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documentclassarticle
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begindocument
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titleEvaluating the Relationship Between Statistical Method Selection and Re-
sult Interpretability in Applied Research
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authorZoey Robinson, Theodore Baker, Luna Adams
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beginabstract This study investigates the critical relationship between statisti-
cal method selection and the interpretability of research findings across applied
disciplines. While methodological rigor has traditionally been prioritized in
statistical training and application, we demonstrate that interpretability—the
ease with which non-specialist stakeholders can understand and apply research
findings—represents an equally important dimension of methodological quality.
Through a mixed-methods approach combining systematic analysis of 347 pub-
lished studies from psychology, public health, education, and business research
with experimental interventions involving 184 practitioners, we establish that
method complexity inversely correlates with interpretability scores across all do-
mains. More significantly, we identify specific methodological characteristics—
including effect size reporting practices, visualization techniques, and statistical
communication strategies—that mediate this relationship. Our findings chal-
lenge the prevailing assumption that methodological sophistication necessarily
enhances research utility, revealing instead that inappropriate method selec-
tion creates interpretability barriers that undermine practical application. We
propose a novel interpretability-weighted methodological framework that bal-
ances statistical rigor with communicative clarity, offering researchers practical
guidance for method selection that optimizes both technical validity and real-
world impact. This research contributes to the growing literature on research
translation by providing empirical evidence for interpretability as a measurable
dimension of methodological quality and establishing concrete strategies for im-
proving the accessibility of statistical findings without compromising analytical
integrity.
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endabstract
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sectionIntroduction
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The selection of statistical methods represents a fundamental decision point in the research process, with implications extending far beyond technical correctness to influence how findings are understood, communicated, and applied. While extensive literature exists on statistical power, validity, and reliability, comparatively little attention has been paid to how method selection affects the interpretability of research outcomes. This gap is particularly consequential in applied research contexts, where findings must often be translated for policymakers, practitioners, and other non-specialist audiences who lack advanced statistical training.

Interpretability in statistical research refers to the degree to which research consumers can comprehend methodological approaches, analytical procedures, and resulting findings without specialized statistical expertise. This concept encompasses not only the clarity of statistical reporting but also the cognitive accessibility of the underlying analytical framework. The prevailing research culture often equates methodological complexity with scientific sophistication, creating pressure for researchers to employ advanced statistical techniques even when simpler alternatives might yield more interpretable results. This tension between methodological rigor and communicative clarity represents a significant challenge for applied research seeking to bridge the gap between scientific discovery and practical implementation.

Our research addresses this critical juncture by systematically examining how statistical method selection influences interpretability across multiple applied disciplines. We move beyond anecdotal observations to provide empirical evidence about the interpretability costs associated with various methodological choices. By identifying specific characteristics that enhance or diminish interpretability, we aim to develop practical guidelines that help researchers select methods that balance statistical appropriateness with communicative effectiveness.

The significance of this investigation extends to multiple stakeholders. For researchers, it offers evidence-based guidance for methodological decisions that consider both analytical requirements and dissemination needs. For journal editors and peer reviewers, it provides criteria for evaluating the accessibility of statistical reporting. For research consumers in applied settings, it highlights the importance of interpretability as a dimension of research quality that affects the practical utility of scientific findings.

This paper proceeds by first reviewing relevant literature on statistical communication and methodological selection. We then describe our mixed-methods approach, including both systematic analysis of published research and experimental studies with research practitioners. Following presentation of our results, we discuss implications for research practice and propose a novel framework for interpretability-aware methodological selection.

sectionLiterature Review

The relationship between statistical methodology and research interpretation has received increasing attention across multiple disciplines, though systematic investigation of interpretability as a distinct dimension of methodological quality remains limited. Existing literature primarily addresses statistical communication through the lens of reporting standards and visualization techniques, with less consideration of how fundamental methodological choices affect interpretability.

Research on statistical communication has emphasized the importance of clear reporting practices, with guidelines developed by various professional organizations advocating for complete description of analytical procedures and transparent presentation of results. These efforts have significantly improved the reproducibility of statistical analyses but have paid less attention to the cognitive accessibility of different methodological approaches. The movement toward open science has further highlighted transparency in statistical reporting, though interpretability concerns extend beyond transparency to include the inherent complexity of statistical concepts and procedures.

Studies examining statistical understanding among non-specialists have consistently demonstrated challenges in interpreting common statistical outputs. Research in medical communication has shown that healthcare professionals often struggle with concepts like confidence intervals and p-values, leading to potential misinterpretation of research findings. Similar difficulties have been documented among educators, policymakers, and business leaders who must frequently consume statistical research to inform decisions. These interpretation challenges are exacerbated when research employs complex statistical methods that require advanced training to comprehend fully.

The literature on methodological selection has traditionally emphasized statistical considerations such as power, assumptions, and robustness, with interpretability receiving minimal attention as a selection criterion. Textbooks and methodological guides typically focus on technical appropriateness without addressing how method complexity might affect the communication and application of results. This gap is particularly notable given evidence that methodological choices influence how research is perceived and utilized in applied settings.

Recent work in data science and machine learning has brought increased attention to interpretability through the concept of explainable AI, which seeks to make complex algorithmic decisions understandable to human users. This literature demonstrates that interpretability represents a measurable quality that can be optimized alongside predictive accuracy, suggesting parallel considerations might apply to traditional statistical methods. However, the translation of these concepts to conventional statistical practice remains underdeveloped.

Our review identified no comprehensive empirical studies examining how statistical method selection specifically affects interpretability across multiple applied domains. While individual disciplines have noted interpretation challenges associated with particular methods, systematic cross-disciplinary investigation is

lacking. This study addresses this gap by providing empirical evidence about the interpretability implications of methodological choices and developing practical guidance for method selection that considers both statistical and communicative dimensions.

sectionMethodology

We employed a mixed-methods research design combining systematic analysis of published research with experimental studies involving research practitioners. This approach allowed us to examine both actual interpretability patterns in existing literature and causal relationships between methodological characteristics and interpretability outcomes.

subsectionSystematic Analysis of Published Research

We conducted a systematic analysis of 347 peer-reviewed articles published between 2018 and 2023 across four applied disciplines: psychology (n=89), public health (n=87), education (n=86), and business research (n=85). Articles were randomly selected from high-impact journals in each discipline, with stratification to ensure representation of diverse methodological approaches. For each article, we documented the primary statistical methods employed, methodological complexity (rated on a 5-point scale by trained coders), and interpretability indicators.

Interpretability was assessed using a validated 15-item interpretability scale measuring clarity of methodological description, transparency of analytical procedures, accessibility of results presentation, and overall comprehensibility to non-specialist readers. Two independent coders rated each article, with interrater reliability of 0.87. Additional data collected included reporting of effect sizes, visualization techniques employed, statistical communication strategies, and stated limitations.

subsectionExperimental Studies with Practitioners

We recruited 184 research practitioners (46 from each of the four disciplines) with varying levels of statistical expertise. Participants were presented with research scenarios employing different statistical methods to address identical research questions. Methodological variations included simple t-tests versus mixed-effects models, correlation analysis versus structural equation modeling, and chi-square tests versus logistic regression.

For each scenario, participants completed interpretability assessments measuring their understanding of the methodological approach, analytical procedures, and practical implications of findings. We also measured time required to achieve comprehension and confidence in interpretation. Additional measures included perceived usefulness for decision-making and likelihood of applying findings in practice.

subsectionData Analysis

Quantitative data from both study components were analyzed using multivariate regression models to examine relationships between methodological characteristics and interpretability outcomes, controlling for discipline, researcher expertise, and study complexity. Qualitative data from open-ended responses were analyzed using thematic analysis to identify specific factors affecting interpretability and strategies for improvement.

sectionResults

Our analysis revealed consistent and substantial relationships between statistical method selection and interpretability across all study components and disciplinary contexts.

subsectionMethod Complexity and Interpretability

We observed a strong negative correlation between methodological complexity and interpretability scores ($r = -0.72$, $p < 0.001$), indicating that more complex statistical methods were associated with significantly reduced interpretability. This relationship persisted after controlling for researcher expertise, discipline, and reporting quality. The negative impact of complexity was most pronounced for methods involving latent variables, hierarchical structures, or interaction effects, which presented particular challenges for non-specialist comprehension.

Notably, the relationship between complexity and interpretability was moderated by several factors. Comprehensive effect size reporting attenuated the negative interpretability effects of complex methods, with studies providing multiple effect size metrics and practical interpretations achieving interpretability scores

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subsectionDisciplinary Variations

While the inverse relationship between method complexity and interpretability was consistent across disciplines, we observed significant variation in baseline interpretability levels and specific interpretability challenges. Psychology studies demonstrated the highest average interpretability scores, potentially reflecting the discipline's historical emphasis on statistical training and methodological transparency. Business research showed the greatest interpretability variability, with some studies achieving excellent accessibility while others presented substantial interpretation barriers.

Public health studies exhibited particular challenges in communicating complex longitudinal and multilevel analyses, while education research struggled with interpretability when employing advanced measurement models. These

disciplinary patterns highlight the need for field-specific interpretability guidelines that address particular methodological traditions and communication challenges.

subsectionPractitioner Comprehension

Experimental findings confirmed that methodological selection significantly affects practitioner comprehension and application. Participants demonstrated 58

Perhaps most importantly, methodological complexity substantially influenced practitioners' confidence in applying research findings. Participants reported 72

subsectionMediating Factors

Our analysis identified several specific factors that mediate the relationship between method selection and interpretability. Transparent reporting of analytical decisions and limitations improved interpretability by 28

We also identified methodological characteristics that inherently supported interpretability. Methods with intuitive graphical representations, clear effect size metrics, and straightforward practical interpretations consistently achieved higher interpretability scores. These characteristics often crossed traditional methodological categories, suggesting that interpretability represents a distinct dimension of methodological quality rather than simply reflecting method simplicity.

sectionDiscussion

Our findings challenge the prevailing assumption that methodological sophistication necessarily enhances research quality and utility. While advanced statistical methods offer important analytical advantages for addressing complex research questions, these benefits must be balanced against interpretability costs that can undermine practical application. The consistent inverse relationship between method complexity and interpretability across disciplines and study components suggests that interpretability represents a fundamental consideration in methodological selection that has been largely overlooked in statistical training and research practice.

The significant impact of methodological choices on practitioner comprehension and application has important implications for research translation. The substantial confidence and application gaps we observed between interpretable and complex methods suggest that methodological selection directly influences the real-world impact of research findings. This relationship is particularly critical in applied fields where research must inform decisions by stakeholders with varying statistical expertise.

Our identification of specific factors that mediate the complexity-interpretability relationship offers practical guidance for enhancing interpretability without sacrificing methodological appropriateness. The substantial interpretability benefits associated with comprehensive effect size reporting, strategic visualization, and transparent communication suggest that these practices can mitigate many interpretability challenges associated with complex methods. However, even with optimal communication, inherent interpretability differences between methodological approaches persist, highlighting the importance of considering interpretability during initial method selection.

subsectionInterpretability-Weighted Methodological Framework

Based on our findings, we propose an interpretability-weighted methodological framework that explicitly considers interpretability alongside traditional statistical criteria during method selection. This framework involves evaluating potential methods across multiple dimensions, including statistical appropriateness, analytical power, implementation feasibility, and interpretability. Rather than prioritizing any single dimension, researchers would select methods that optimize across dimensions based on their specific research context and dissemination goals.

The framework includes practical tools for assessing interpretability during method selection, including interpretability prediction metrics based on methodological characteristics and communication requirements. For studies requiring complex methods with inherent interpretability challenges, the framework provides guidance for compensatory communication strategies that enhance accessibility. This balanced approach acknowledges that methodological decisions involve trade-offs and encourages explicit consideration of how these trade-offs affect research utility.

subsectionLimitations and Future Research

Several limitations of the current study warrant consideration. Our analysis focused on four applied disciplines, and additional research is needed to examine interpretability relationships in other fields. The experimental component employed simulated research scenarios, and real-world interpretation may involve additional contextual factors. Future research should also explore longitudinal effects of interpretability on research application and impact.

Additional investigation is needed to develop discipline-specific interpretability guidelines and to examine how emerging statistical methods affect interpretability. The relationship between interpretability and other research quality dimensions, including innovation and methodological rigor, requires further exploration. Research examining interpretability from the perspective of diverse stakeholder groups would enhance our understanding of varied interpretation needs and challenges.

sectionConclusion

This study provides empirical evidence that statistical method selection significantly influences the interpretability of research findings, with important implications for research communication and application. The consistent inverse relationship between methodological complexity and interpretability across disciplines challenges the assumption that advanced methods inherently enhance research quality and suggests that interpretability represents a crucial dimension of methodological evaluation.

Our findings highlight the need for greater attention to interpretability during methodological selection, particularly in applied research contexts where findings must inform decisions by non-specialist stakeholders. The interpretability-weighted framework we propose offers a practical approach for balancing statistical appropriateness with communicative effectiveness, helping researchers select methods that optimize both technical validity and practical utility.

By establishing interpretability as a measurable and consequential dimension of methodological quality, this research contributes to ongoing efforts to enhance research transparency, communication, and translation. The specific factors we identified as enhancing interpretability provide immediate guidance for improving statistical reporting and communication across applied disciplines. As research continues to address increasingly complex questions using sophisticated methods, simultaneous attention to interpretability will be essential for ensuring that scientific advances achieve their full potential for informing practice and policy.

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