

From Use Events to Value Signals: Establishing a Need–Accuracy–Duration Framework for Object-Centered Evaluation of Assistive Technologies

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Hintergrund/Background

Assistive technologies often fail not at delivery, but during routine integration into everyday care. Existing sensing approaches either prioritize activity recognition or collect more data than are needed for a concrete care, service, or design decision. This paper introduces the Need–Accuracy–Duration (NAD) framework to a health services research audience and extends it from a sensing-selection heuristic into a value-oriented evaluation method.

Zielsetzung/Objectives

NAD specifies the minimum sensing configuration required for a stakeholder question by linking three design decisions: Need, that is, who needs the information, for which decision, and with what consequences of error; Accuracy, that is, the minimum signal fidelity required to answer that question credibly; and Duration, that is, the observation window needed to capture uptake, stabilization, and early decline. Rather than prioritizing full activity recognition, the proposed approach focuses on an object-use value signal: a stakeholder-specific, longitudinal quantity indicating whether an assistive object is becoming sufficiently useful, reliable, and actionable in everyday care to justify continuation, adaptation, servicing, or upscaling.

Methode/Method

This value is estimated from sparse event-based object data such as counts, inter-event intervals, regularity, temporal trends, and interaction-quality proxies. Statistically, object-associated value is treated as a latent longitudinal signal that can be estimated with mixed-effects models, time-to-event models, and change-point analyses. In this way, binary use, routine formation, ergonomic fit, and early drop-off risk become analytically distinguishable without requiring high-burden continuous monitoring. Decision points identified through declining value trajectories can then be linked to adaptive support logic, drawing on micro-randomized trial and just-in-time adaptive intervention research, where time-varying signals are used to test proximal effects of context-sensitive support.

Ergebnisse/Results

To address implementation beyond measurement alone, the NASSS framework is used to situate value generation and value loss across the domains of technology, value proposition, adopter system, organization, wider context, and adaptation over time.

Implikation für Forschung und/oder (Versorgungs-)Praxis/Implications for Research and/or (Healthcare) Practice

The expected contribution is a statistically explicit and implementation-aware framework for deciding when sparse object-mounted sensing is sufficient, when richer proxies are justified, and how low-burden sensing can produce actionable evidence on sustained assistive technology use in home and transitional care.