

Peer-review report of

Sekulovski, N., Keetelaar, S., Haslbeck, J., & Marsman, M. (2024). Sensitivity analysis of prior distributions in Bayesian graphical modeling: Guiding informed prior choices for conditional independence testing. *advances.in/psychology*, 2, e92355. <https://doi.org/10.56296/aip00016>

Round 1

Dear authors, it is my pleasure to inform that we have now finished a detailed review of your manuscript titled “Sensitivity Analysis of Prior Distributions in Bayesian Graphical Modeling: Guiding Informed Prior Choices for Conditional Independence Testing”.

The reviewer provided a detailed analysis and critique of your paper investigating the influence of priors on network structure and network parameters in the context of modeling ordinal and binary data. The paper's clarity and utility in helping researchers set informative priors for estimating network structure and parameters through extensive simulations and the development of an R shiny app is highly praised both by the reviewer and myself.

However, the reviewer raises several concerns and suggestions aimed at improving the paper's clarity and comprehensiveness, notably:

1. Clarification on the necessity of setting two sets of priors for network structure and interaction parameters, questioning the added benefits of distinguishing between the two when interaction parameters can imply network structure.
2. Explanation on handling ordinal data in the Markov Random Field equation, especially how the model preserves the order of Likert scale levels.
3. Comprehensive introduction of Equation 1, suggesting a more thorough explanation of its components for readers unfamiliar with referenced materials.
4. Clarification on the variability of threshold values (m_i) across different variables and how the model handles variables with differing numbers of ordinal levels.
5. Suggestions for improved organization, like adding specific subtitles to sections dealing with prior distributions for interaction parameters for better consistency and readability.
6. Concerns about the simulation design, noting a disconnection between the introduction's focus on setting priors and the simulation's emphasis on data characteristics like sample size and sparsity, suggesting a need to align these sections more closely.
7. Clarity on results and comparison of different prior distributions, advising on isolating the effects of prior distributions by holding other factors constant during comparison.

8. Lack of clear evaluation metrics for assessing different conditions, questioning how the concept of "exclusion" should be interpreted by readers.
9. Recommendation to include screenshots of the Shiny app in the manuscript to ensure future readability, acknowledging potential issues with software updates and cloud service providers.
10. Inclusion of referred figures to aid in the understanding of specific results mentioned in the text.
11. Explanation for the counterintuitive impact of Cauchy slab scale on edge exclusion, querying why increased exclusion is observed with increased scale.
12. Consistency in discussion, suggesting that it should more closely mirror the introduction's focus and summarize the impact of interaction parameters and network structure on estimation more effectively.

Overall, the reviewer thinks the paper offer a significant contribution to the literature, but highlights areas for improvement to enhance its clarity, organization, and comprehensiveness, ensuring that it can serve as a valuable resource for researchers without reliance on external materials.

Please, revise the paper accordingly, and submit a detailed response letter.

I am sure the research team can address all concerns and suggestions raised by the reviewer, and am looking forward to reading the updated version of the manuscript.

Best wishes,

Hudson

Reviewer 1

The paper aims to explore the impact of both priors of network structure and network parameter on the inclusion Bayes factor in network modeling for ordinal and binary data. The paper conducted extensive simulation and developed an R shiny app to help researchers examine the impact of priors themselves. Overall, I appreciate the paper is clearly written, especially in the introduction part, and the research work will be useful for researchers to set informative priors to estimate network structure and parameters, but there are several suggestions or questions that need to be addressed (listed below) to improve the clarity of the paper without having to rely on other materials (papers or software):

1. Page 3 setting two sets of priors: Please explain briefly why it is necessary or advantageous to set two sets of priors, namely the network structure and interaction parameters. Specifically, if the interaction parameter estimation includes the value of zero, then the network structure information can be derived from interaction

parameters. Please clarify why it is essential to set network structure or what the additional benefits are?

2. Page 6 Ordinal versus categorical: the paper proposed to examine ordinal data because psychology data are often measured by Likert scale instruments, but in the Markov Random Field equation 1, the variable X is categorical. Please explain briefly how Equation 1 preserves the order of the Likert scale levels (e.g., does threshold μ_i increase its value as the Likert scale level increases/decreases?). I understand there might have been other papers that explained this in details, but it would still be helpful to mention briefly how ordinal data are handled.

3. Page 6: Please consider introducing all the information in an Equation. Equation 1 might be introduced in other papers referenced, but it is still new if the readers who haven't read the other papers yet, so a thorough introduction of the parameters and subscriptions will help readers understand this paper more efficiently. E.g., introduce the definition of X , p , m_i , function l , and the equation of Z .

4. Related to comment #3 about Equation 1, can m_i take different values for each variable i ? I would assume yes based on the equation, but it doesn't seem like the simulation included only the same number of levels, namely 2 or 4 respectively. If the model cannot handle different number of levels for the ordinal variables, it needs explicit clarification and m_i can be reduced to m .

5. Page 9-11, please consider adding a subtitle of "prior distributions for interaction parameters" (or update the "options for the slab component", like the "prior distributions for the network structure/edge indicators" on page 15. It makes the sections more consistent with the introduction and easier to follow for readers.

6. Page 19: disconnection between introduction and simulation design. Based on the introduction of setting priors, I expected the simulation to evaluate the different prior distributions of interaction parameters (unit information, Cauchy, Laplace), network structure (Bernoulli, Beta-Bernoulli), and threshold (beta-prime). However, the simulation was designed to vary by sample size, number of variables, the sparsity of the network, and number of ordinal levels. Arguably, the third one, sparsity of the network (or the proportion of missing edges), is about the priors of network structure but the introduction did not cover how sparsity might affect estimation. Alternatively, if the data characteristics are important factors, the introduction should focus on the impact of data characteristics on estimation thoroughly.

7. Page 23: results. Similar to comment #6, the result is convoluted between various conditions. The comparison of different prior distributions should be evaluated while holding other factors equal, to isolate the effect of prior distributions.

a. It seems like the result is structured to compare the prior distributions of network structure while holding the interaction parameter the same, hence the subtitle of “unit information”, “Cauchy”, “Laplace”. It would also be consistent to compare different prior distributions while holding the network structure the same.

b. It is unclear which prior this result is comparing, e.g., “if increasing sparsity of the network to 0.5 and 0.8, we can see that the Beta-Bernoulli prior shows stronger evidence... relative to the Bernoulli prior”. Is it sparsity of 0.5 vs. 0.8 with the sparsity of 0.2 previously mentioned in the paragraph, or is it Beta-Bernoulli vs. Bernoulli?

8. Page 23: evaluation of estimation. It is unclear what the evaluation metric is for different conditions. “Exclusion” was mentioned as part of the comparison results, but it is unclear how readers should act upon this, e.g., is stronger evidence of exclusion favorable or not.

9. Page 23: Shiny app as an essential part of the results. The paper recommended opening the Shiny app when reading the results. As software development often goes through updates and versions, and it is uncertain how this will impact the shiny app (and it’s not solely dependent on the developers, sometimes it’s also dependent on the cloud service provider, aka Posit). To ensure the manuscript will be readable in the future, I recommend including the screenshots as figures.

10. Page 24: please include the figure referred to, e.g., “if we switch to the plots showing the edges....” It is unclear where this figure is.

11. Page 25: Impact of Cauchy slab scale on edge exclusion. If the slab scale increases which has less certainty about the interaction parameter, shouldn’t the exclusion be lower? It seems counterintuitive that the exclusion increased as scale increased, please explain why this happened.

12. Page 28-29, similar to comment #6 and 7, the discussion can be more consistent with the introduction and structured as summary of impact of interaction parameters and network structure on estimation.

Round 2

Dear authors,

The reviewer revised your updated manuscript (“Sensitivity Analysis of Prior Distributions in Bayesian Graphical Modeling: Guiding Informed Prior Choices for Conditional Independence Testing”), and sent me the following remark: “The authors did a commendable job addressing my comments. This version of the paper is a significant improvement compared to the original submission”.

Based on the very positive feedback from the reviewer, and my own analysis of the paper, I am very happy to share that your paper is now accepted for publication, pending the editorial process.

You can expect to receive an email from the editorial/production team in case there is any adjustment is necessary.

Thanks for submitting a very innovative and impactful research paper for our special issue.

Best wishes,

Hudson Golino

Editor of the Special Issue on Network Methods in Psychology.