

Extending Machine-Learning Methods to Detect Response Shift in Patient-Reported Outcomes Data

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Response shift

- Response shift is an effect on observed change that cannot be attributed to target change because of a change in the meaning of the subjective evaluation of the target construct, which is a special case of violation of the principle of conditional independence (Sprangers et al., forth coming)
- Response shift could arise due to:

recalibration

- internal standards of measurement

reprioritization

- values (i.e. the importance of component domains constituting the target construct)

reconceptualization

- definition of the target construct

Why Response Shift?

- Distinguish “true change” from response shift
 - Ignoring response shift could result in
 - bias (attenuation or over-estimation) in estimates of change in PROM scores
 - reduced statistical power to detect change over time
- Contributes to understanding regarding the response processes
- A desired outcomes in chronic disease management and palliative care
- Impact on healthcare decision making

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Implications of response shift for micro-, meso-, and macro-level healthcare decision-making using results of patient-reported outcome measures

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Abstract

Purpose Results of patient-reported outcome measures (PROMs) are increasingly used to inform healthcare decision-making. Research has shown that response shift can impact PROM results. As part of an international collaboration, our goal is to provide a framework regarding the implications of response shift at the level of patient care (micro), healthcare institute (meso), and healthcare policy (macro).

Methods Empirical evidence of response shift that can influence patients’ self-reported health and preferences provided the foundation for development of the framework. Measurement validity theory, hermeneutic philosophy, and micro-, meso-, and macro-level healthcare decision-making informed our theoretical analysis.


Results At the micro-level, patients’ self-reported health needs to be interpreted via dialogue with the clinician to avoid misinterpretation of PROM data due to response shift. It is also important to consider the potential impact of response shift on study results, when these are used to support decisions. At the meso-level, individual-level data should be examined for

Machine-Learning Methods to Detect Response Shift

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Critical examination of current response shift methods and proposal for advancing new methods

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Abstract

Purpose This work is part of an international, interdisciplinary initiative to synthesize research on response shift in results of patient-reported outcome measures. The objective is to critically examine current response shift methods. We additionally propose advancing new methods that address the limitations of extant methods.

Methods Based on literature reviews, this critical examination comprises design-based, qualitative, individualized, and preference-based methods, latent variable models, and other statistical methods. We critically appraised their definition, operationalization, the type of response shift they can detect, whether they can adjust for and explain response shift, their assumptions, and alternative explanations. Overall limitations requiring new methods were identified.

- Classification and recursive partitioning (Li & Rapkin, 2009)
- Relative importance analysis based on discriminant analysis (Lix et al, 2013)
- Random forest regression (Boucikine et al 2013)

Extending IRTrees to Examine Response Shift

- IRTree models for DIF can be extended to test for response shift in longitudinal PROMs data (Komboz et al, 2018)
 - Convert the longitudinal data from a wide-format to longitudinal person-period format (i.e., there is a separate row for each person for each period they were observed)
 - Fit IRTrees to the longitudinal data using time and other baseline covariates as input variables.
 - Subgroups or items with response shift can be identified if time is used as a splitting variable in the model

Example: Response Shift by Recursive Partitioning



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METHODOLOGICAL INNOVATIONS

Classification and regression tree uncovered hierarchy of psychosocial determinants underlying quality-of-life response shift in HIV/AIDS

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Abstract

Objectives: Rapkin and Schwartz define response shift as otherwise unexplained, discrepant change in health-related quality of life (HRQOL) that is associated with change in cognitive appraisal. In this article, we demonstrate how a recursive partitioning (rpart) regression tree analytic approach may be used to explore cognitive changes to gain additional insight into response-shift phenomena.

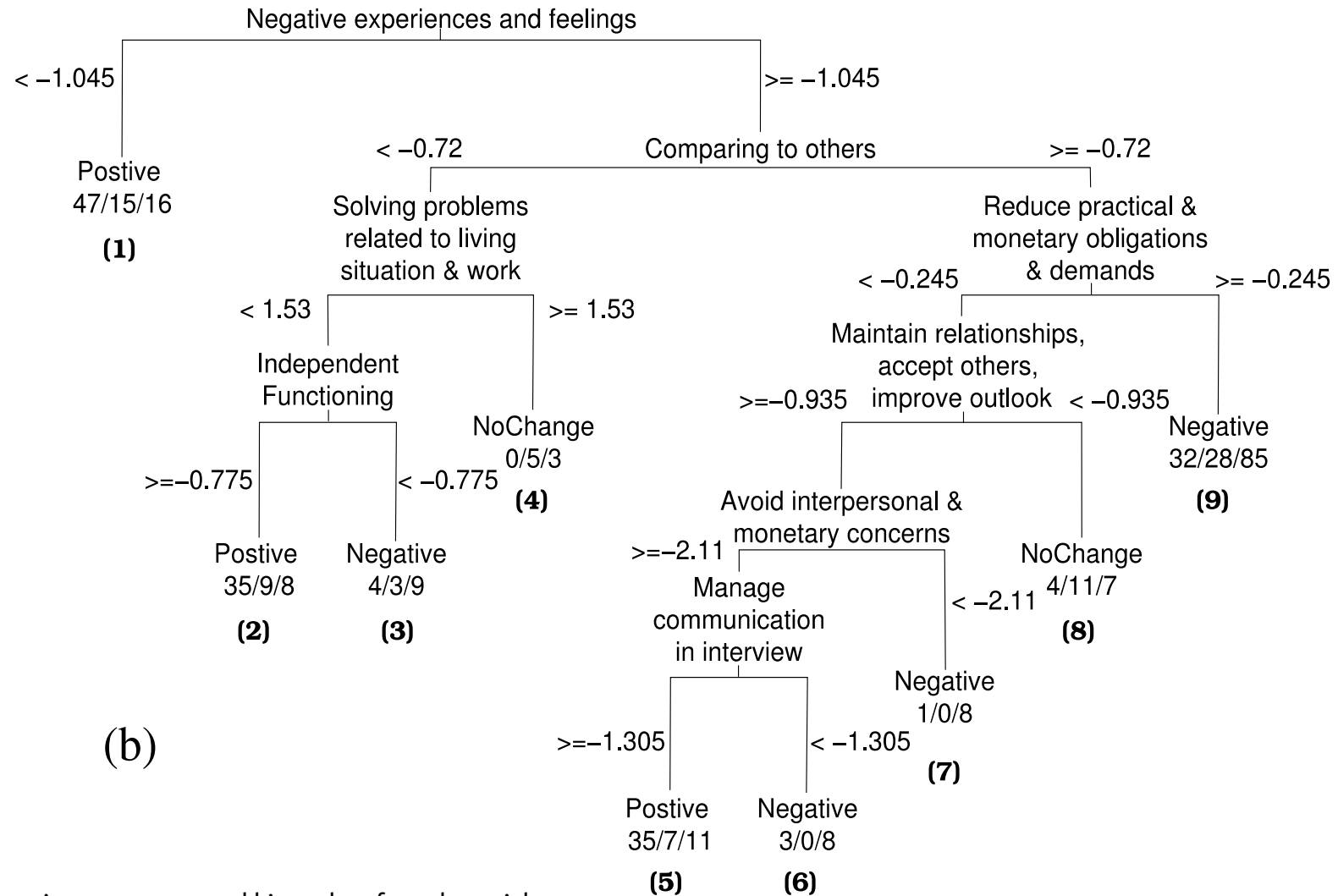
Study Design and Setting: Data are from the “Choices in Care Study,” an evaluation of HIV+ Medicaid recipients’ experiences and outcomes in care ($N = 394$). Cognitive assessment was based on the QOL appraisal battery. HRQOL was measured by the SF-36 Health Survey, version 2 (SF-36v2).

Results: We used rpart to examine 6-month change in SF-36v2 mental composite score as a function of changes in appraisal, after controlling for patient characteristics, health changes, and intervening events. Rpart identified nine distinct patterns of cognitive change, including three associated with negative discrepancies, four with positive discrepancies, and two with no discrepancies.

Conclusion: Rpart classification provides a nuanced treatment of response shift. This methodology has implications for evaluating programs, guiding decisions, and targeting care. © 2009 Elsevier Inc. All rights reserved.

Keywords: Response shift; Health-related quality of life; Classification and regression trees; Segmentation strategies; Idiographic quality of life assessment; Rpart

Example: Response Shift by Recursive Partitioning



Li Y, Rapkin B. Classification and regression tree uncovered hierarchy of psychosocial determinants underlying quality of life response shift in HIV/AIDs. *Journal of Clinical Epidemiology* 2009; 62(11): 1138 – 1147.

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