea, acupuncture is to be practiced only by qualified TKM doctors who have completed six years of undergraduate or three years of graduate studies at TKM medical schools and have passed the national examination for TKM doctors. At present, there are eleven undergraduate and one graduate TKM medical schools in Korea (The Association of Korean Medicine, 2020).

Currently, acupuncture and TKM are practiced at university TKM hospitals and private (large and small) clinics. TKM treatments have been officially supported by the Korean National Health Service since 1987. Acupuncture and TKM are now generally practiced in substantial collaboration with Western medicine, and there are many special hospitals specialized in coordinating TKM and Western medicine under legal support (Korea Ministry of Government Legislation, 2020). Furthermore, there have also been some recent developments in introducing acupuncture into veterinary medicine (Nam et al., 1992).

With this social background, TKM, including acupuncture, is believed to be an independent discipline with equal levels of education and professional training as Western medicine. According to a survey of the use and consumption of TKM services, 73.8% of people experienced TKM once or more during their lifetime. Women and older people use TKM more frequently, and the most popular TKM treatment is acupuncture (NIKOM, 2018). The academic foundation of TKM and acupuncture is also quite secure. For example, the *Journal of Acupuncture Research* is a professional journal that publishes the results of clinical observations and treatments in the form of research papers, and the Korea Institute of Oriental Medicine is a governmental research institute that carries out various research and patent activities on TKM drug tests, health diagnosis and experimental methods (Jin & Lee, 2012; Korea Institute of Oriental Medicine, 2002).

## 2.2.2 Four Pillars of Destiny

Being one of many fortune-telling methods in East Asia, FPD refers to a traditional way of predicting an individual’s fate and future based on birth year, month, day and hour. The term is used interchangeably with Four Pillars of Eight Characters and Four Pillars

of Ming-Li. The idea of FPD dates back to the Han Dynasty and had evolved throughout the Tang and Song Dynasties of China. Around early 10C, this idea was imported into the Koryo Dynasty of Korea. From the mid-10C when the national examination for civil service was initiated, the field of fortune-telling was included into the examination to select and train professionals. The idea of FPD soon became popular among the scholar-gentry class. From 15C, during the Chosun Dynasty, the knowledge of FPD was tested and instructed through a more systematic way for the civil service examination under the name of Yin and Yang Area and was consumed by the middle-class people (Kim, 2010; Park, 2014).

In the Korean traditional culture, there have been three different kinds of divination bliss: shamanism, Ming-Li and Feng Shui. The first two and their variations are more basic and have made significant influences on the lives and values of people (Hwang, 2017). Among the two, Ming-Li is the theoretical and philosophical basis of the practice of FPD. Throughout the history of Korea, FPD has largely been one of the “basic but marginal” cultures. After a popular tabloid, the “Daily Sports”, first included FPD as one of its regular corners in 1973, FPD as well as general fortune-telling activities became one of Korea’s popular cultures, and this process was accelerated by the expansiveness of recent ICT and internet technologies (Hwang, 2017). In her meta-analysis study on one thousand dissertations, journal articles and books, Hwang (2017) found that while literature published until the 1990s were either on the theoretical basis or educational materials of FPD, those after the year 2000 were more academic oriented and often cross-disciplinary with other disciplines like TKM, counselling, MBTI, politics and history.

A Korean FPD expert, Professor D. G. Kim, claimed in his interview with one of the major newspapers in Korea that FPD is an established discipline and that, by informing a person about his or her misfortunes, FPD provides him or her the opportunity to self endeavour and compensate for those misfortunes. Kim further stated that “FPD is a way of objectifying oneself,” and “[it] becomes the last oracle when someone has to make the final decision but with little self-confidence to execute his/her already made decision” (from *JoongAng Sunday*, May 9–10, 2020). For many Koreans, FPD has a two-sided character. It is something fateful to be followed and, at the same time, something to be overcome. The discourse upon FPD in Korea has evolved along the two paths of “fate vs. will” and “science vs. pseudoscience”, reflecting the feelings of duality in the minds of Koreans (Kim, 2013).

Despite its long history as a popular practice, scholarly studies of FPD were scarce until the 1990s in Korea. Common topics of recent studies on FPD cover its history (Kim, 2010; Hwang, 2017), philosophical nature (Lee, 2006; Kim, 2013, 2015; Hwang, 2017), scientific aspects (Jang, 1999; Jang et al., 2006), pseudoscientific aspects (Kim, 2004) and peoples’ views (Kim et al., 2008; Hong & Woo, 2009; Kim & Baek, 2010; Kang, 2013; Park, 2014).

There is only a small number of studies that critically examined the scientific nature of FPD. However, few empirical studies have investigated people’s activities, attitudes and perceptions related to FPD, mostly through the method of survey. For example, from a survey study conducted on over 212 adults (ranging in the twenties to fifties), Kim and Baek (2010) found that 45.3% had one to three times, 13.7% had four to nine times and 41% had no experience in FPD. They also found no significant difference in people’s experience of FPD in terms of their various psychological aspects (field dependency vs. field independency, positive vs. negative problem orientation, rational/impulsive/aversive decision-making).

In a survey study investigating the views of science teachers and secondary students on six kinds of pseudoscience (including fortune and fate, parapsychology, spiritual



beings, alternative medicine, UFO and mystery and creationism), Kang (2013) asked the participants to express their degree of agreement to the expression of “we can know a person’s fate if we know his or her birth year, month, day and time”. Although the mean score (2.18 out of 1 to 5 response range) was one of the lowest among 30 items, there appeared to be some noticeable differences among the sub-groups. Among the students, girls (2.38) and high school students (2.25) scored higher than boys (1.98) and middle school students (2.01). Among the science teachers, female teachers (2.42) scored higher than male teachers (1.84). It can be interpreted that there is an overall tendency of females being less opposed to FPD than males.

However, some other studies show much higher engagement of Korean people in FPD. Park (2014) gathered the opinions of Korean adults and the contributing factors of FPD by conducting self-administered surveys through home visits followed by one-to-one interview with 270 adults in Busan city. The survey results can be summarized as follows: (a) nearly 90% of the participants had the experience of FPD once (47.4%) or more (41.5%); (b) nearly 90% responded that they trust FPD (slightly 63.7%, modestly 18.1% or strongly 6.7%); (c) there was no gender difference in their opinions on FPD; (d) the participants appeared to agree strongly with the scientific and academic values and accuracy of FPD (i.e. 4.5 out of 5 points). Although the generalizability of the results is questionable, this study illustrated how significant and wide-ranged the influence of FPD is over the lifestyles and everyday activities of Koreans. However, there has been no study answering why and how the Koreans arrived at such perceptions.

### 3 Research Methods

#### 3.1 Research Participants

To explore why Korean trust acupuncture and FPD, this study conducted semi-structured, in-depth interviews with ten adults who participated in this study voluntarily. The selection of the participants was made by adapting the criterion sampling method in purposive sample methods (Patton, 2014). The criteria of participant selection were as follows. Firstly, we selected Koreans who had experiences with acupuncture treatment as well as FPD. Secondly, to derive implications to science education, we limited the participants to those who received primary and secondary school education in Korea. In addition, all participants had at least a university level of education. Thirdly, to have an evenly distributed participant group, we selected five people with degrees from humanity or social science and five with degrees from science or engineering for undergraduate studies. Their final academic degrees stretched from bachelor to doctoral degrees. Fourthly, we selected participants who are in their thirties or older to ensure that they have sufficient experience of acupuncture and FPD based on their own knowledge and decisions. Fifthly, we attempted to achieve an evenly distributed participant group in terms of gender, where one grew up and age. Lastly, in order to have different voices on acupuncture and FPD, we selected participants with varying degrees of experience on acupuncture and FPD. To check their degree of experience, we asked them and their surrounding people how they used to respond and react to acupuncture and FPD. Table 1 displays the background information of the participants.

**Table 1** Background information of participants

Participants	Gender	Age	University major	Degree	Growing up area
A	Female	Early 30s	Science & Engineering	Master	Small or medium city
B	Male	Late 30s	Science & Engineering	PhD candidate	Metropolis
C	Female	Early 40s	Humanity & Social Science	Bachelor	Small or medium city
D	Female	Mid 40s	Humanity & Social Science	Bachelor	Metropolis
E	Male	Late 40s	Science & Engineering	PhD	Small or medium city
F	Male	Late 40s	Science & Engineering	PhD	Metropolis
G	Male	Early 50s	Humanity & Social Science	PhD	Small or medium city
H	Female	Early 40s	Humanity & Social Science	PhD candidate	Metropolis
J	Female	Early 50s	Science & Engineering	PhD	Metropolis
K	Female	Early 30s	Humanity & Social Science	Master candidate	Small or medium city

### 3.2 Data Collection and Analyses

The interviews were conducted in the form of one-to-one conversation by two of the authors between September to November 2020, except for the first interview. The first interview was conducted by the two interviewers together in order to assure a consistent way of conducting interviews. The remaining interviews were performed by one of the two interviewers. While most interviews were face-to-face, some interviews had to be done via Zoom application due to COVID 19. For additional information and communication with the interviewees, mobile messenger and smartphone texting were also used.

The interviews lasted until they repeated what they have already said. The interviews were conducted at least twice for each participant. While the first interviews lasted on average one hour (precisely ranging from 26 to 112 min), the second was only half an hour on average (precisely ranging from 7 to 64 min). An additional third round of interviews was conducted with two participants (for 19 and 23 min each). The second and third interviews served to clarify and attain additional information on their prior responses, and there were 2 to 3 weeks of the interval between consecutive interviews. All the interviews were either video-recorded or audio-recorded. The participants were asked a set of questions concerning their experiences and opinions towards acupuncture and/or FDP. The interview questions were developed, firstly by suggesting potential questions necessary to pursue the research aims by two of the researchers and secondly by extracting essential questions from them which were considered appropriate through collective discussion between all three researchers. The questions were then revised carefully for depth and clarity. The interview questions were finalized based on the concepts of six types (i.e. experience/behaviour, opinion/value, emotion, knowledge, sense and background) and three time (i.e. past, present and future) by Patton (2014). Since the interviews were semi-structured, some additional questions were given to further elicit the ideas and experience of the participants. The questions are as follows:

- When did you have the first experience?
- Is there any special reason for having the first experience?
- What was your feeling after having the first experience?
- Is there any reason for you to trust (or not to trust) it?
- Do you recommend it to other people?

- Do you think if it is scientific? Why do you think so?
- What would be the difference between science and non-science?
- What do you think science is?
- Do you think that we need to teach about science and pseudoscience?

All interviews were fully transcribed and then analysed through the constant comparison method (Strauss & Corbin, 1990). One interviewer read a portion of transcriptions, extracted the key contents from the conversation and performed an open coding. Afterwards, the other interviewer repeated the same procedures independently for 10% of that portion to confirm a 96% correspondence between the analyses of the two interviewers. When disagreements were found between the analyses of the two interviewers, further discussions and a repeated open coding were conducted until the interviewers arrived at a consensus. Then, the data from the open coding were grouped, and the categories were named.

In this study, based on the contents of the interviews, we classified the degree of participants’ trust into five stages using the inductive method. First, each of the two researchers extracted related behaviours through the method of constant comparison, then identified the most active one among his or her current behaviours and determined its degree and stage. After that, the results of the analyses by the two researchers were compared. Figure 1 shows an example of this analysis.

In order to verify the interpretations of the interviewers, the interviewers described their understandings to the interviewees to receive confirmation. Furthermore, after the analysis of the interview data, we had the third round of interviews with two participants to see if the results of the analysis were correct for member checking (Hollway & Jefferson, 2000; Glesne, 2006). Member checking was conducted to ensure that the categories derived from data analysis and the results extracted from categorisation well reflected the opinions from the participants (Lincoln & Guba, 1985).

Interview extracts	Coding	Degree of Trust
G: Um, I think I recovered very soon after having acupuncture. When I had the needle penetrating my skin, it was hurting and thus I was afraid of, but after the treatment my sprained ankle gradually subsided and recovered. <u>Ah... then I realized that acupuncture is effective.</u>	⇒	5 Stages (in terms of how much they trust and recommend to others acupuncture)
I: After that experience, have you had another acupuncture treatment by yourself? Or you have not?		
G: Well, <u>after that</u> , when I had some problems with my joints and muscles, <u>I often had acupuncture treatment.</u>	⇒	
I: Do you recommend acupuncture to others? If so, why?		
G: In cases of muscle ache, nerve disease, and sprain, <u>I recommend them to have acupuncture, because its effect is instant and prompt.</u>	⇒	

Fig. 1 An example of data coding and analysis (acupuncture)

## 4 Research Results

In this section, we will describe the experiences of our ten participants with acupuncture and FPD and the degree to which and why they trust them.

### 4.1 Acupuncture

First, we will look into the participants' first experience of acupuncture. The first experiences were either in the teens (middle school years) or the twenties (university years), as shown in Table 2. According to a survey on the use and consumption of TKM treatment and herbal medicine in 2017 (NIKOM, 2018), the most common symptom or illness was backache (52.7%) followed by sprain (37.3%). The participants of this research also visited TKM clinics to receive acupuncture for musculoskeletal system problems (i.e. sprain and backache).

G: My first experience [of having acupuncture treatment] was during middle school years. When I was having an exercise, I had my ankle sprained.

I: At that time, did *you* decide to receive the treatment by yourself? Or did somebody recommend it to you? What made you to do so?

G: Because I was a middle school student... my parents took me there. They told me that acupuncture is effective on sprained ankles.

Their decisions over the first experience of acupuncture at TKM clinics were greatly influenced by their parents. Six participants (A, B, E, G, H and I) said that they had their first acupuncture treatments after their parents' suggestions. For instance, one participant recollected that she was scared of acupuncture but was forced by her family members to go to the clinic.

J: Grandma. Grandma and mum together took me there, I think. Umm... They were saying that having acupuncture is better than having surgery using knives,. I was so young, and they took me and I just followed them.

I: At that time, didn't you have any negative feelings?

J: Of course. It was scary. I was scared.

I: Did you think it would hurt you?

J: I was scared because it would hurt me.

Although participants C and D went to TKM clinics at their will for acupuncture treatments, they could not recall exactly from whom they heard that acupuncture is effective for their symptoms relating to the musculoskeletal system and why they chose to do so. Participant K also chose acupuncture treatment after reading stories of people's improvements from online communities.

K: ... I was just looking for this and that... and there were 'Mum-cafes.' For example, if you go to Mum's-Holic Café, you can find people who had improvement from it [acupuncture]. Then... you hear stories like that, after having the treatment, you can go to work without pain for some days. I think I was trying to hang around there, at a mum-café.

**Table 2** Participants' first experiences of acupuncture

Participants	A	B	C	D	E	F	G	H	J	K
When?	In 10s	In 20s	In 10s	In 20s	In 10s	In 10s	In 10s	In 20s	In 10s	In 20s
For what symptom?	Sprain*	Sprain	Sprain	Sprain	Sprain	Sprain	Sprain	Circulatory system	Sprain	Morning sickness
Whose decision?	Parent	Parent	Self	Self	Parent	Self	Parent	Parent	Parent	Self
Effective?	No	Yes	Yes	Yes	Uncertain	Yes	Yes	Yes	Yes	Yes

\*Sprain: sprain, backache, etc.

In other words, the participants' first experiences of acupuncture treatments were influenced by the words of surrounding people, especially from those of their family members, because they were young and therefore had parental control over their decisions.

Based on Table 2, excluding participants A and E, the rest reported alleviations of symptoms, and this led them to trust acupuncture and continuing the use of it. The changes in the degree of trust towards acupuncture are presented in Table 3.

The degree of trust towards acupuncture can be classified into five stages from stage 1 to stage 5 in ascending order. Stage 1 (no trust) is the stage in which, despite some experiences of acupuncture, participants do not trust it and often have negative perceptions towards it. They are reluctant to receiving acupuncture. Stage 2 (voluntary participation) is the stage in which they by themselves willingly have acupuncture treatments when they undergo symptoms. Stage 3 (behavioural change) is the stage in which they themselves receive the treatment and also recommend it to others. Stage 4 (active practice) is the stage in which they personally perform some light treatments, such as pricking thumbs to release impure blood for relieving upset stomachs or purchasing acupuncture instruments for home remedies. The final stage 5 (semi-professional) is the stage in which they seriously study the field (such as Korean hand acupuncture, acupuncture points) and frequently put it into practice. As shown in Table 3, except for participant A, all demonstrated some trust towards acupuncture but at varying degrees.

K: When having upset stomach, my husband pricks my hands and my daughter's hands. Then, it has effects. I feel that my stomach becomes smooth and easy.

I: Don't you do that yourself?

K: I can't. I cannot sting and thus cannot prick hands.

I: Have you ever studied Korean hand acupuncture? or do you do the action of pressing the acupuncture points?

K: No, I did not do myself, but we always prepare the needles or ballpoint pens for impure bleeding treatment. Sometimes we purchase them on purpose. We often press our hands hard.

The degree of trust towards acupuncture increased and remained high after the first experience for participants G and K and remained high from the beginning for participant H. In contrast, for participant F, the degree of trust increased after the first experience but gradually decreased as his experience accumulated and later realized the limitations of TKM doctors. While participant J's degree of trust is on the rise, participant A's degree of trust remained low even after her first experience. From these, we know

**Table 3** The degree and change of participants' trust towards acupuncture

Participants		A	B	C	D	E	F	G	H	J	K
Degree of Trust (Stage)		1	3	2	4	4	5	5	5	3	4
Change in Degree of Trust											
Scope of Trust	Theory	×	×	○	○	×	○	○	○	○	○
	Symptom Improvement	×	○	○	○	×	×	○	○	○	○

that the first experience (voluntary or not) of acupuncture treatments impacts the trust towards it.

G: When I was in middle school, my friend's thumb was badly sprained and swollen so we went to a TKM clinic together. I have that memory. The pain of his finger decreased quite a lot and he could move his finger. I guess that this served as a momentum of my trust. After that, when in university, I had a sprained leg and went to a TKM clinic for acupuncture treatment. The result was fast and effective, ever since that my trust towards acupuncture remains high.

H: It was even before the first treatment, and my trust sustained after the treatment.

F: I was positive, so I went to TKM clinic for my shoulder pain. It was nonsense. They asked me to have restorative herb medicine. Reasonably thinking, it was so absurd. I had similar experience several times.

To determine whether their trust towards acupuncture stems from its treatment effects or its basis principle, we asked the participants on which aspects of acupuncture they trust. The data reveals that its treatment effects and its theoretical basis were each supported by seven of the ten participants. Thus, it was found that the basis of their trust is Eastern ideology (Ki, Yin & Yang, Five Elements, etc.) itself on which acupuncture is based. However, participant E claimed that, although he did not believe that his relief of symptoms is due to the treatment itself or the theoretical basis of acupuncture, he considered the treatment as effective for the psychological effect, such as emotional stability, which was provided by TKM and acupuncture.

We asked the participants whether or not they had conflicts in choosing between TKM or WM when they experienced health symptoms. Surprisingly, all declared that they had no conflict and appeared to have their own decision criteria, including the participants with science and engineering backgrounds (A, B, E, F and J). Participants were not concerned about whether or not TKM is scientific and its basis theory has been verified. They responded that TKM and WM have different sets of strengths and weaknesses, thus chose accordingly. They believe that TKM has a strength in treating musculoskeletal system disorders and searching for the fundamental causes of diseases, while WM has a strength in examining the internal parts of the body and providing direct treatments towards disease symptoms.

G: Well... as getting old, I generally realized that while WM is better for certain symptoms, TKM medicine is better for others. Gradually I got my own criterion for this matter.

E: Yes, I think that TKM medicine surely has its own limits and WM do so too. Just like that science does not know everything about the nature, [Western] medicine does not understand all of our body, I think. ... In our present paradigm, WM is more verified scientifically, but not-verified yet areas can be better covered by the other [TKM]... I hope more research to be done in that direction.

Some participants were convinced that WM and TKM conduct research in the same manner, and this was also demonstrated by participants with science and engineering backgrounds.

H: Basically, I think that WM and TKM hospitals are the same because they are equally scientific.

H: so, that's ... if they use drug chemically or do surgery for treatment. I think it's same to TKM. What kinds of herbal medicine, what kinds of needles to which points, and

then checking how much the symptom improved... I guess there must have been lots of cases and clinical treatments. Thus I think they [WM and TKM] are not different each other.

J: Really, why TKM is unscientific? ... It's not trivial. Although I do not know how it developed, I just think that it is based on anatomy. Thus, the way they [WM and TKM] do is different, but both of them are science.

Whether or not the participants regarded acupuncture to be scientific is shown in Table 4. Seven of the ten participants thought that acupuncture also belonged to science, among which two are of science-engineering backgrounds.

G: Um... I think acupuncture is scientific.

I: Why do you think it's scientific?

G: It's because to be scientific means ... when there is a cause, if there is a result after having some treatments, it can be considered scientific. If an illness is cured after treatments and if that happens repeatedly and is accumulated, not by accident, at large it can be called science. ... Because this happens repeatedly... in that sense, it's scientific. I think like that.

The two participants with science-engineering backgrounds thought that acupuncture belongs to science because it also adopts scientific methods or methods similar to those of WM.

J: That is too a theory. If you think how a theory is made scientifically, although I cannot remember the book, after observations a theory is made somehow... I think it [acupuncture] is not different from modern sciences which are made in such a way.

B: I think that [Western] medicine is also similar. Don't you think that medicine has been developed in such a way? Just like that medicine has found methods [solutions] after trying this and that, acupuncture and TKM are also something that people tried repeatedly from the past. I think they are similar.

The participants were asked "what is science?" Participant B said that science is something of doing experiments and of summarizing and interpreting the data and results of the experiment. For participant J, science is something that has empirical data and can induce a law out of the data, while non-science is something that is based on simple beliefs, faith and authority. Participants D, H and K also emphasized the process of the inductive proof through empirical data, and participants C, G and K considered science as something that can explain causal relationships. In other words, they thought that acupuncture is similar to science because it also shares these features with science.

J: I think... non-science is something like simple belief or faith or relying on somebody's name. On the other hand, science might be a trust, which can make a certain law out of numerous cases, compared to empiricism, right?

Nine out of the ten participants trusted acupuncture but at varying degrees. Then, why do the participants trust acupuncture? Table 5 displays the reasons for trusting acupuncture.

**Table 4** Participants' perception of acupuncture as science

Participants	A	B	C	D	E	F	G	H	J	K
Acupuncture as science	×	○	○	○	×	×	○	○	○	○



**Table 5** Reasons for trusting acupuncture

Reasons	Participants										
	A	B	C	D	E	F	G	H	J	K	
Self-experienced acupuncture effects		○	○	○	○	○	○	○	○	○	○
Other people's experience of acupuncture effects		○					○				○
Home environment in favour of acupuncture					○					○	
Social status with a university degree		○	○					○			
National certificate system								○			
Being used even in national organizations				○							
Systemic discipline (with books)		○		○			○		○		
Long history		○		○			○		○		○
Eastern ideology basis											○
Positive experience related to the basis theory of acupuncture								○			
Perception of using scientific methods			○				○	○	○		

One reason is because they have had positive experiences of acupuncture. All nine participants who demonstrated trust had their own personal experiences as the source of their trust. They also reported someone else's positive experience without side effects as reason for their trust.

I: Why did you become to think so? What was a motive to think that?

K: My husband told me that he had acupuncture when he was young and the effect was fast.

I: Because of your own those experience, your opinion is firm, right?

K: On top of that, because our elders do the same, and said so.

A second reason for trusting acupuncture is from being surrounded by acupuncture-friendly environments. Participants E and J, with science-engineering backgrounds, held no personal opinions or values over whether acupuncture is science. However, their acupuncture-friendly family environments exposed them to acupuncture, from early years.

E: When I had acupuncture treatments... Um... it was so natural to accept it, and I did not have any fear of hurt. At that time, I was not old enough to think if it is science or not. My parents took me there, and I just accepted it, I think.

Another reason stems from the national and social recognition of acupuncture. In Korea, there are TKM medical schools established at Bachelor or Master levels, and to be qualified as TKM doctors with a national certificate, people have to pass the examination (KHPLEI, 2020; The Association of Korean Medicine, 2020). Students of these schools demonstrate high academic performance and usually become elites of the society after graduation. Furthermore, acupuncture performed by these doctors is even provided at training camps for national Olympic athletes.

H: Because there are such universities.

I: Ah, TKM universities, right?

H: Yes, it's license. It is a national license.

I: Is it important?

H: Yes, it's important. Because there is a national certificate and universities with necessary data. There are teachers and students, and the government recognize it. It means there are unique contents. And the contents must be empirical data from clinics. There are courses where it is taught, learned, and transferred.

D: Yes, there would be principles. In the National Olympic Camp, athletics are served by acupuncture. If it is not scientific, they would not do that. But, they do that, right?

Acupuncture is also trusted because it is recognized as a discipline. Some participants acknowledged its long history and considered acupuncture a systemic discipline with many books on it. It is also trusted because it is established upon Eastern ideology, which is the root of Korean people's life. Others said that, based on their positive experiences, it shares a relationship with the theories of Ki, acupuncture points, Yin & Yang, Five Elements, etc.

G: Ah, surely there are positive effects. And it is a discipline with systemic structure, together with its long history of several thousand years. So I became to trust it.

K: Isn't it a discipline with long history. What I think is ... that has been inherited for a longtime has something reasonable although not everything is correct. Thus, I think that although its approach is different from that of WM, the world view of TKM would be persuasive.

Lastly, some stated that their trust emanates from acupuncture's use of scientific methods. Their claim that acupuncture implements the scientific method proceeds from acupuncture's accumulated data of its long clinical applications and consistent results from its treatments over the symptoms.

I: Then, you just told me that acupuncture is scientific, right? When you say that, what is science? How does something become scientific?

K: Maybe statistics? Well how can I put it? Um... there are lots of old data from clinical applications. A long history of clinics, and statistics out of it. There must be something correct if we follow statistics, and so on. ...

In sum, there are various reasons for the research participants to trust acupuncture. They trusted acupuncture, not only based on their personal experiences and its social recognition but also due to its perceived features. Acupuncture's perceived features include its systematic disciplinary nature, its long history, the support from Eastern ideology and its use of scientific methods.

## 4.2 Four Pillars of Destiny (FPD)

Participants' first experiences of FPD are as follows. As shown in Table 6, most of them had their first FPD experience either during their teenage or younger through their parents or during their twenties by themselves.

B: Well... then my mother ... When young, I didn't know that. I now know that my mother had FPD from time to time. It was when I entered high school that I myself had FPD... Nothing special... There must have been a philosophy hall [a common Korean expression referring to FPD place] that she knew well. I didn't like that but went there once. Maybe, because of that, I decided to go to engineering college.

Five out of ten participants thought that their first FPD results were accurate in predicting their fortunes, and thus, some felt eerie about the uncannily accurate results. Participants A and F who had no special feelings from the first experience, after their second experiences were led to think that FPD was accurate.

I: When did you first experience FPD?

F: First experience ... Um ... My mum was not different. As you know, mums often enjoy fortune-telling.

I: Yes, you are right.

F: But ... it seems to be correct. I got such feelings from my middle and high school years. I had that experience several times. My mum got [FPD results] from somewhere and surprisingly they were correct.

Based on Tables 6 and 7, it can be observed that if participants thought that the FPD results are accurate, they are more likely to trust it. Participants who had negative feelings even before the first experience due to personal belief or religion did not feel or show trust to FPD. Participant E who thinks that FPD is unscientific and is difficult to be verified shows no trust towards FPD.

H: That is somehow related to religious belief. Um ... I don't think PFD is scientific. ... For me, having FPD is something like having affairs.

**Table 6** Participants' first experiences of FPD

Participants	A	B	C	D	E	F	G	H	J	K
When? (by whom)	Others In 20s	In 10s In 20s	- In 20s	Child In 20s	In 10s -	In 10s In 20s	In 50s -	In 30s -	Child In 20s	Child In 30s
For what? (Self-participation)	For fun	Career anxiety	Friend's sugges- tion	Career anxiety	-	By accident	-	-	For fun	Career anxiety
What feelings?	No special	Accurate	Accurate & surprise	Accurate	Accurate & scary	No special	Repulsion & no trust	Repulsion	Scary	Accurate

**Table 7** Degree and change of participants' trust towards FPD

Participant		A	B	C	D	E	F	G	H	J	K
Degree of Trust (Stage)		3	4	5	3	1	5	1	1	4	3
Change in Degree of Trust											
Scope of Trust	Theory	×	○	○	×	×	○	×	×	○	○
	Inborn Tendency	○	×	○	○	×	○	×	×	○	○
	Future Prediction	×	○	○	×	×	○	×	×	○	×

E: Anyway, they explain some phenomena, somehow. From that point of view, it is scientific, but for other points it does not satisfy scientific conditions. One of them is that it does not match with modern sciences.

E: [Acupuncture] can be checked through considered methods and others, but FPD cannot be checked. ... thus, I don't believe ... From my old days ... I was quite suspicious. My mother told me that I decided what I do ...

Except participants E, G and H, the others demonstrated varying degrees of trust towards FPD. Similar to acupuncture, the degree of trust towards FPD can be classified into five stages from stages 1 to 5. Stage1 (no trust) is the stage in which, despite some experiences of FPD through someone else, participants do not trust it and often have negative perceptions towards it. They are reluctant to undergo FPD voluntarily. Stage 2 (voluntary participation) is the stage in which they willingly undergo FPD. Stage 3 (behavioural change) is the stage in which they voluntarily undergo FPD and although doubtful about the results, do make some changes in their behaviour accordingly. Stage 4 (active practice) is the stage in which they change their behaviour and trust the results of FPD. Finally, stage 5 (semi-professional) is the stage in which they seriously study the theory of FPD and frequently perform it on someone else. As shown in Table 3, all, except participant A, demonstrated trust towards acupuncture at varying degrees.

A: (...) Now I realized that this tendency of mine can influence other people. ... So, because I know my such tendency, I now became a little bit cautious (...) Because I knew that my uncontrolled words can be interpreted differently, I behave more carefully.

B: I think there are such kinds of effect. If I heard that there is a chance of accident, then rather than overtaking, I just follow slowly another car which is moving slowly in the 1<sup>st</sup> lane. Ha ha ...

F: At first, I studied it alone, and after returning to Korea, I began to study it in earnest, from my master.

The degree of trust towards FPD appeared to change differently after its first experience. Trust increased continuously or increased first and then remains high like participants C, J and K. In contrast to participant B who showed trust even before his first experience of FPD,

participants E, G and H maintained their negative attitude towards FPD even after their first experience.

J: It gradually increased.

I: Why was it so?

J: As I live and have more experiences, I feel that there are many accurate cases. It's empirical.

Five out of the seven participants who expressed trust towards FPD stated that they trust its basis theory. Within the seven, six expressed trust in terms of their inborn temperament, and four attributed their trust to FPD's future predictions.

Surprisingly, no participants replied "yes" when asked whether or not they felt any conflict between FPD and their scientific knowledge. In other words, participants do not take whether FPD is scientific into consideration when deciding to undergo FPD. This includes even the participants with science and engineering backgrounds. For example, participant J stated that, even though she had been taught that FPD is a superstition, the predictions of FPD turned out to be correct, and she now believes it.

J: ... if I say FPD is science, as a person majored science, it would be a bit strange. Because having fortune telling is ... in fact what they say is different from fortune-teller to fortune teller. ... Thus strictly speaking it [FPD] can hardly be science. But there are still some points to be trusted because we cannot say that it is completely nonsense and nothing to be trusted. ...

J: Yes, right! In my thinking, it turns out to be correct. So, not being like a law, but it [FPD] provides some results that are to be trusted somehow. ... Something like that ...

Hence, we questioned whether the participants perceived FPD as science. Table 8 displays the responses. Unlike acupuncture, no participants replied that FPD belongs within the boundaries of modern science. Nonetheless, seven participants regarded FPD as the result of statistics. In particular, participants D and K said that FPD may be considered science since it is the results of statistic and accumulated outcomes. If statistics is science, then FPD is science as well. They also claimed that modern science investigates the unknown things but there are still many things are remained unknown and that FPD is in the territory of the unknown and this unknown world will be discovered some time in the future. This is why participants D and K claimed FPD is not completely unscientific.

K: FPD ... I think it is rather humanities, stories of people's life. But it is statistics, thus science. By the way, what I am confused is (...) if you insist to classify, I think it belongs to science.

D: For example, like time machine. These days, dramas deal with this kind of topic. You know, scientists continue to try this. Although lay people think it [time machine] is unscientific ... although lay people think it is unscientific, scientists keep trying to explain it, right?

For participant D, science is something that can be detected or measured through experiments and that can provide statistical values or results. Participant K also considered

**Table 8** Participants' perception of FPD as science

Participants	A	B	C	D	E	F	G	H	J	K
FPD as science	×	×	×	△	×	×	×	×	×	△

science to be verified inductively with lots of accumulated empirical data. That is, participants D and K are inclined to think that FPD shares some common features with science because it is also the outcome of accumulated empirical data and provides statistical values.

D: Because ... it should have statistics and results after having experiments that you can witness.

In particular, participant F who has a doctoral degree in natural science and is working as a research scientist appeared to be critical towards the objectivity and strictness of scientific research and its methods. He considered that although FPD might be regarded as unscientific from the perspectives of modern science, he trusts FPD quite strongly. In fact, his trust in FPD is strongly linked with the limits of scientific research that he experienced as a scientist.

F: So it[FPD] has a system of inductive verification, but it may only lack of research papers (...) Surely, they must pass a certain training course and through this have FPD experience with at least several hundreds of people, then they can work as competent experts of FPD.

F: Frankly speaking, established scientific theories are also ... Since I myself published SCI-class research papers, I knew that it [scientific research] is nothing special. To be honest, it is okay if you pass just two reviewers. It is not that special, right? (...) Don't you think so? FPD and its theory have been reviewed and passed down by tens of thousands scholars for the last six thousand years. It is ridiculous if we respect SCI papers than this[FPD]. You know, the two reviewers are not that great persons.

One of the main reasons for trusting FPD was the inner structure of its theory. FPD is often respected and trusted for its well-elaborated theoretical structure including the interconnected links with Eastern ideology, i.e. Yin and Yang and the Five Elements. This may be the point of attraction that propels a person from stage 4 to stage 5.

C: When I first came across the principle, I felt that there is something special. Right after that, on my way back to ... I went to a library and started to read the book there.

C: I began to have criteria, and my criteria of classification became tree-fire-earth-metal-water [referring to Five Elements]. From that time, I began to see the world through Yin & Yang and Five Elements. Criteria of classification... Wow, it was really interesting and I came to enjoying it very much. (...) From there, I have been studying in earnest its history and system, Eastern astrology, Feng Shui geography, Five Elements-based disciplines.

F: Four different physical constitutions in Sasang Constitutional Medicine and each person's tree, fire, earth, steel, water? I think, I trust those things.

Then, why do the seven participants trust FPD? Table 9 demonstrates the reasons for their trust in FPD.

First of all, it is because they think that what they were told by FPD is correct. All seven participants who demonstrated trust towards FPD reported that their trust stems from their own experience. In addition, some said that cases from FPDs of celebrities and close friends match with what they regarded about them.

C: We went there together. And the FPD results of my friend were very interesting. It was so accurate one after another, and even predicted correctly the relationship

**Table 9** Reasons for trusting FPD

Reasons	Participants										
	A	B	C	D	E	F	G	H	J	K	
Self-experience of FPD	○	○	○	○		○			○	○	
Experience of accurate FPDs of friends and acquaintance			○							○	
Cases from celebrities' experiences of FPD						○					
FPD-friendly family environment		○		○		○			○	○	
The same message from different FPD experiences	○			○							
Theoretical basis and academic system of FPD			○	○		○			○	○	
Relation to Eastern ideology			○							○	
Being based on the data accumulated for a long time	○	○		○							



between my friend and another friend who was not there with us. It was so interesting.

F: You know... he is a really famous music critic. This guy was talking about his story in radio (...)

Another reason is rooted in the family environments in favour of FPD. For instance, participants B, F and J with science and engineering backgrounds grew up in family backgrounds dominated by Buddhism or Eastern ideology. They had FPD experiences through their parents or other family members well before they could make their own choices based on their science learning. That is, their experiences obtained through their parents or guardians led them to accept FPD without much oppositions. In addition, this established perception of FPD was not easily influenced by the science education that was received afterwards. They experienced no conflict between the self of doing FPD and the self of doing science, and these two selves have co-existed as the frameworks for different situations.

J: There were no negative feelings. Because, in my yearly years, my mother and aunts had FPD and talked about it each other. I thought that it was nothing special and that people do the same thing just for fun. And people do FPD at the beginning of a new year for their future fortunes. In fact, I had no negative feeling.

F: Well, it is something like ... to see through FPD is to see through infrared ray, and to see through science is to see through visible ray, so neither of them are perfect. To be perfect, we need to see something through X-ray, gamma ray, visible ray, infrared ray ... But we cannot see it at the same time through all these, but we see it through one by one.

The co-existence of the self of doing science and the self of doing FPD might be an indication of the mechanism of human psychology to reduce the anxiety. For example, participants A, B and J trusted and relied on FPD as a source of relief and courage regarding the difficulties in life of future and present time, even though they knew that FPD is unscientific.

A: Um ... Well ... At that time, I just really wanted to know who I am. That's why ...

B: ... For such as tough examination, we need a luck. I went to FPD place because I needed a luck. I did not have any negative feeling over that action. Not all things can be done scientifically.

J: (...) For me, to have FPD is something like to have a hope or belief, I think. Thus, it is like a religion. When life is really tough, I need a little bit of relief and courage so that I can think that the future will be better. (...)

One of the reasons for their trust was that they could get the same results from different occasions of having FPD. Since the results appeared to be consistent and thus systemic, they considered it to be trusted.

D: My basic FPD is ... dragon day, dragon hour ... something like that ... I have heard that so many times.

The ideas that FPD is based on the data accumulated for a long time, that FPD has its theoretical foundation and disciplinary system and that FPD is something firmly based on Eastern ideology appear to be other grounds of their trust. Concerning FPD, they also often mentioned words and concepts which are to be used in science, such as big data, inductive hypothesis and deductive hypothesis.

A: "Yes, it's something that could classify people through thousands and tens of

thousands of years. I think that's statistics and it's no more and no less than that"

C: Um ... I think it is a mass of knowledge and wisdom out of a lot of people from the ancient times. I perceive it in that way.

F: The scientific method is to set up a hypothesis inductively ... after setting up a hypothesis deductively, and then verify it inductively, and if passed, we say it is a scientific method. Well, this discipline, called FPD, it seems that there is a firm theoretical basis of it.

B: They check year, month, day, and hours, right? I think it's like big data because there must be other people who were borne at the same day and on a similar hour. A tendency out of those people ...

In sum, there are various reasons for the research participants to trust FPD. They trusted FPD, not only based on their personal experiences and its social recognition but also due to its own perceived features. FPD's perceived features include having the same claims from different occasions, its theoretical basis and systematic disciplinary nature, the support from Eastern ideology and its accumulated data from the past.

## 5 Summary and Discussion

In order to investigate why people trust something other than science in the Korean context, we conducted in-depth interviews with ten participants for their experiences of and trust towards acupuncture and Four Pillars of Destiny (FPD). Acupuncture and FPD have long been among the most popular activities in Korean society. These kinds of personal activities and everyday decision-makings are as important and frequent, if not more, as global issues like climate change, in terms of the aims of science education and scientific literacy. We intentionally selected participants who had at least a university education and a secure job for a living. The group was well-spread in terms of gender, age (ranging from thirties to fifties) and academic backgrounds (being either humanities and social science or science and engineering). The interviews were semi-structured, and the participants were given a common set of questions regarding their first and following experiences of acupuncture and FPD and their trust towards each.

The findings from the interviews can be summarized as follows:

For acupuncture, many of the participants had their first experience of acupuncture treatment when they encountered health problems that are known to be better treated by TKM than WM. The most typical health problem was sprained ankles. The first acupuncture experience was often triggered by suggestions from their family members, especially the elders like parents and grandparents. The majority of the participants trusted acupuncture on the basis of their own experience of its treatment effects and of surrounding people's positive attitudes towards it. Many also trusted acupuncture due to TKM doctors sharing equal socio-institutional status (including acupuncture as a part) with WM doctors. They claimed that TKM and WM have different sets of strengths and weaknesses, and they often go to TKM hospitals or clinics because they feel more relieved psychologically and stable due to the friendly and smooth counselling with TKM doctors. Most of them considered acupuncture (and TKM) as another kind of science or medicine, as manifested by the established systems of TKM medical schools and of TKM national certificate of doctors. The largest reason for viewing acupuncture as science is acupuncture possessing accumulated data and statistics that are supported by its long history. Over time, the degrees of

trust towards acupuncture changed based on their first and following experiences of treatment and other factors.

For FPD, participants' first experiences were often driven by their family members, esp. mothers, and sometimes even conducted without them being present at the scene of FPD. A family culture that is friendly towards FPD (e.g. Buddhism) appeared to be an influential factor. The participants sought out for FPD when they felt stress and anxiety about their future (e.g. facing important examinations, career choice, marriage) or sometimes simply for amusement. Many did not trust the predictions of FPD but nonetheless had the tendency to follow the prophecy in order to prevent any potential risk anticipated by FPD. Some of them considered FPD as a kind of science because they believed that it has a well-structured theoretical system with theoretical consistency and consistency in practice (i.e. the predictions are consistent). They believed that FPD is based on big data and thus on the knowledge and wisdom accumulated over a long history. Viewing FPD as statistics, the participants sometimes considered it not fundamentally different from modern science (e.g. quantum mechanics) and like how modern science provides a fundamentally different worldview from traditional science. Thus, a participant called FPD the "East Asian Science".

For both acupuncture and FPD, family culture and environment like the presence and influence of mother and grandmother served as the most important factor that led participants to their first experiences. The positive experiences of friends and other surrounding people also played influential roles. In fact, the influence of family members and friends are one of the key features of Korean culture (e.g. Park & Kim, 2005). If the first experience left a positive impression, the participants were more likely to replicate the experience when they encountered personal problems (relating to health, examination, career choice, etc.). We classified the degrees of trust towards acupuncture and FPD in five stages: stage 1 (no trust), stage 2 (voluntary participation), stage 3 (behaviour change), stage 4 (active practice) and stage 5 (semi-professional). Depending on their first and following experiences, the degree of their trust changed over time. Several participants regarded acupuncture and FPD as science or statistics, based on the belief that these are the outcomes of big data or statistics accumulated throughout the long history. For some participants, the theoretical basis, which is closely linked to Eastern ideology, was also found to be a source of their trust. The backgrounds of the participants (of science and engineering or of humanities and social science) seemed not an influential factor over these common features. On the contrary, there were some differences between acupuncture and FPD. Acupuncture was often trusted in terms of its socio-institutional status similar to the medical school and national certificate systems, while FPD was often trusted in terms of its theoretical consistency and consistency in practice.

The topic of this study, which is people's experience and trust related to acupuncture and FPD, is certainly linked to many other inter-related "boundaries" of science education, such as the demarcation of science, nature of science (NOS), socio-scientific issues (SSI) and scientific literacy. Here, based on the findings of this study, we discuss some issues regarding these boundaries of science education for future implications.

First, the demarcation between science and non-science or science and pseudoscience is not straightforward (e.g. Oreskes, 2019) and cannot be easily applied to acupuncture and FPD especially in the Korean context. In Korea, acupuncture is only practiced by authorized TKM doctors who have completed 6 years of medical school education and are qualified by the national certificate system. There are 12 TKM medical schools and 25,000 qualified TKM doctors, and acupuncture is the most popular medical service used by about 90% of TKM patients (NIKOM, 2018; The Association of Korean Medicine, 2020). With

this social environment, although being debated with much criticism, hot debates over its theoretical foundation connected to Eastern ideology still continues between TKM and WM doctors (Yoo, 2015; Chi, 2019). There is a general consensus that TKM (including acupuncture) is an established discipline like WM (Bae, 2004). However, the situation of FPD is quite different from this. There are neither government-approved professional schools nor a national certificate system for FPD. The professionals of FPD usually are taught and trained by private masters or institutions or through self-study. Hence, while we might claim that FPD is somewhat pseudoscientific, we can hardly do that to acupuncture. We might need another category in between the two ends, “unorthodox science” as explained earlier, which has a less negative meaning (Henry, 1981). In Bunge’s ten features of a mature science, acupuncture may satisfy the features of “community of trained inquirers” and “real events and processes as the domain of investigation”, and perhaps in a less degree “specific background with up-to-date and testable theories, hypotheses and data”.

Second, in connection to the first issue, the current practice of teaching NOS (nature of science) in science education needs to be reconsidered and expanded. For the past three decades, NOS has been one of the key aims of school science education (e.g. AAAS, 1989; MaComas and Olson, 1998; Lederman, 2007). The most widely known list of NOS elements is the so-called Lederman Seven consisting of empirical basis, scientific theories and laws, creativity, theory dependence, cultural embeddedness, scientific method and tentativeness (Lederman et al., 2002; as quoted in Matthews, 2011). Although the Lederman Seven includes the aspect of “social and cultural embeddedness” in its list, the social, cultural, historical, philosophical and institutional aspects of acupuncture and FPD described in this study demonstrate how narrow and restricted the traditional NOS list is. Focusing on this limitation, a few new frameworks have been proposed to encompass the wider aspects of scientific (and unscientific) nature. For example, Matthews (2011) urged the need for “a change of terminology and research focus from the essentialist and epistemologically focused ‘Nature of Science’ (NOS) to a more relaxed, contextual and heterogeneous ‘Features of Science’ (FOS)” (p. 4). Expanding to the FOS, Matthews (2011) added another eleven items to the Lederman Seven, and some of the items are model, values and socio-scientific issues, worldviews and religion. Another meaningful framework is the “FRA wheel” proposed by Erduran and Dagher (2014), which is a reconceptualization of the family resemblance approach (FRA) (Irzik & Nola, 2011). In the FRA wheel (or also known as RFN), science is viewed as a cognitive-epistemic and social-institutional system. These new approaches pay more attention to the socio-cultural, institutional and contextual aspects of science, which are quite extensively demonstrated in this study.

Third, people’s science-related trust issues need to be explored further. In this study, we found that the participants’ trust towards acupuncture and FPD mainly stems from their perceptions that these are based on a massive data accumulated throughout a long history. This was also the main reason for viewing acupuncture and FPD as types of science. In other words, the participants’ criteria for something to be scientific and thus trustworthy is almost exclusively linked to the first element of the “Lederman Seven” list (i.e. empirical basis), despite that this claim is still subjected to the debate of whether or not the data of acupuncture and FPD are really empirical. This limited understanding of what is science might be an example portraying the characteristics of pseudoscientific belief like “cherry-picking evidence” (Hansson, 2009) and “while not trusting the nature of science but trying to use scientific methods and claims” (Kim, 2004). Another reason for trust that has been found in this study is people’s feelings of relief, stability and comfort towards acupuncture and FPD. For example, in Korea, the way patients are treated by TKM doctors deviates greatly from that by WM doctors. As shown in an

anthropological study (Kim, 2016), while the conversation between WM doctors and patients is mainly mediated by a computer screen, the conversation between TKM doctors and patients is always intimate and directly person-to-person. These issues give us an opportunity to think over how to teach school science where data collection and interpretation are taught and controversial issues related to science and technology are debated. This would be a good example of the topics for science education to be considered in relation to Vision III (Aikenhead, 2007) mentioned in Section 1.

Fourth, more attention needs to be given to personal and everyday life issues in science education. As mentioned earlier, the STS approaches in the 1980s and 1990s and the SSI approaches in the twenty-first century have focused more on global and large-scale issues, such as global warming, climate change, energy saving and bioethics. Surely, these are the most dire and important science-related problems and complex as they often link to the political and economic point of view. Tackling these big issues, current science education has placed less attention on day-to-day issues such as health-related decisions, career choices, consumer behaviour and future plans that citizens of modern society face. Such routine issues are as important, and they also require rational and critical thinking as well as scientific communications and decision-making, which are included as key elements in many recent movements for scientific literacy (e.g. AAAS, 1997; NGSS States, 2013; Song et al, 2019) and competence-based school education (e.g. OECD, 2003; WEF, 2016). In particular, the new Korean science education standard, KSES, gives special attention to the “participation and action” aspect and lifelong learning of science education, which are to be key elements of citizen science. The topics investigated in this study, including people’s trust towards acupuncture, FPD and science, are indications for this need for science education, which is strongly related to Vision II.

In conclusion, it can be claimed that the cases of peoples’ experience and trust regarding acupuncture and FPD in the Korean context are good examples of topics that contribute to expanding science education from the discipline oriented, content centred and school based to the more people oriented, context inclusive and community based.

Finally, this study has several limitations due to its research method. The research participants are by no means the representatives of (Korean) adults. They are only a limited section of society. In particular, most of the research participants have much higher degrees of education than average Korean adults do, even though there is no indication of the effect of their high education over their experience and action related to acupuncture and FPD. Besides, all the data and information in this study are based on their recollected memories, which are culture dependent and prone to cherry-picking and confirmation bias (Viskontas, 2018). Being science educators, unfortunately, we were able to raise some cultural issues in understanding the data of this study but could not interpret them more seriously from cultural perspectives. It is important to be in mind that the findings of this study should not be overgeneralized without caution and that further in-depth investigations from the perspectives of cultural studies and anthropological studies need to be conducted.

#### Declarations

The Institutional Review Board (IRB) of Chuncheon National University of Education monitored all procedures, including recruitment of participants, consent form for the participants, data collection, and analysis. This study received IRB approval (No.2020-13). Following the guidelines for conducting an ethical study, we used the code for all participants.

**Conflict of interest** The authors do not have any conflict of interest.

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