

A Systematic Review of Connectionist Modeling Approaches in Autism Spectrum Conditions

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Introduction

- ▶ **Autism** is a form of atypical neurocognitive development, usually labeled a pervasive developmental disorder. **Connectionist models** have had a large amount of success in accounting for atypical development, but how have they fared in autism in particular?
- ▶ Connectionist models are a **subset of computational models** [1]. They contain a set of nodes, a set of connections between the nodes, and usually an algorithm that determines how the system functions over time. Nodes most commonly stand for neurons, but they can also serve as abstractions of larger brain areas, ideas, words, phonemes or any kind of concept.
- ▶ **Tension:** Connectionist models are **better-suited to modeling lower-level processes** (neural connectivity, atypical perception etc.) but current **theories of autism postulate higher-level factors** driving atypical development: atypical theory of mind, executive function etc. [2]

Objectives

1. Examine **which features** of ASDs have been modeled using connectionist techniques
2. Assess the **quality** of extant research
3. Survey the **chronological trends** in the literature

Criteria

Inclusion:

- ▶ Connectionist models of any autism spectrum condition
- ▶ English-language, peer-reviewed publications (inc. publicly available theses)
- ▶ All papers featuring models, even ones which did not discuss model characteristics in detail (to avoid inflating study quality metrics)

Exclusion:

- ▶ Connectionist methods to aid diagnosis of autism
- ▶ Models originally built to be used in autism, but used exclusively in typical development

Search procedure

First round:

- ▶ **PubMed:** "autism connectionist" – 6 publications, keywords "autism artificial neural" – 18 publications.
- ▶ **Google Scholar:** first 10 pages for "autism connectionist" – 100 publications. First 4 pages for "autism connectionist" + "Since 2011" option to find more recent papers – 40 publications.
- ▶ **Google Scholar Cited By:** for 13 classic papers – 19, 8, 123, 51, 15, 24, 113, 117, 33, 4, 59, 141, 62 publications (cannot be added directly due to overlap)

→ **67 publications** were included based on titles and/or abstracts

Second round:

- ▶ Remove duplicates and erroneous citations
- ▶ Read papers to remove exclusions

→ **37 publications** remained → **26 separate studies**

Quality assessment

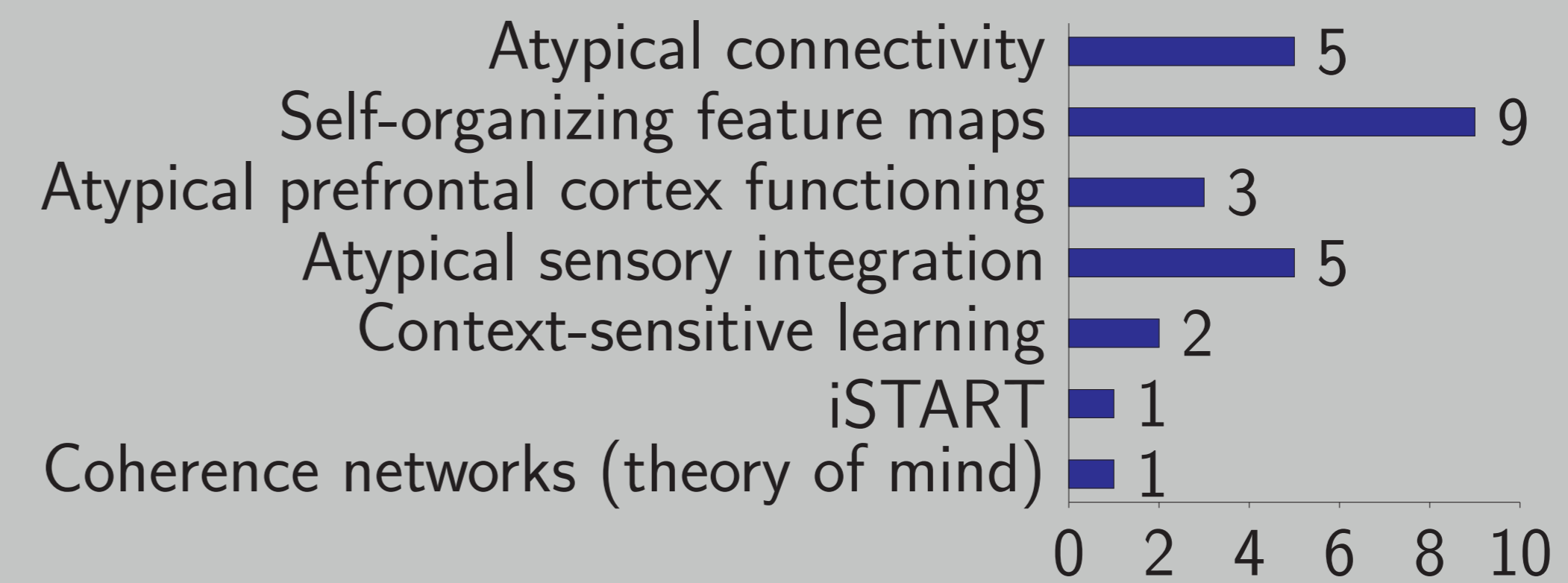
No preexistent framework for evaluating connectionist models. Designed five binary criteria:

Criterion	Operationalized as
1. Quant. comparison to experiments	Existence of comparison
2. Neurological plausibility	No features <i>known</i> to be implausible
3. No overly small networks	50+ nodes
4. Multiple mechanisms	Multiple mechanisms implemented
5. Replicability	Author could potentially replicate

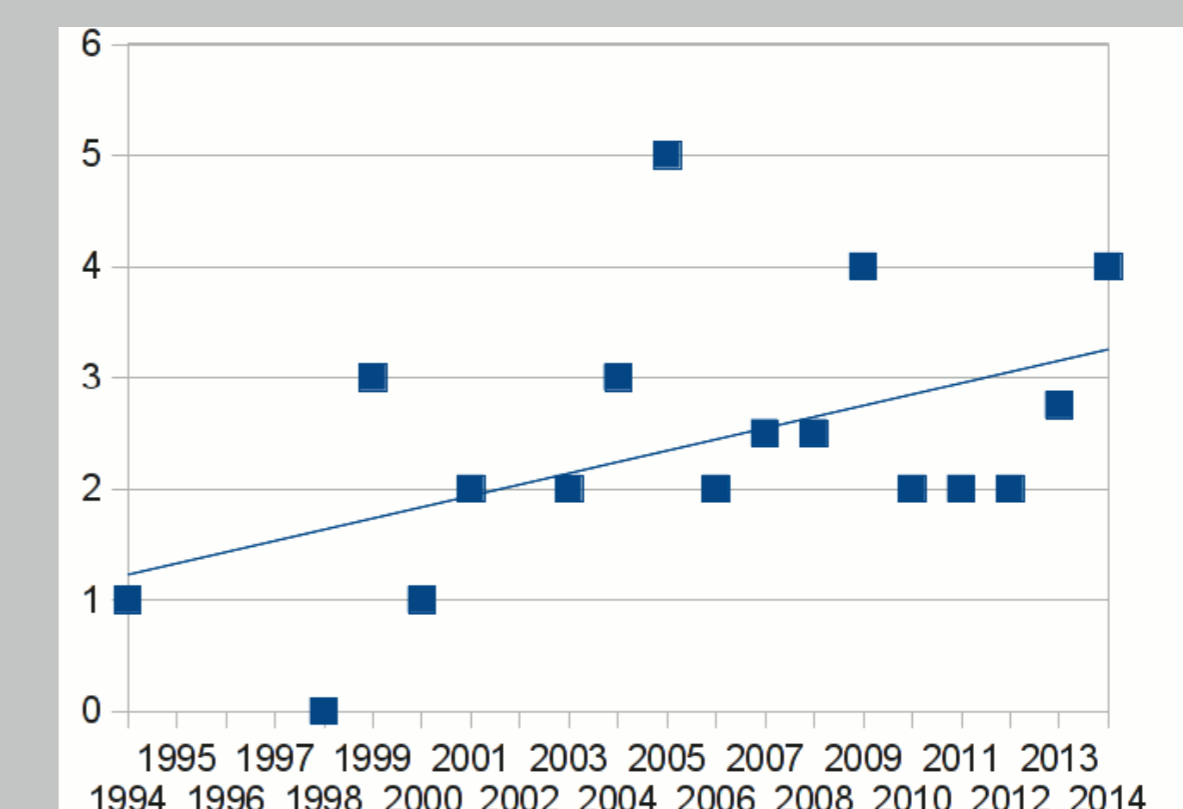
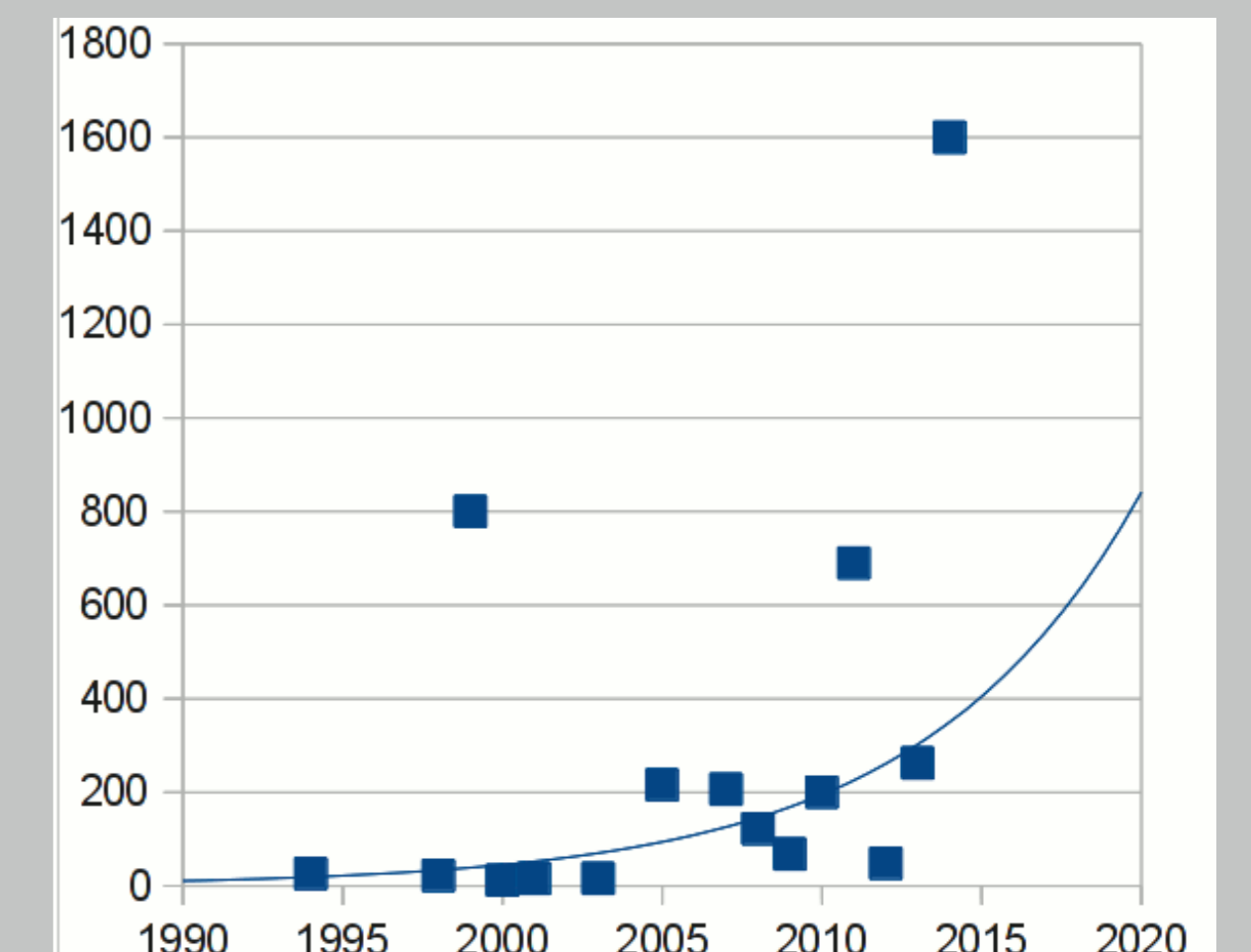
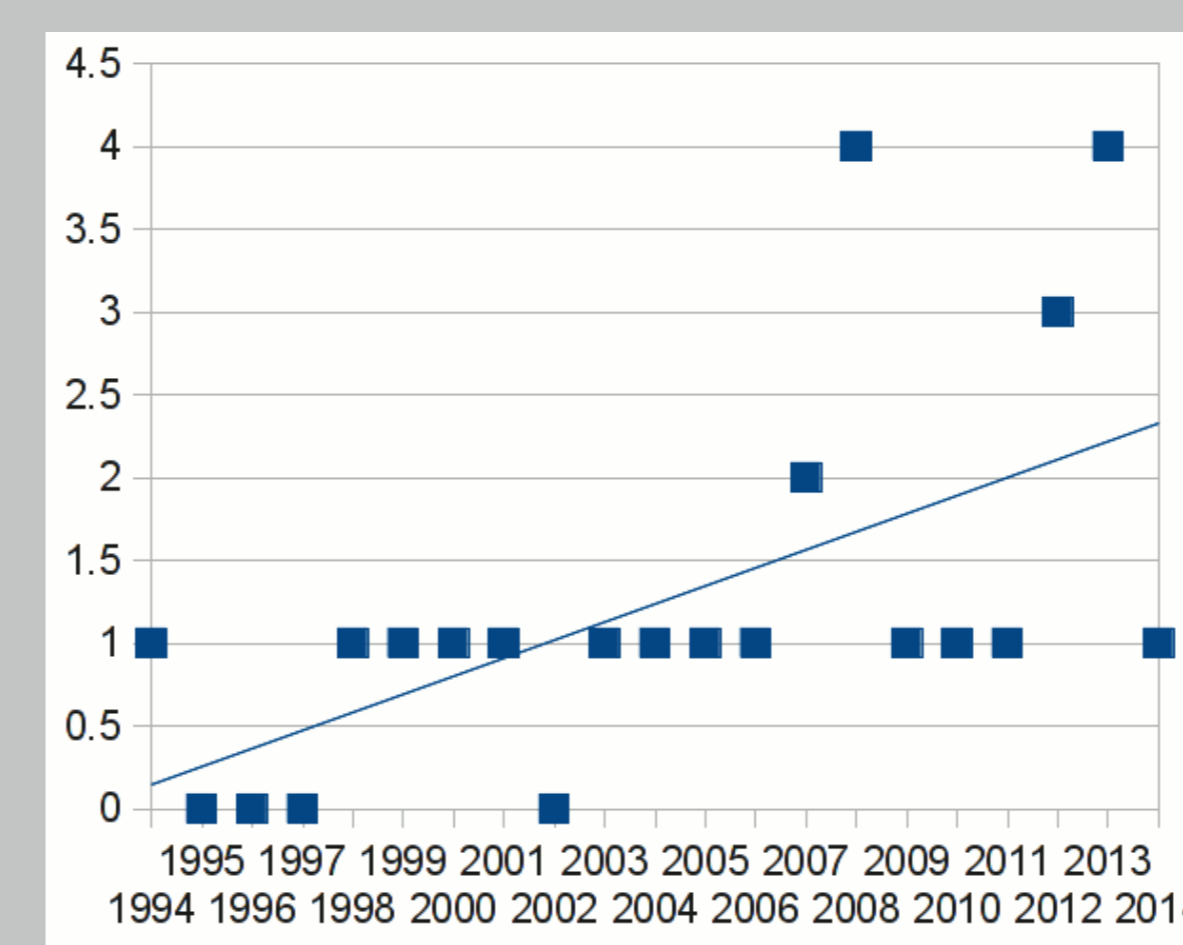
Mean quality rating = 2.423 (SD = 1.39)

Results: Areas modeled

Number of papers, topics ordered from **lower-level to higher-level** cognition:



Results: Trends in the data



Conclusion

1. Models are more **tailored to the strengths of connectionism** than to the dominant theories in autism research
2. Study **quality is mixed**; a weak point is the quantitative comparison to empirical data from experiments
3. The number of new studies is increasing. Similarly, **study quality is showing a linear upward trend**; part of it is the exponential increase in model size (probably fueled by the concurrent exponential increase in computing power)

References

1. Sun, R. (2014). Connectionism and neural networks. *The Cambridge Handbook of Artificial Intelligence* (Eds. Frankish, K., & Ramsey, W. M.). Cambridge: Cambridge University Press.
2. Schopler, E., & Mesibov, G. B. (Eds., 2013). *Learning and cognition in autism*. Berlin: Springer.

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