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Relation Analysis –Methodological Approach for Complex Empirical Phenomena

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Introduction: Across disciplines such as psychology, medicine, and biology, the reproducibility of research findings is a recurring reported challenge. Commonly cited causes include study falsification, questionable research practices, insufficient statistical power, and a lack of statistical literacy. However, a potentially even more significant issue is the scientific tendency to formulate overly simplistic hypotheses for complex empirical phenomena. Despite the well-known methodological limitations of correlation statistics - such as linearity, bidirectional associations, and pairwise relationships - these methods (e.g., correlations, regressions, structural equation modeling) remain prevalent in hypothesis evaluation.
Methods: Relation analysis (RELAN; Maderthaner, 2022, 2024) is a methodological framework designed to account for all possible interactions among up to ten binary variables. This allows the testing, exploration, and simulation of highly complex hypotheses. Furthermore, Relation Analysis enables the integration and statistical evaluation of causal, moderating, and mediating variables within these hypotheses, providing a comprehensive tool for analyzing multifaceted relationships in empirical data.
Results: Examples from research on learning and teaching illustrate the difficulties of using conventional statistical methods to clarify complex empirical relationships. In contrast, the RELAN method effectively overcomes these challenges, providing clearer insights into complex empirical relationships.
Discussion: The high complexity of logical hypotheses requires (1) the use of dichotomous variables for hypothesis testing, (2) a more precise approach to uncovering insights into research topics, and (3) the development of more specific assumptions regarding the presumed effect structures and underlying empirical phenomena.
Conclusion: Developing more precise theoretical representations of learning and teaching relationships through logical hypotheses increases the likelihood of replication and facilitates clearer explanations of discrepancies between results.

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Please indicate up to five keywords regarding the content of your contribution

statistical methods, complex hypotheses testing, propositional logic, simulation, exploration

Primary author: MADERTHANER, Rainer (Universität Wien)

Presenter: MADERTHANER, Rainer (Universität Wien)

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