Author's response to reviews

Title: Exploring laypeople's epistemic beliefs about medicine - a factor-analytic survey study

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Author's response to reviews: see over
Dear editors, reviewers, editorial board members, and associate editors,

We are pleased to enclose a revised version of our submission ‘Exploring laypeople’s epistemic beliefs about medicine – a factor-analytic survey study’. We would like to thank all reviewers for the positive and thoughtful feedback on our manuscript, and for the valuable time and effort they have invested. In the revision of the manuscript, we have attended very carefully to all the issues the reviewers raised and hope you agree that these have strengthened the manuscript. The attached tables present each of the reviewer’s concerns and details how these points are addressed in the manuscript.

Yours sincerely,

The authors

Comments by Reviewer 1:

1) The second paragraph on page 4 where the authors discuss the "apprehension structure" of epistemic beliefs - elaboration on what exactly this means would be helpful.

- We have outlined this in some more detail, see:
  “Epistemic beliefs are furthermore seen to function as an “apprehension structure” [10]: they allow for an anticipation of the knowledge to be learnt or to be dealt with, which includes for example an expectation of the complexity of a topic and of how much is already known about a topic.

2) Page 5 last para "exemplarily study" is not correct English

- We corrected this phrase, now it reads “An exemplary study...”

3) It would be helpful to describe the study on the top of page 6 in more detail. How were less advanced, moderate and more advanced epistemic understanding defined and measured?

- We now outline further details of the study, see:
  “In this study, an initial test of epistemic understanding asked participants to indicate for pairs of contrasting statements whether they think that only one of the views described is right or whether both views could have some rightness and – depending on the response to this question ("if both could be right") – whether one view could
be better than the other. According to this initial test, participants were assigned to three groups of different epistemic positions: participants primarily holding a less advanced (seeing knowledge as absolute and either right or wrong), moderate (seeing knowledge as idiosyncratic, so that all positions are equally right), or more advanced view (seeing knowledge as derived from reason, so that some positions are more justified and sustainable than others).”

4) On page 8, where the authors describe the selection of some dimensions from EBAPS, it would be helpful to have greater elaboration on what dimensions they selected and why. Similarly, some additional description of the Global Certainty Scale is needed. This overall section that discusses the creation of the items requires more explanation. Why did the authors select these?

➢ The guiding idea for the selection of dimension is pointed out in the first part of the paragraph; see:

“We aimed for a questionnaire that explicitly focuses on the appearance of medical knowledge in everyday life. That is, it should consider such aspects of epistemic beliefs that are crucial for laypeople’s search and evaluation of competing sources of medical knowledge.”

➢ We also now mentioned the EBAPS dimensions that we decided not to consider and why we did so:

“We left out the EBAPS dimensions “nature of knowing and learning” and “source of ability to learn”, as they focus on aspects of intelligence and learning and are therefore in our view [35] and the view of many other researchers [18,36] outside the construct of epistemic beliefs.”

➢ We also added some further information on the Global Certainty Scale, see:

“The Global Certainty Scale [40], which focuses on the fallibility of scientific knowledge, seemed to be a promising source of inspiration. This scale consists of 7 items measuring in how far knowledge and theories in the soft and hard sciences are perceived as certain and unchangeable respectively as changing and fallible (a sample item for this scale is “Scientific theories can be proven false at any time“ (reverse scored)).”

5) Data on demographics and other sub-group characteristics were collected but no analysis is reported. Were there any differences?
Reviewer 1 asked the interesting question of differences between sub-groups. The main aim of this study was the development of the instrument EBAM and the associated research question was whether a meaningful factor structure could be found. With regard to this, equal factor solutions emerged when factor analyses were conducted separately for the younger (high school students) and the older sample, so there were no differences.

It is furthermore an interesting question for future research in how far the instrument will be able to differentiate between specific subgroups, e.g. between persons with low and substantial prior medical knowledge. We point to this in the discussion now, see:

“In addition, it will be interesting to investigate whether the EBAM is able to differentiate between specific subgroups, e.g. between persons with low and substantial prior medical knowledge.”

5) On page 13, when the authors talk about the fact that EBAM dimensions are similar to those of other instruments, some elaboration would be useful. Are there some significant differences that are of interest in EBAM? Are there factors that other instruments have that EBAM does not? Ultimately, the objective of the instrument is to help doctors communicate with their patients. Understanding how medicine-related epistemic beliefs is different from other discipline specific beliefs would be useful.

We have rewritten the discussion of the factor structure and added some more information on the specificity of the EBAM dimensions, see:

“The dimensions found are similar to those found in most popular epistemic questionnaires, because the EBAM takes into account aspects of the certainty and stability of knowledge, the justification for knowing, and the source of knowledge. The dimension Certainty of Medical Knowledge focuses on the extent that medical knowledge is fixed. The dimension Justification of Medical Knowledge taps how laypeople justify knowledge, e.g. by making use of authority and expertise (similar to Hofer’s dimension “justification for knowing” [37]). However, the EBAM thereby also considers that people also make use of patients who have a specific disease (as specialized “experts”) to justify knowledge. The two EBAM factors on sources of knowledge, factor 2 and factor 3, both explicitly focus on the credibility of sources. In contrast to other instruments on epistemic beliefs, the EBAM does not explicitly
consider the self as a knowing person. In the context of the EBAM where a layperson deals with medical information, it is rather unrealistic that the layperson becomes a knower herself or himself in the sense of an active maker of meaning. Instead, a layperson will probably use different and more or less reliable sources to come to know. Therefore, the factor solution for the EBAM underlines the importance of considering the role of sources in laypeople’s understanding of medicine: due to the fact that laypeople only have limited medical knowledge on their own, they have to rely on others. For example they may gain information from medical textbooks (Credibility of Medical Textbooks) or the Internet (Credibility of Medical Information on the Internet). The factor Stability of Medical Knowledge focuses on how stable or variable medical knowledge is perceived to be.”

6) The conclusion section repeats some of what was presented in the background. I think this section would be stronger if the authors discussed how this instrument might be used by doctors and public health professionals and what additional research would be needed to make it usable. For example, the authors mentioned earlier the correlation between the level of advancement of epistemic understanding and epistemic beliefs - how would this apply to the medical discipline? What additional analysis would make this instrument a practical tool for the medical profession?

- We have outlined some further aspects for future research in the discussion, see:
  “Furthermore, subsequent studies should aim for a replication of the factor structure across other, more heterogeneous samples, as the sample in this first study is rather homogenous with regard to age and education. In addition, it will be interesting to investigate whether the EBAM is able to differentiate between specific subgroups, e.g. between persons with low and substantial prior medical knowledge. A further topic for future research is how people’s medicine-specific epistemic beliefs guide their decision making when facing a health problem.”

Quality of written English: Needs some language corrections before being published

- Before we turned in the paper, we hired a professional native speaker editor to avoid unclear writing.
Comments by Reviewer 2:

# The authors provide a number of arguments for the claim that ‘beliefs about medicine are important…’: 1/ Important for patients to understand the complexity and uncertainty of knowledge, 2/ the justification for knowing and 3/ the high occurrence of ill-structured questions in medicine. Being an EB researcher, I am convinced of the importance and relevance of this framework. However, I wonder whether in this case, it may be important to also refer other factors which may be very or even more important factors in ‘shared decision making’. For example: we could all imagine a patient who, once he enters the consultation room, prefers to take the ‘subject’ role rather than to actively participate in the decision making. “Yes doctor, if you say that tablets would be the best treatment option for me, I will take them”. It may be that concerning decision about his health may be guided by anxiety, rather than by beliefs. And: how do you think doctor’s communication skills can interfere in shared decision making? How important is for example the price of a medicin in the patients' decision whether to take or not take it? Do you think that the EB play an equally important role for all patients, or mainly for the reflective patients who want to be involved in decision making? I think that providing a broader theoretical picture may be beneficial to reader of BMC Public health.

➢ Reviewer 2 points out very important aspects in this remark. We fully agree that decision making is in itself a highly complex - and under-researched – topic and that of course not only epistemic beliefs play a role in the process of decision making. We have now outlined this in more detail in the introduction, and we have also re-structured and re-written some parts of the introduction, see for example:

“Of course, whether the patient will take advice from his doctor and in how far he is willing to participate in the decision making process, is not only influenced by epistemic beliefs but also by many other factors, e.g. the patients’ degree of anxiety, age or even their numeracy skills [5]. Furthermore, various characteristics of the doctor will play a role, e.g. his general consultation skills [6] but also in how far he appears to be trustworthy and competent [7] (and this evaluation of trustworthiness and competence might again be influenced by epistemic beliefs, see below).”

“However, also in the case that patients prefer a rather paternalistic decision making model, their epistemic beliefs will still play a role insofar as they may guide the choice of the expert to be trusted.”
How do the authors define ‘medical decision making’ and ‘shared decision making’? The medical decision making research has a long tradition in the medical domain. Knowing this research, I was somehow confused with the way the authors used this terminology.

- We decided to use the term medical decision making throughout the text because it is a broader term than shared decision making. It should neither imply a paternalistic nor a consumerist decision-making style. Furthermore, we also subsume the decisions a patient may make on her/his own under the umbrella term “medical decision making”. We hope that this gets also clear in the introduction.

P2: methods: last word: beliefs: do you mean knowing?

- Thank you, we got something wrong in this sentence. It now reads “…different sources as a way to justify knowledge.”

Authors state that ‘For shared decision making and for patients’ treatment adherence, it is necessary for patients to understand the complexity….’ Is it possible to provide a reference for this claim?

- We added two references to underline the claim made (see references 1 and 2).

Subsequently, the authors give the example of a patient with high cholesterol levels. In my opinion, this well elaborated example does not illustrate the complexity and uncertainty of knowledge, but rather addresses the question as to which factors will determine the sources of information the patient is going to rely upon (justification for knowing). I think in the cholesterol case, with current understandings, there are quite clear guidelines on how to treat the patients. So to me, this is not so much a good example of an ill-structured question, of complexity and uncertainty of medical knowledge. Maybe it could be worth looking into the screening for prostate cancer using PSA-levels or the treatment of an ankle sprain may provide better examples.

- We have re-structured and re-written some parts of the introduction (see above), so we hope that this could also remove some of your concerns.

- We agree with some of the limitations of the cholesterol example you pointed out. The following aspects encouraged us to maintain the cholesterol example (and we hope you can accept that we did so): firstly, dealing with high cholesterol in our view offers a considerable scope of action for laypeople (e.g. they can change their diet;
with regard to the treatment of an ankle sprain, laypeople’s scope of action is much more limited); Secondly, when someone searches the internet for information on cholesterol and its treatment this information is particularly widely spread and really heterogeneous (Google finds about 104,000,000 results for the keyword “cholesterol”). In consequence, the treatment of cholesterol may at least in a layperson’s view be a complex and ill-structured problem, although the cholesterol example also addresses the question of which factors will determine the sources of information the patient is going to rely upon, as you pointed out. Thirdly, although we are not medical experts ourselves, there seem to be some studies pointing out that the treatment of cholesterol might provide aspects of an ill-structured problem even for experts (see reference 4). We have pointed to these aspects in the paper now.

# P9: the questionnaire was presented at an open campus day: to what extent do you think this biased the results?

- In our view, this influenced the data insofar as the sample is rather young (see comment by reviewer 3), but, as we pointed out in our answer to reviewer 1, equal factor solutions emerged when factor analyses were conducted separately for the younger (high school students) and the older sample. Participants at the open campus day filled in the questionnaire in a quiet room and had plenty of time. In sum, we do not think that the data collection at the open campus day biased the results.

# P12: last paragraph: Results not only indicated that …., they also showed that laypeople have meaningful beliefs about the…, which may guide their medical decision making. Isn’t it the case that the results don’t indicate that EB may guide the medical decision making? The study wasn’t set up to be able to make this claim…

- Yes, you are right, this study only can show that people hold meaningful beliefs, we deleted the last part of the sentence. We also now point to the claim in the future research section in the discussion, see:

“A further topic for future research is how people’s medicine-specific epistemic beliefs guide their decision making when facing a medical problem.”

Comments by Reviewer 3

- Although mentioned in the discussion, the Public Understanding of Science theory can help support your argument in the introduction.

- In the revised manuscript, we have rewritten parts of the introduction (see also the
I have some concerns regarding the sample:
- According to average age of participants (20.79±3.83) the sample consisted mainly of young participants, this fact might influence the results, as younger people tend to use the Internet more. - The same goes for the fact that 50% of the participants were students; this might bias the results regarding epistemic beliefs and understanding of medical information and Internet use.
These two issues should be addressed.

- We now address these issues in the discussion as an aspect of future research, see:
  “Furthermore, subsequent studies should aim for a replication of the factor structure across other heterogeneous samples, as for example the sample in this first study is rather homogenous with regard to age and education.”

- Please refer to ethical considerations: IRB approval, informed consent.
- What was the compliance rate?

  - In Germany, IRB approval for survey studies is rather unusual so far. In consequence, we did not apply for IRB approval. However, as we did not collect data with identifying information and as participation was voluntary, we hope that this is okay.
  - Unfortunately, in our case it is not possible to calculate a compliance rate, as we do not know the base rate (we neither know how many people read the invitation on the social networking website nor how many people came to the psychology department during the open day).

- The conventional test for factor analysis is "varimax rotation" explain the considerations for the statistical test chosen.

  - We have sketched why we chose oblique rotation in the section “Decisions on model-fitting method, rotation method and number of factors retained“. The reason behind the decision for oblique rotation was that although epistemic beliefs are often conceived as consisting of more or less independent dimensions (e.g. Schommer, 1990), it is questionable in how far these dimensions are statically independent in the sense of uncorrelated factors. If the factors are truly uncorrelated, orthogonal and oblique rotation produces nearly identical results. In contrast, if the factors are correlated, orthogonal rotation would result in a loss of valuable information.
- The a cronbach of the factors are fairly low (<.70), I would not described them as acceptable when building a new scale

- Several authors state that an .6 is an acceptable level of reliability for exploratory studies, e.g. Robinson, JP, Shaver, PR, & Wrightsman, LS: *Measures of personality and social psychological attitudes*. San Diego: Academic Press; 1991. Furthermore, measuring epistemic beliefs is extremely challenging, as the article by DeBacker et al. [46] points out. In sum, in our view the Alpha values are, even though not excellent, acceptable.

Table:
- Title should include the statistical test used and an explanation of the numbers presented.
- Some items are with meaning, hence they are negative, to ease on the reader, it would be better to reverse score these items so all will be in the same direction (i.e. positive).

- The title of the table now reads:
  
  “Pattern matrix for the five-factor solution obtained through exploratory factor analysis“

  Furthermore, the note provides further information on the test used.

- We decided not to reverse score the items with negative loadings in the table, but point to this in the note, which now reads:
  
  “Note: Pattern matrix, EFA, oblimin rotation, delta = 0, Maximum-Likelihood extraction. The factor analysis was conducted on the original item scores. For the calculation of sum scores for the five factors, several items need to be recoded (see section “Recoding of the items for further analyses”).”

- Furthermore, we added a short section on how to recode the items for further analyses, see:
  
  “For the calculation of sum scores for the five factors, several items need to be recoded. For factor 2 and factor 3, the forth item needs to be recoded. Furthermore, all items of factor 5 should be recoded. As a result, for factor 1 higher scores indicate a deeper belief in the certainty of medical knowledge and in the solvability of medical questions. For factor 2 and factor 3, higher scores indicate a deeper belief in the trustworthiness of medical textbooks respectively in the trustworthiness of medical information on the Internet. For factor 4, higher values mean that participants believe more that medical knowledge is better justified by (daily) experience than by..."
medical research. For factor 5, higher values point to a stronger belief in the stability of medical knowledge.”