



## Dimensions of beliefs without strong supporting evidence and reasons for holding them<sup>☆</sup>

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### A B S T R A C T

Beliefs without strong supporting evidence (BWSSE) are commonplace, such as religious beliefs and conspiracy theories. The goals of the current study were to identify dimensions of BWSSE in the general public and study how reasons for holding each dimension depend on the strength of the belief. Participants completed a BWSSE questionnaire online, and principal component analysis suggested that the questionnaire captured 6 dimensions of beliefs that range in strength: New Age Spiritual, Traditional Spiritual, Nonconformist, Science, Mythical, and Conspiracy Theory. Mixed-model analyses of variance showed that while high-strength believers in both New Age and Traditional Spiritual shifted their reasons-for-belief away from 'just believe' and towards personal experience, only Traditional Spiritual shifted away from 'just believe' to culture. In contrast, for Conspiracy Theory and Mythical, the dominant reason for belief was media, but for Conspiracy Theory only, there was a shift from media to education/personal research for high-strength believers. This demonstrates that although spiritual beliefs are strengthened by personal experience, conspiracy theory beliefs are strengthened by information gathering. Understanding the source of an existing belief is important for debiasing attempts to move people towards beliefs with strong supporting evidence, including greater acceptance of evidence provided by experts, a likely requirement for negotiating global humanitarian emergencies in the not-so-distant future.

#### Statement of Relevance.

Beliefs without strong supporting evidence (BWSSE) have been gaining attention in mainstream society; particularly, the sources of information that may contribute to their formation and resistance to correction. Understanding the source of an existing belief is important for debiasing attempts to move people towards beliefs with strong supporting evidence, including greater acceptance of evidence provided by experts, a likely requirement for negotiating global humanitarian emergencies in the not-so-distant future.

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## 1. Introduction

Beliefs without strong supporting evidence (BWSSE) can describe a wide range of beliefs, including beliefs almost universally accepted to be false by adults (such as that the tooth fairy exists), and beliefs that are supported by evidence that is primarily only meaningful to the believer (e.g., the belief that angels watch over us, with the personal supporting evidence being exceptionally good fortune). BWSSEs were first studied under the concepts of schizotypy, psychosis-proneness, or delusional ideation, conceptualized to occur on a continuum with clinically significant delusions in schizophrenia and psychosis [1–9]. However, given the recent coronavirus disease (COVID-19) pandemic and related political events, BWSSE have captured the attention of the media and the general public, and it has become clear that BWSSE are much more widespread than previously thought [10–13], extending well beyond parallels for psychotic delusions. In particular, endorsement of conspiracy theories can lead to social and health-related consequences, such as increased risk of viral infection with refusal of vaccinations (Oleksy et al., 2021; Ripp & Röer, 2022). Misinformation has been recognized to support BWSSE, and the manifestation of such beliefs should be taken into consideration [11].

Although recent studies have investigated the impact of specific sources of information on the development of BWSSE [14,15; 2021], the relationships between different sources of information (e.g., education vs. personal experience) and their impact on the strengths of such beliefs have not been systematically examined. This is important for the development of debiasing strategies which endeavour to change beliefs from BWSSE towards those with stronger supporting evidence [13], which could lead to an increased acceptance of evidence provided by experts. In the current study, we investigate a range of BWSSE from a dimensional perspective, with a focus on the self-proclaimed sources of the evidence for holding these beliefs.

Despite psychotic delusions sometimes involving elements of both new age (e.g., thought reading) and traditional spirituality (e.g., chosen by God), traditional beliefs have been neglected under the study of schizotypy. This is because traditional religious beliefs are widely held in society, so were not considered on a continuum with delusions. Many schizotypy scales look at BWSSEs which share some overlap with common delusional themes. For example, the Schizotypal Personality Questionnaire [6], Oxford-Liverpool Inventory of Feelings and Experiences [4] and Peters et al. Delusions Inventory (PDI; Peters et al., 1999) query about belief in phenomena related to new age beliefs such as telepathy, astrology and extra-sensory perception. None directly ask about traditional religious

**Table 1**

Questionnaire items listed in the order in which they were presented to participants. Due to technical errors, data on item 1 was not collected.

1	I believe in the law of karma—you get what you give.
2	Meteorologists can predict weather patterns days in advance.
3	I believe that when the stars align in a certain way, wonderful things will happen.
4	The US government conspired to commit 9/11.
5	If I step on a crack in the sidewalk, I'll injure my mother.
6	Big Foot exists.
7	I believe in reincarnation.
8	People can pass information to one another through thinking alone.
9	Washing your hands can help prevent spreading illness.
10	Elementary school children are conspiring to overthrow the U.S. government.
11	Thinking certain ways or thoughts can have an effect on the universe and in turn, what happens to you.
12	Dinosaurs once walked the planet.
13	I believe in heaven and/or hell.
14	Some people have the ability to predict the future.
15	I believe in ghosts.
16	Being overweight can be a health threat.
17	The US military engaged in a cover-up of a crashed alien space craft.
18	I have attracted everything in my life through my thoughts alone.
19	Santa Claus exists and lives at the North Pole.
20	Remote viewing, such as seeing scenes located miles away "in one's mind" is possible.
21	Healing stones and crystals can improve our health.
22	The British Royal Family plotted to have Princess Diana killed.
23	I believe in God.
24	If you change your thinking you can change your behaviour.
25	The Loch Ness monster exists.
26	People can pass information to another person nonverbally.
27	People can be healed without being touched if the energy around them is manipulated.
28	The Apollo moon landing of 1969 was staged inside a Hollywood studio.
29	If I tap a pen on a desk in the right pattern I will become rich.
30	Angels or spirits watch over us.
31	Bacteria exist.
32	People and/or places can be possessed by evil spirits.
33	There are pills that can relieve a headache.
34	I believe in life after death.
35	At certain points in history, military and political leaders have secretly conspired to plan military attacks on other countries.
36	There is a reason for everything that happens to me and my life is determined by fate.
37	The Tooth Fairy is real.
38	The provincial premiers are conspiring to take over Ottawa.
39	If your self-esteem is low this can affect your behaviour.
40	Aliens have visited the earth.

beliefs such as a belief in God or heaven/hell, although the PDI prompts about feeling “especially close to God” and “chosen by God in some way” as a proxy for subclinical religious delusions. Since both traditional and new age concepts are good examples of BWSSE and are widespread, we included both in the current study. To cover a range of widely held BWSSEs, we included health threats and treatments, conspiracy theories, belief in the supernatural, and beliefs widely known to have no supporting evidence such as a belief in the tooth fairy. Beliefs with strong supporting evidence (e.g., bacteria exist) were also included as control questions.

In addition to the strength of the BWSSE, we were interested in understanding the sources/basis of each belief, because the strength of the belief may interact with the basis of the belief. For example, if the belief were based on a personal experience (e.g., experiencing what is perceived as a miracle versus a miracle viewed on television), this could affect the strength of the belief [16], and research into the source/basis of BWSSE is lacking to date. Therefore, we queried about the strength of BWSSEs and the sources/basis of each belief.

## 2. Methods

### 2.1. Construction of the questionnaire

Development of the BWSSE questionnaire was motivated by measurement of two constructs: (1) survey a wider range of beliefs than what is already available on other scales, and (2) ask about the reasons for holding these beliefs. The questions that were included in the finalized questionnaire are listed in Table 1.

These items were selected to sample beliefs in paranormal human abilities, health threats and treatments, conspiracy theories, mythical creatures, and traditional spirituality. Beliefs with strong supporting evidence were also included, restricted to material that is not viewed in plain sight, but for which there is substantial scientific evidence (e.g., the existence of dinosaurs). Also included were absurd beliefs that are almost universally accepted to be false by adults, such as the existence of Santa Claus and the Tooth Fairy.

Each questionnaire item displayed a statement, and participants were asked to indicate the degree to which they believe it by selecting from the following Likert scale responses: Disbelieve, Weakly Believe, Moderately Believe, Strongly Believe, 100% Certain (Fig. 1). To determine their reasons for holding this belief, participants are then prompted to select from the following categories from

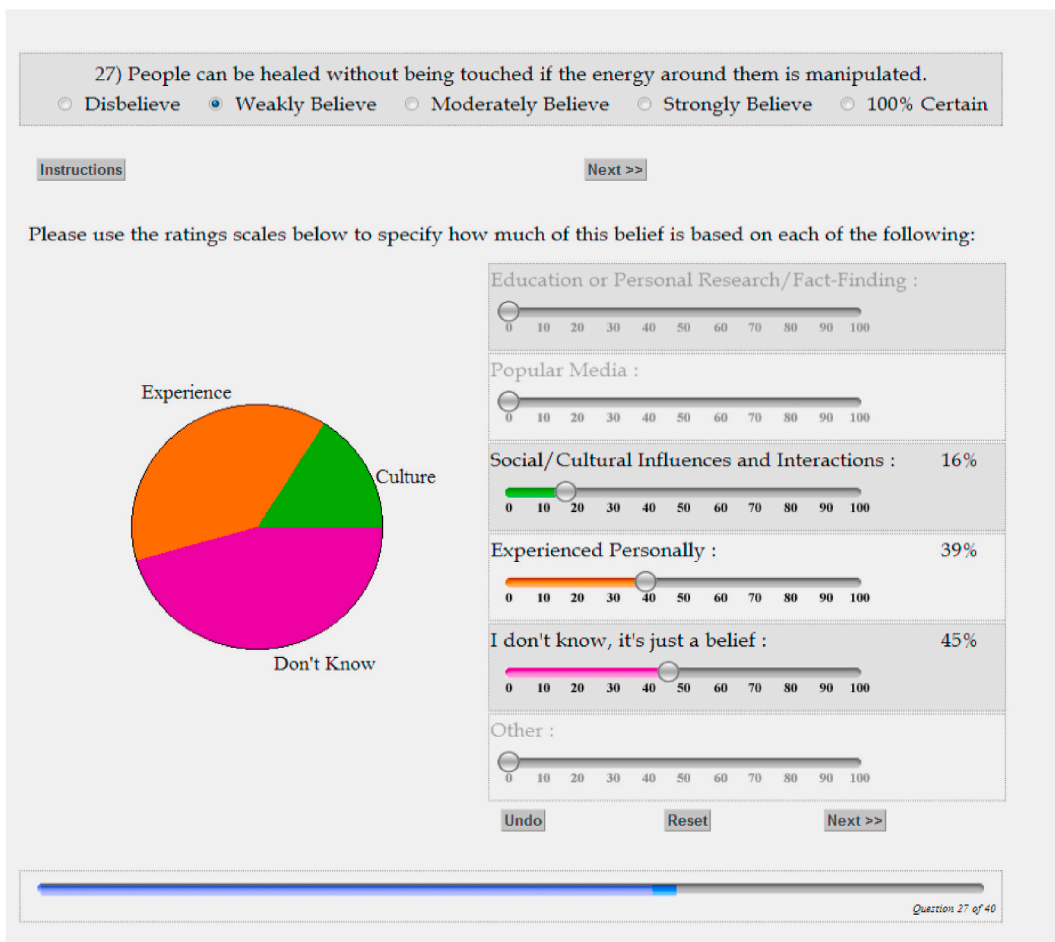


Fig. 1. Screenshot of an example question with response options in the online questionnaire system.

which their belief originated: “Education or Personal Research/Fact-Finding”, “Popular Media”, “Social/Cultural Influences and Interactions”, “Experienced Personally”, “I don’t know, it’s just a belief” and “Other.” In order to not only identify each originating source, but also to determine their dominance, a pie chart of the percentage breakdown from each category was displayed, and participants toggled the scales to show a visual representation of their response out of a total of 100% (Fig. 1). The pie chart and percentages adjusted automatically when participants added or modified their rating of a source of belief such that it always summed to 100%. Participants were given the option to type out their answer if they selected the “Other” response.

### 2.2. Subjects and procedure

Participants were recruited through advertisements posted online (eg. Craigslist, Kijiji) and posters in various community venues (e.g., universities, community centres, coffee shops, libraries) in the Greater Vancouver Area/Lower Mainland. Participants received the study link by emailing the address listed on the poster and received an auto-reply with a link to the study and login information as well as a separate email address where they could contact someone with any questions or issues. A total of 472 participants from the general public completed the questionnaire. 31 participants were excluded due to missing data or invalid response patterns, such as extremely fast ( $n = 10$ ) or slow ( $n = 9$ ) response times or restricted variability in responses ( $n = 12$ ), and a total of 441 subjects were included in the final sample. According to Cohen (Cohen, 1992), 400 subjects is sufficient to detect even a small sample size with analysis of variance (ANOVA) at  $p < .05$ , so the current sample size of 441 should provide sufficient power. Since the questionnaire was administered via an online platform and anyone with a link to the website could complete the questionnaire, no eligibility criteria were presented prior to participating in the study. Participants were asked for age, sex, handedness, level of education, and occupation/student status. The sample was 68.2% female and mean age was 34.01 ( $SD = 13.66$ ;  $min = 19.08$   $max = 79.93$ ). The education level

**Table 2**  
PCA Component loadings. New Age, Trad = Traditional, Nonc = Nonconformist, Sci = Science, Myth = Mythical and Cons = Conspiracy Theory. \* Loaded onto two components with loadings >0.4 and within 0.05 of one another. Dominant loadings are displayed in bold font.

	New Age	Trad	Nonc	Sci	Myth	Cons
27. People can be healed without being touched if the energy around them is manipulated.	<b>0.77</b>	0.12	0.10	0.02	0.23	0.16
21. Healing stones and crystals can improve our health.	<b>0.72</b>	0.06	0.06	-0.09	0.23	0.02
7. I believe in reincarnation.	<b>0.70</b>	0.17	-0.02	-0.10	0.22	0.00
8. People can pass information to one another through thinking alone.	<b>0.70</b>	0.15	0.03	0.04	0.14	0.15
11. Thinking certain ways or thoughts can have an effect on the universe and in turn, what happens to you.	<b>0.69</b>	0.12	-0.02	0.05	-0.08	0.21
18. I have attracted everything in my life through my thoughts alone.	<b>0.69</b>	0.11	0.15	-0.12	-0.04	0.12
20. Remote viewing, such as seeing scenes located miles away “in one’s mind” is possible.	<b>0.67</b>	0.04	0.13	0.08	0.31	0.05
14. Some people have the ability to predict the future.	<b>0.64</b>	0.32	0.11	0.08	0.29	-0.02
3. I believe that when the stars align in a certain way, wonderful things will happen.	<b>0.58</b>	0.15	0.13	0.00	0.12	0.12
24. *If you change your thinking you can change your behaviour.	0.40	0.05	-0.07	0.38	-0.21	0.03
13. I believe in heaven and hell.	-0.02	<b>0.89</b>	0.11	-0.01	-0.02	0.08
23. I believe in God.	0.08	<b>0.87</b>	0.08	-0.02	-0.05	0.02
34. I believe in life after death.	0.33	<b>0.78</b>	-0.04	-0.06	0.12	0.03
30. Angels or spirits watch over us.	0.40	<b>0.76</b>	0.00	0.01	0.11	0.07
32. People and/or places can be possessed by evil spirits.	0.24	<b>0.70</b>	-0.01	-0.06	0.32	0.14
36. There is a reason for everything that happens to me and my life is determined by fate.	0.40	<b>0.51</b>	0.00	-0.02	-0.01	0.14
29. If I tap a pen on a desk in the right pattern I will become rich.	0.08	0.05	<b>0.78</b>	-0.07	0.03	0.06
37. The Tooth Fairy is real.	0.07	-0.02	<b>0.76</b>	-0.10	0.15	-0.10
19. Santa Claus exists and lives at the North Pole.	0.07	0.03	<b>0.66</b>	-0.12	0.28	-0.16
5. If I step on a crack in the sidewalk, Ill injure my mother.	0.04	0.10	<b>0.61</b>	-0.12	-0.02	0.15
10. Elementary school children are conspiring to overthrow the U.S. government.	0.06	0.00	<b>0.55</b>	0.02	-0.10	0.19
38. The provincial premiers are conspiring to take over Ottawa.	0.06	-0.03	<b>0.46</b>	-0.05	0.18	0.21
33. There are pills that can relieve a headache.	-0.11	0.08	0.03	<b>0.64</b>	0.09	-0.24
39. If your self-esteem is low this can affect your behaviour.	0.10	-0.03	-0.14	<b>0.64</b>	-0.13	0.07
9. Washing your hands can help prevent spreading illness.	-0.18	-0.04	-0.09	<b>0.60</b>	0.05	-0.06
35. At certain points in history, military and political leaders have secretly conspired to plan military attacks on other countries.	0.03	-0.16	0.07	<b>0.59</b>	0.01	0.30
16. Being overweight can be a health threat.	0.04	0.08	-0.13	<b>0.54</b>	-0.07	-0.06
31. Bacteria exist.	-0.17	0.02	-0.21	<b>0.52</b>	0.09	-0.06
12. Dinosaurs once walked the planet.	-0.08	-0.28	-0.18	<b>0.50</b>	0.25	-0.02
2. Meteorologists can predict weather patterns days in advance.	0.06	0.03	0.03	<b>0.39</b>	-0.01	-0.05
26. People can pass information to another person nonverbally.	0.18	-0.16	0.14	<b>0.33</b>	-0.05	0.09
6. Big Foot exists.	0.24	0.08	0.16	-0.03	<b>0.73</b>	0.08
25. The Loch Ness monster exists.	0.20	0.09	0.22	0.01	<b>0.67</b>	0.08
40. Aliens have visited the earth.	0.35	0.04	0.01	0.01	<b>0.60</b>	0.36
17. The US military engaged in a cover-up of a crashed alien space craft.	0.34	0.02	0.01	0.06	<b>0.56</b>	0.44
15. *I believe in ghosts.	0.45	0.39	-0.03	0.05	<b>0.49</b>	0.07
28. The Apollo moon landing of 1969 was staged inside a Hollywood studio.	0.11	0.14	0.13	-0.06	0.12	<b>0.71</b>
4. The US government conspired to commit 9/11.	0.22	0.08	0.02	-0.05	0.20	<b>0.70</b>
22. The British Royal Family plotted to have Princess Diana killed.	0.15	0.12	0.22	-0.06	0.05	<b>0.68</b>

was as follows: some highschool: 3.0%; highschool graduate: 9.2%; some college/university: 20.8%; college graduate or professional degree: 12.1%; undergraduate degree (Bachelors): 32.8%; graduate degree (Masters or PhD) 18.6%; other: 4.0%. As an incentive for completing the study, participants were entered into a monthly draw to win a \$25, \$50 or \$100 Amazon gift card. The first question of the questionnaire (I believe in the law of karma—you get what you give) was not recorded due to a programming error and was therefore omitted, resulting in a total of 39 questions in the final dataset. This study was approved by the University of British Columbia Behavioural Research Ethics Board (H10-01140), and informed consent was obtained from all study participants.

Data Analysis: Principal Component Analysis (PCA) on Strength of Beliefs, followed by Mixed-Model Analyses of Variance (ANOVA) on Reasons for Beliefs.

PCA followed by ANOVAs on the component scores were conducted to explore associations between strength of beliefs and reasons for these beliefs. PCA was carried out with varimax rotation on ratings of strength of belief, and a scree plot [17,18] was inspected for selection of the number of components. PCA was selected because the follow-up ANOVA analysis investigating reasons for beliefs used ranked PCA component scores. In PCA, component scores can be directly and uniquely computed; in contrast, in exploratory factor analysis (EFA) factor scores are not unique, such that different sets of factor scores can account for the same set of observed variables, known as factor score indeterminacy [19]. Following the PCA, 4 × 6 Mixed-model ANOVAs were carried out, with “Strength” of belief (4 levels based on ranked PCA component scores: Low, Medium-Low, Medium-High, and High) as the between-groups factor, and “Reasons” for beliefs (Education, Media, Social/Cultural Influences, Experienced Personally, Just a Belief, and Other) as the within-subjects factor. “Reasons” percentages were computed for the variables which dominated the component loadings for each component (items set in bold in Table 2). The percentages of the 441 participants who endorsed in each level of belief for each questionnaire item (1 = Disbelieve, 2 = Weakly Believe, 3 = Moderately Believe, 4 = Strongly Believe, 5 = 100% Certain) are listed in Table S1.

### 3. Results

#### 3.1. PCA component interpretation

Six components were extracted from PCA and explained a cumulative total of 52.60% of the total variance. We also completed a parallel analysis as recommended by Preacher and MacCallum [20]; and this also indicated a 6 component solution. The component loadings are presented in Table 2. After manual inspection of the types of questions found in each extracted cluster, components 1–6 were labelled as New Age, Traditional, Nonconformist, Science, Mythical and Conspiracy Theory, respectively. For comparisons across studies, each belief scale can be computed as the mean of their respective indicators, the items set in bold font in Table 2, but may have restricted variance because many subjects will have a score of 0 on these scales, because belief endorsement levels are not above 50% for any of the non-science scales (see Table S1). Chronbach’s alpha for each component was computed on the items set in bold font in Table 3 as a measure of internal consistency.

Component 1 was dominated by loadings for beliefs related to New Age thinking, such as energy manipulation healing and reincarnation ( $\alpha = 0.89$ ). Component 2 was dominated by loadings for beliefs related to traditional spirituality, such as belief in heaven and hell, God, and life after death ( $\alpha = 0.89$ ). Component 3 consists primarily of loadings involving absurd events or fairy tales, like believing in the Tooth Fairy or bizarre statements such as “if I tap a pen on a desk in the right pattern I will become rich.” We interpret endorsing these statements as mischievous or being deliberately contrarian in nature ( $\alpha = .70$ ). Component 4 involves endorsement of belief in scientifically validated events, such as washing hands to prevent spreading illness and the existence of dinosaurs ( $\alpha = 0.65$ ). Component 5 involves belief in unseen beings, such as Big Foot, the Loch Ness monster, and aliens ( $\alpha = 0.80$ ). Component 6 indexes belief in conspiracy theories, such as a staged moon landing and the US government conspiring to commit the 9/11 incident ( $\alpha = 0.77$ ).

The distribution of participants who, to any degree, endorsed at least one of the beliefs which dominated the component loadings for each component (any of those items set in bold font in Table 2) is listed in Table 3, and these numbers also determined the sample sizes for the ANOVAs. For example, the value 48 in the cell for Strength of Belief: Low and New Age in Table 3 indicates that 48/110 participants in the lowest quartile of the component scores for the New Age component (i.e., the Low belief category) endorsed some degree of belief in any of the items from the New Age component listed in Table 2 in bold font. The reason many participants are

**Table 3**

Sample sizes of participants who endorsed any level of belief for any items of a particular type (loadings listed in bold font in Table 2), and therefore followed up with a reason for their belief. Strength of belief is based on percentile ranking of component scores from the PCA. Based on quartile determinations on component scores of 441 subjects the component scores (computed on *all* variables), there were ~110 subjects in each of Low, Medium-Low, Medium-High and High categories. The distribution of these participants who, to any degree, endorsed at least one of the beliefs on the dominant items (set in bold font in Table 2), is depicted here.

Strength of belief (ranked component scores)	Type of Belief					
	New Age	Non-conformist	Science	Traditional	Mythical	Conspiracy Theory
Low	48	2	106	28	48	43
Medium-Low	70	2	106	72	43	39
Medium-High	107	3	109	108	81	76
High	107	50	109	106	109	107
Total	332	57	430	314	281	265

excluded from Table 2 is that subjects are ranked on belief strength on their component scores, which are computed on all variables, but can only be included in the ANOVAs using “Strength” and “Reasons” if they endorsed at least one of the items selected based on dominant component loadings (any of those items set in bold font in Table 2).

The types of beliefs and how they interacted with Reasons are listed in Table 4.

The percentage of participants endorsing some level of belief is plotted as a function of type of belief, averaged over items classified into each belief type, is displayed in Fig. 2 (computed as the subtraction of 100% – values in Column 1, 1 = Disbelieve, displayed in Table S1).

Fig. 3 shows the mean percentage of reason for endorsed belief, plotted as a function of strength of belief. All add up to 100 within a group because the task interface required the reasons to total 100%.

### 3.2. New age spiritual

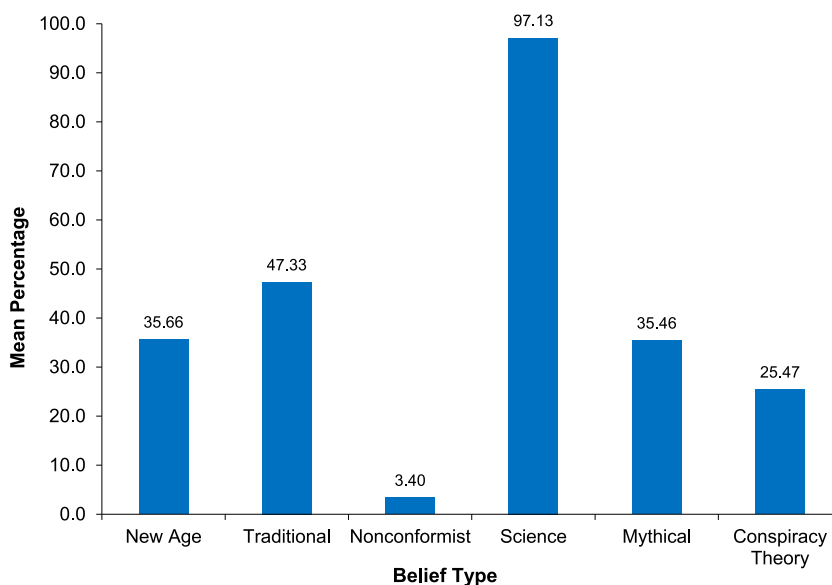
For New Age Spiritual (see Fig. 3A), there was a strong main effect of Reasons,  $F(5,1640) = 34.97, p < .001, \eta^2 = 0.10$ , whereby culture and ‘just a belief’ were highest but did not differ from one another ( $p = .85$ ). Similarly there was no main effect present when the analysis was restricted to media and experience ( $p = .30$ ), but the average of culture/just believe was significantly higher than the average of media/experience,  $F(1,328) = 50.11, p < .001, \eta^2 = 0.13$ , and the average of media/experience was significantly higher than education,  $F(1,328) = 13.40, p < .001, \eta^2 = 0.04$ , and other,  $F(1,328) = 55.16, p < .001, \eta^2 = 0.14$ . There was also a significant Strength  $\times$  Reasons interaction,  $F(15,1640) = 2.49, p < .005, \eta^2 = 0.02$ . The interaction was not significant when the high-belief-strength group was excluded ( $p > .6$ ); therefore, the interaction was interpreted by comparing the average of the three lowest level of beliefs-strength groups to the highest one. This analysis found that the high-belief-strength group differed significantly from the average of the three lower strength groups on media,  $F(1,328) = 4.96, p < .05, \eta^2 = 0.01$  (lower value for high-strength believers), experience,  $F(1,328) = 19.68, p < .001, \eta^2 = 0.06$  (higher value for high-strength believers), and just a belief,  $F(1,328) = 5.48, p < .05, \eta^2 = 0.02$  (lower value for high-strength believers). This suggest that, for high-strength believers in new age beliefs, their reasons for believing are shifted towards personal experience and away from media and “just believing” (no specific source), relative to those with lower belief strengths.

### 3.3. Traditional Spiritual

For Traditional Spiritual, there was a strong main effect of Reasons,  $F(5,1550) = 40.89, p < .001, \eta^2 = 0.12$ , whereby culture and ‘just a belief’ were highest, but did not differ from one another ( $p = .67$ ). There was no main effect present when the analysis was restricted to education, media, experience and other ( $p = .34$ ), and culture/just believe was significantly higher than the average of the other four,  $F(1,310) = 208.98, p < .001, \eta^2 = 0.40$ . There was also a significant Strength  $\times$  Reasons interaction,  $F(15, 1550) = 3.30, p < .001, \eta^2 = 0.03$ . If the high-belief-strength group was excluded, this interaction was not significant, which was not the case for any other group, suggesting that the high-belief-strength group is essential for the significant interaction (see Fig. 3B). Therefore, to understand the interaction, the high-belief-strength group was compared to the average of the other three. This comparison was significant for media,  $F(1, 310) = 7.16, p < .01, \eta^2 = 0.02$  (reduced for high believers), experience,  $F(1, 310) = 5.55, p < .05, \eta^2 = 0.02$

**Table 4**  
Types of beliefs and how they interaction with Reasons for Belief, (N = 441).

Type	Example Items	Reasons	Interaction with Level of Belief
New Age	27. People heal if energy manipulated 8. People can pass info by thinking 21. Healing stones improve health	Major: “Just a belief” Minor: “Culture”	High belief group: + Experience - Just a belief
Traditional	23. I believe in God 30. Angels or spirits watch over us 13. I believe in heaven and/or hell	Major: “Culture” Minor: “Just a belief”	High belief group: + Experience + Culture - Just a belief
Nonconformist	19. Santa lives at North Pole 37. The Tooth Fairy is real	Major: “Just a belief” Minor: “Media”	none
Science	12. Dinosaurs once walked the planet 31. Bacteria exist 35. Leaders plan attacks on countries	Major: “Education” Minor: “Experience”	High belief group: + Education - Media
Mythical	6. Big Foot exists 25. The Loch Ness monster exists. 40. Aliens have visited the earth.	Major: “Media” Minor: “Just a belief”	none
Conspiracy Theory	4. The US government conspired to commit 9/11 22. The British Royal Family plotted to have 28. Princess Diana killed. 28. The Apollo moon landing of 1969 was staged.	Major: “Media” Minor: “Just a belief”	High belief group: + Education - Media



**Fig. 2.** Percentage of 441 participants endorsing some level of belief, plotted as a function of type of belief, averaged over items classified into each belief type (computed as the subtraction of 100% – values in Column 1, 1 = Disbelieve, displayed in Table S1).

(increased for high-strength believers), and just a belief,  $F(1, 310) = 9.20, p < .005, \eta^2 = 0.03$  (reduced for high-strength believers). This suggests that, as was the case for New Age Spiritual, for high-strength believers in traditional spirituality, their reasons for believing are shifted towards personal experience, and away from media and ‘just a belief’ (no specific source). Also, when comparing the high-belief-strength and medium-high-strength groups to the lowest two, a significant difference was present for culture only,  $F(1, 310) = 6.53, p < .05, \eta^2 = 0.02$  (increased for high believers). This suggests that, unlike for New Age Spiritual, for medium-high-strength or high-belief-strength believers, their reasons for believing are shifted towards culture.

### 3.4. Nonconformist

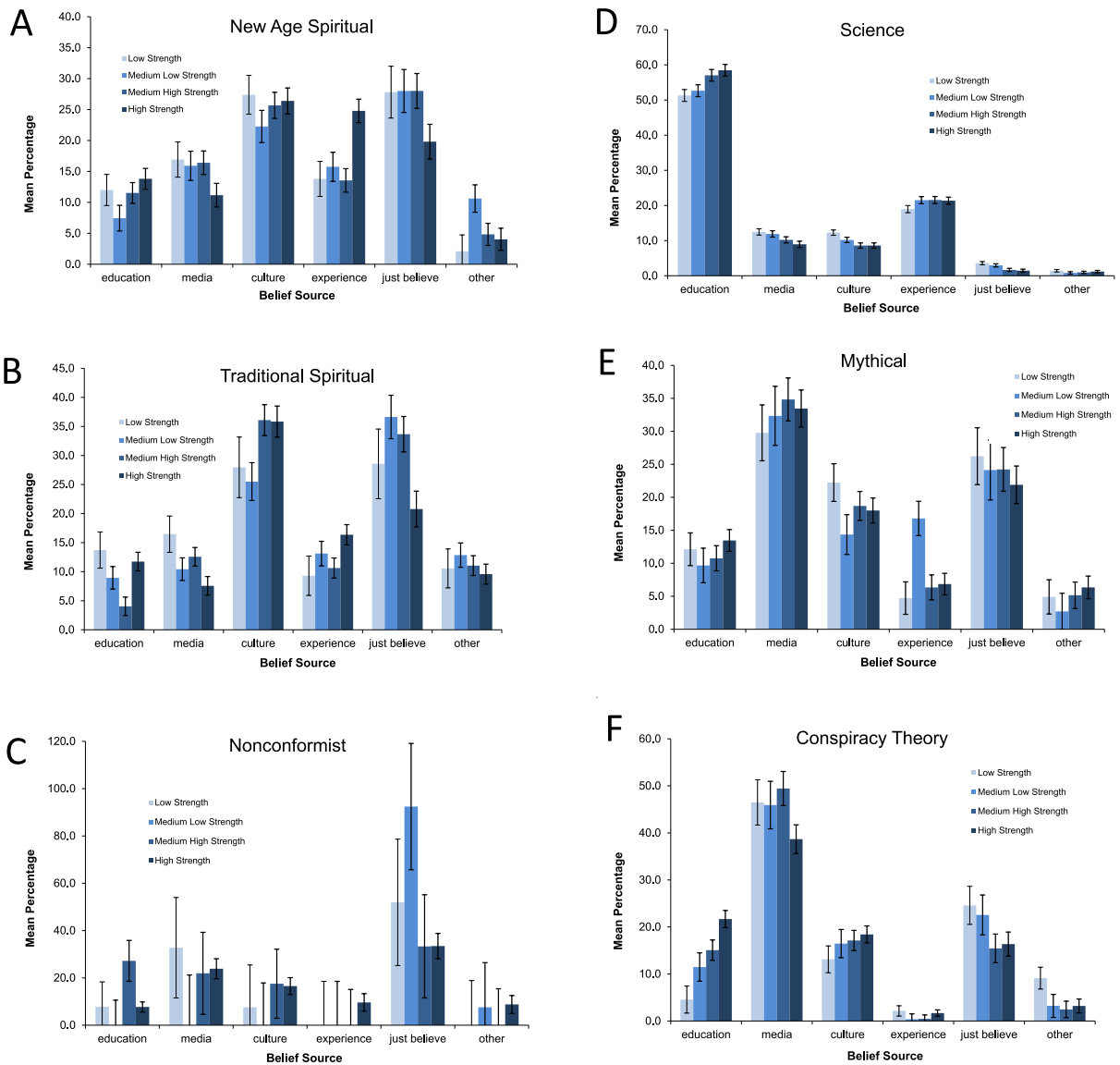
For Nonconformist responses, looking at participants in the 0–75th percentiles on belief strength from the Nonconformist component scores, only 7 subjects endorsed beliefs on the dominant items from the Nonconformist component (see Table 3). Averaged together, those 7 did not differ on Reason for Belief from the 50 participants who reported having strong beliefs in the dominant Nonconformist items. Therefore, we averaged all participants together regardless of strength of belief for this component. This showed a significant main effect of Reason,  $F(5, 265) = 4.51, p < .001, \eta^2 = 0.08$ , with ‘just a belief’ as the most common reason across all subject groups,  $F(1, 53) = 10.81, p < .005, \eta^2 = 0.17$ . In contrast to the other components, which show similar sample sizes for high and medium-high-strength believers (new age: 107, 107; science: 109, 109; traditional: 108, 106; mythical: 81, 109; conspiracy theory: 76, 107, respectively), for the Nonconformist component the samples sizes were: 50, 3, for high and medium-high-strength believers, respectively (see Table 3).

### 3.5. Science

For Science beliefs, there was a strong main effect of Reasons,  $F(5, 2130) = 1448.68, p < .001, \eta^2 = 0.77$ . All sources of reasons differed significantly from one another, in the following order, from highest to lowest: education, experience, media, culture, ‘just believe’, other. There was a significant Strength  $\times$  Reasons interaction,  $F(15, 2130) = 3.64, p < .001, \eta^2 = 0.02$ . This interaction was not significant when restricted to the high- and medium-high-strength groups ( $p > .9$ ), or when restricted to the low- and medium-low-strength groups ( $p > .1$ ). Therefore, these were averaged respectively, and compared as weak vs. strong, and this Strength  $\times$  Reasons interaction was significant,  $F(5, 1610) = 4.46, p < .001, \eta^2 = 0.01$ . Strong believers responded with education as their reason for belief more frequently than weak believers,  $F(1, 322) = 6.44, p < .05, \eta^2 = 0.02$ , media as significantly lower,  $F(1, 322) = 4.44, p < .05, \eta^2 = 0.01$ , and ‘just a belief’ as significantly lower,  $F(1, 322) = 9.07, p < .005, \eta^2 = 0.03$ . This suggests that, for medium-high-strength and high-strength believers in science, relative to low-strength and medium-low-strength believers, their reasons for believing are shifted towards education, and away from media and ‘just a belief’.

### 3.6. Mythical

For the Mythical beliefs, there was a main effect of Reasons,  $F(5, 1385) = 43.43, p < .001, \eta^2 = 0.14$ , whereby media was the highest, but education and personal experience did not differ from one another ( $p = .08$ ). All other sources of reasons differed



**Fig. 3.** Mean percentage of reason for endorsed belief in New Age Spiritual (A), Traditional Spiritual (B), Nonconformist (C), Science (D), Mythical (E), and Conspiracy Theory (F), plotted as a function of strength of belief. All add up to 100 within a group because the task interface required the reasons to total 100%.

significantly from one another, in the following order, from highest to lowest: media, ‘just a belief’, culture, education/experience, and other. The Strength × Reasons interaction was not significant ( $p = .58$ ). Media and ‘just a belief’ were the strongest endorsed reasons, and differed significantly from each other,  $F(1, 277) = 6.91, p < .01, \eta^2 = 0.02$ , with media highest. However, ‘just a belief’ was still significantly higher than the average of the other four,  $F(1, 277) = 35.98, p < .001, \eta^2 = 0.11$ , and culture significantly higher than the remaining three,  $F(1, 277) = 45.01, p < .001, \eta^2 = 0.14$ . ‘just a belief’ was also significantly higher than culture on a pairwise comparison,  $F(1, 277) = 4.99, p < .05, \eta^2 = 0.02$ . This suggests that reasons for believing in mythical creatures are mainly media, ‘just a belief’, and culture, in that order.

### 3.7. Conspiracy theory

For Conspiracy Theory, there was a main effect of Reason,  $F(5, 1305) = 101.42, p < .001, \eta^2 = 0.28$ , whereby education and culture did not differ significantly from one another ( $p = .09$ ) but all others did, in the following order: media, ‘just a belief’, education/culture, other, and experience. There was also a significant Strength × Reasons interaction  $F(15, 1305) = 2.65, p < .001, \eta^2 = 0.03$ . If the high-strength belief group was excluded, this interaction was not significant ( $p > .25$ ), which was not the case for exclusion of any



other group, suggesting that the high-strength group is the only one essential for the significant interaction. Therefore, to understand the interaction, the high-strength-belief group was compared to the average of the other three. This comparison was significant for education/personal research,  $F(1, 261) = 22.12$ ,  $p < .01$ ,  $\eta^2 = 0.08$  (increased for high believers), and media,  $F(1, 261) = 4.58$ ,  $p < .05$ ,  $\eta^2 = 0.02$  (reduced for high believers). This suggests that for high-strength believers in conspiracy theories, their reasons for believing are shifted towards education/personal research and away from media.

#### 4. Discussion

We identified six dimensions from the BWSSE scale based on ratings of strength of belief, and captured the reasons for weakly or strongly holding each dimension. The six dimensions were: Traditional Spiritual, New Age Spiritual, Science, Nonconformist, Mythical, and Conspiracy Theory. Compared to weaker believers, stronger believers in Traditional and New Age spirituality attributed their beliefs more to personal experience, and stronger believers in Conspiracy Theory more to education/personal research. This demonstrates that although spiritual beliefs are strengthened by personal experience (Traditional or New Age), others are strengthened by information gathering (Conspiracy Theory).

The New Age Spiritual beliefs involved items such as clairvoyance, reincarnation, and healing with crystals. Traditional Spiritual included beliefs in God, angels or spirits, and heaven/hell. Previous classification studies differentiated “religious exclusives” from “New Age spiritualists” [21], which parallels the separation observed here between Traditional and New Age spirituality. Despite this separation of Traditional from New Age Spiritual, when looking at reasons for belief, personal experience was higher for high-strength believers in both New Age and Traditional Spiritual (see Fig. 3A and B), consistent with a previous study [21]. The clear difference between the Traditional and New Age Spiritual categories with respect to reasons for belief was a shift towards culture for high-strength and medium-high-strength believers for Traditional Spiritual that was not seen in New Age Spiritual (see Fig. 3A and B), reflecting the importance of cultural influences in traditional religious beliefs.

Low, medium-low, and medium-high strength believers in the New Age Spiritual category attributed their beliefs to culture and “just a belief,” but high-strength believers shifted their reasoning away from ‘just believe’ and towards personal experience, resulting in similar influence of culture, “just a belief,” and personal experience for high-strength believers in New Age Spiritual (Fig. 3A). These experiences may overlap with what is captured on schizotypy scales, such as perceived spirit possession or telepathic thought [22]. In contrast, for Traditional Spiritual, high-strength believers showed stronger influence of culture than personal experience or ‘just a belief’ (see Fig. 3B).

There was a bigger difference between the culture/just believe categories and the other four sources for Traditional relative to New Age Spiritual. In the future, culture may become a more important source for New Age, because the status of “spiritual-but-not-religious (SBNR)” is becoming an increasingly popular self-designation as people turn away from traditional organized religion and towards alternative views such as spiritual retreats and healing crystals [23,24]. Nearly 20% of our sample showed at least a medium-strong belief in the New Age Spiritual category (Table S1, columns labelled 3, 4 or 5), compared to about 30% for Traditional Spiritual.

Nonconformist beliefs involved beliefs almost universally accepted to be false (by adults), such as the existence of Santa Claus and the Tooth Fairy. We interpreted high-strength belief endorsement of such beliefs as a playful response pattern, rather than an indication that these were the respondents’ actual beliefs. Correspondingly, 52.79% of participants who at least weakly endorsed the Nonconformist items attributed their belief to ‘just a belief’, in comparison to media (19.64%) or other factors (27.57%; see Fig. 3C). The Nonconformist component differs from the other belief categories, as the proportion of high-strength Nonconformist believers was much higher than that of lower strength believers. These items were designed to have essentially no supporting evidence, extending the full range of strong supporting evidence to no imaginable supporting evidence on the scale, and correspondingly, 96.6% of participants expressed non-belief in these items (see Table S1).

Mythical beliefs ranged from belief in supernatural beings such as ghosts to phenomena such as aliens visiting the earth. Questionnaire items that describe these types of events loaded onto the same component, and about 20% of the participants reported moderate-to-strong belief averaged over Mythical items (Table S1). Media was determined as the main source of belief regardless of level of mythical belief (Fig. 3E). Common media sources likely involved the news, radio stations and various social media platforms [25,26]. Consistent with our findings, people who frequently engage in media sources that feature supernatural phenomena, such as watching paranormal reality television shows, are more likely to endorse in mythical beliefs [26], and the reasons for beliefs did not depend on the strength of the belief for Mythical.

Conspiracy theories have been defined as alternative explanations to historical or current events that result from conscious manipulation by powerful or malevolent groups with hidden schemes [27,28]. Conspiracy theory beliefs often revolve around actions hidden from public scrutiny and the use of disinformation as a cover-up [28]. Access to online media has allowed belief in conspiracy theories to proliferate across various cultural contexts [27]. This is consistent with our current findings, as media was reported as the main source behind conspiracy theory beliefs, with a shift towards education/personal research for strong believers (Fig. 3F).

Although both strong and weak believers in the Science category equally attributed their beliefs to education/personal fact-finding (Fig. 3D), for Conspiracy Theory, high-strength believers shifted from the most common source, media, to education/personal fact-finding (Fig. 3F). Given that the number of people who endorse scientific beliefs is much higher than those with conspiracy theory beliefs (Table S1 and Fig. 2), the type of fact-finding performed for these two categories likely differ [15]. For example, personal fact-finding is prone to data fabrications on the internet and confirmation biases specific to each individual, or the tendency to gravitate towards information that conforms to one’s existing views [29]. Additionally, the type of personal research that gives rise to conspiracy theory beliefs is likely related to weak media literacy, where individuals have difficulty critically evaluating material

produced by the media and are prone to media manipulation or “fake news” [30]. This suggested overlap between personal fact-finding and media literacy as a source for conspiracy theory beliefs is consistent with our findings, as media was the major source for all believers, but strong believers tended to shift towards education/personal research/fact-finding (Fig. 3F); perhaps more intensive research into claims from the media can be interpreted as personal fact-finding in the strong believer group.

## 5. Limitations

One limitation of this study is the inclusion of education and personal fact-finding together as a single option for source of belief, as information delivered through a standardized education system likely differs from that attained through personal research or fact-checking, which may incorporate unexpected biases [31]. Separating these sources into separate response options would aid in discriminating between the origin of scientific and conspiracy theory beliefs. In addition, by including the media as a single source of belief, we are unable to extend our findings to specific types of media, such as radio stations or social media platforms. Since social media has become an increasingly relevant source of beliefs in cross-cultural contexts [32,33], parsing the media option into social media and “general news or other media” [15] would increase our understanding of the types of beliefs that arise from either category. Another limitation is the absence of items that involve attitudes toward climate change and events related to the recent global pandemic. This method of capturing BWSSE trends in the healthy population provides a template for investigating where different types of beliefs originate and can be extended to include questions regarding COVID-19 and future global health crises, pressing climate change issues, and the influence of political events. Additionally, reasons for not endorsing the beliefs with strong supporting evidence should also be recorded, as they may be considered a different type of BWSSE. Finally, our sample population was quite highly educated, so future studies may target people with lower education levels, as a highly educated sample may be more likely to believe in/support science.

## 6. Implications

These findings may have important social implications. Research has now clearly shown that BWSSE are not ‘fringe’, but instead are common [10–13]. In the COVID-19 health pandemic, surveys from the UK, Europe, and North America suggested that 30–40% of the population endorsed, to some degree, at least one COVID-related conspiracy theory belief [34,35]. The conspiracy theory mentality has been linked to lower willingness to vaccinate against COVID-19 (Oleksy et al., 2022), and uncovering individuals’ reasons for pursuing these beliefs provide the sources from which vaccine hesitancy may originate. Overall, these findings reinforce the importance of considering both degree of endorsement of belief categories and reasons for either weakly or strongly holding each dimension of belief. In the current study, strong believers in traditional and new age spirituality shifted their belief sources away from ‘just believe’ to personal experience, while strong believers in conspiracy theories shifted their beliefs away from media to education/personal research. Conspiracy theories may be more amenable to debiasing attempts to move people away from their false beliefs [13], since high-strength beliefs are shifted towards education/research as a source. Debiasing can give rise to skepticism through framing, exposure, and observational learning [13], and may involve identification of specific sources of information and separating out scientifically validated sources from informal sources on social media or other non-credible sources. A form of debiasing has been used by our group to help people with schizophrenia gain insight about their psychotic paranoid delusions [36–40], and to reduce anti-Muslim bias in a German population [41]. However, only certain beliefs may be changeable, and likely only for people with certain reasons-for-belief profiles. This research is a first step to identifying these candidate profiles, important for negotiating global humanitarian emergencies in the not-so-distant future.

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Wrote the paper: Todd Woodward; Judy Cheng; Katie Lavigne; Jessica Khangura; Abhijit Chinchani; Hafsa Zahid; Mahesh Menon; Andrew Ryder; Ryan Balzan; Jiaying Zhao; Maiya Rasheed; Bryan Woodward.

### Data availability statement

Data included in article/supp. material/referenced in article.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to

influence the work reported in this paper.

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## Appendix A. Supplementary data

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