Causes and effects in Dichotomous Comparative Judgments: a plausible information-theoretical system of mechanism

Jose Manuel Rivera Espejo[a,*], Tine van Daal[a], Sven De Maeyer[a], Steven Gillis[b]

[a] *University of Antwerp, Education sciences,*

[b] *University of Antwerp, Linguistics,*

Abstract

Dichotomous Comparative Judgment (DCJ, Pollitt (2012a), Pollitt (2012b)) requires judges to evaluate the relative manifestation of traits between pairs of stimuli, resulting in a dichotomous outcome indicating which stimulus exhibits the trait more strongly. Research has demonstrated DCJ's effectiveness and reliability in various domains (Pollitt, 2012b; Bartholomew et al., 2018; van Daal et al., 2019; Lesterhuis, 2018; Bartholomew and Williams, 2020; Boonen et al., 2020). However, the literature lacks a clear and transparent depiction of the plausible mechanisms underlying DCJ data. Specifically, there is no detail explanation of how the different assessment factors can potentially influence the observed DCJ data. This study aims to fill this gap by applying the framework of causal analysis and Directed Acyclic Graphs (DAG; Pearl (2009)). Using this framework, the study will construct a scientific model to elucidate the causal assumptions and mechanisms inherent the system. This model will enable researchers to draw inferences about causal relationships from DCJ data. Subsequently, the study will translate this model into a probabilistic statistical model, aiming to derive statistical estimands for different targets of inference. The outcomes of this study will inform the planning of DCJ experiments and hold significance for researchers or analysts involved in education and assessment procedures who implement the DCJ methodology.

Keywords: comparative judgement, directed acycilc graph, causal analysis, probabilistic statistics

*Corresponding author

Email addresses: JoseManuel.RiveraEspejo@uantwerpen.be (Jose Manuel Rivera Espejo), tine.vandaal@uantwerpen.be (Tine van Daal), sven.demaeyer@uantwerpen.be (Sven De Maeyer), steven.gillis@uantwerpen.be (Steven Gillis)

Declarations

Funding: The project was founded through the Research Fund of the University of Antwerp (BOF).

Conflict of interests: The authors declare no conflict of interest.

Ethics approval: The University of Antwerp Research Ethics Committee has confirmed that no ethical approval is required.

Consent to participate: Not applicable

Consent for publication: All authors have read and agreed to the published version of the manuscript.

Availability of data and materials: No data was utilized in this study

Code availability: All the code utilized in this research is available in the different notebooks and `CODE LINKS` referenced in the digital document. The digital document is located at: https://jriveraespejo.github.io/paper2_manuscript/.

Authors' contributions: *Conceptualization:* S.G., S.dM., and J.M.R.E; *Data curation:* J.M.R.E.; *Formal Analysis:* J.M.R.E.; *Funding acquisition:* S.G. and S.dM; *Investigation:* S.G.; *Methodology:* S.G., S.dM., and J.M.R.E; *Project administration:* S.G. and S.dM.; *Resources:* S.G. and S.dM.; *Software: J.M.R.E.*; *Supervision:* S.G. and S.dM.; *Validation:* J.M.R.E.; *Visualization:* J.M.R.E.; *Writing - original draft:* J.M.R.E.; *Writing - review & editing:* S.G. and S.dM.

References

Bartholomew, S., Nadelson, L., Goodridge, W., Reeve, E., 2018. Adaptive comparative judgment as a tool for assessing open-ended design problems and model eliciting activities. Educational Assessment 23, 85–101. doi:10.1080/10627197.2018.1444986.

Bartholomew, S., Williams, P., 2020. Stem skill assessment: An application of adaptive comparative judgment, in: Anderson, J., Li, Y. (Eds.), Integrated Approaches to STEM Education. Advances in STEM Education. Springer. doi:10.1007/978-3-030-52229-2_18.

Boonen, N., Kloots, H., Gillis, S., 2020. Rating the overall speech quality of hearing-impaired children by means of comparative judgements. Journal of Communication Disorders 83, 1675–1687. doi:10.1016/j.jcomdis.2019.105969.

Lesterhuis, M., 2018. The validity of comparative judgement for assessing text quality: An assessor's perspective. Ph.D. thesis. University of Antwerp.

Pearl, J., 2009. Causality: Models, Reasoning and Inference. Cambrige University Press.

Pollitt, A., 2012a. Comparative judgement for assessment. International Journal of Technology and Design Education 22, 157—170. doi:10.1007/s10798-011-9189-x.

Pollitt, A., 2012b. The method of adaptive comparative judgement. Assessment in Education: Principles, Policy and Practice 19, 281—300. doi:10.1080/0969594X.2012.665354.

van Daal, T., Lesterhuis, M., Coertjens, L., Donche, V., De Maeyer, S., 2019. Validity of comparative judgement to assess academic writing: examining implications of its holistic character and building on a shared consensus. Assessment in Education: Principles, Policy & Practice 26, 59–74. doi:10.1080/0969594X.2016.1253542.