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Rational inattention: A new theory of neurodivergent information seeking and early individual differences in language development

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Abstract

This project presents rational inattention as a new, transdiagnostic theory of information seeking in children with neurodevelopmental conditions including developmental language disorder (DLD) and dyslexia. Rational inattention holds that the optimal solution to minimizing epistemic uncertainty is to avoid imprecise information sources. The key theoretical contribution of the rational inattention framework is to endogenize imprecision, making it a function of the neurocognitive deficits that have been invoked to explain neurodivergent phenotypes, including deficits in auditory perception, working memory, and procedural learning. We argue that disengagement with information sources with low endogenous precision (e.g., speech in DLD or orthography-phonology mappings in dyslexia) constitutes resource-rational behaviour. We demonstrate the strength of this account in a series of computational simulations. In experiment one, we simulate information seeking in artificial agents mimicking an array of neurodivergent phenotypes, which optimally explore a complex learning environment containing speech, text, and social cues. In experiment two, we simulate optimal information seeking in a cross-modal dual-task paradigm, and qualitatively replicate empirical data from children with and without DLD. Across experiments, simulated agents' only aim was to maximally reduce epistemic uncertainty, with no difference in reward across information sources. We show that rational inattention emerges naturally in specific neurodivergent phenotypes as a function of low endogenous precision. For instance, an agent mimicking the DLD phenotype disengages with speech (and preferentially engages with alternative precise information sources) because endogenous imprecision renders speech not conducive to information gain. Because engagement is necessary for learning, simulation demonstrates how optimal information seeking may paradoxically contribute negatively to an already delayed language learning trajectory in neurodivergent children.