Non-social sensory perception in autism:

An fMRI ALE meta-analysis

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Background

- Autism: a set of neurodevelopmental conditions diagnosed by social and non-social symptoms, namely difficulties in communication and relationships, unusually narrow interests, and strongly repetitive, restrictive patterns of behaviour
  (American Psychological Association, 2013).
- Atypical sensory experience: occurs in up to 90% of autistic individuals; included in the latest diagnostic criteria for autism *(Robertson & Baron-Cohen 2017)*.
- The neural mechanisms driving the co-occurence of social and non-social symptoms are poorly understood.

Aims

- To condense findings from task-based fMRI studies of non-social sensory perception in autistic compared to non-autistic control participants.
- To disentangle the neural substrates of basic and complex perceptual processes in autistic vs non-autistic control groups.

Method

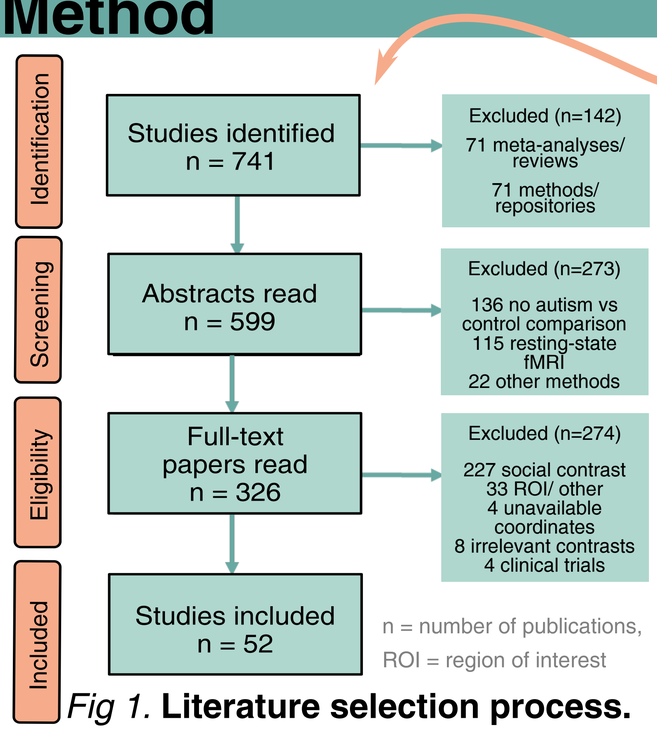

Fig 1. **Literature selection process.**

Systematic literature search via Pubmed in line with best-practice and PRISMA guidelines.

Inclusion criteria: Whole-brain task fMRI studies of non-social sensory perception in autistic vs control participants.

Categorization by task domain.

Activation Likelihood Estimation (ALE): random effects approach; finds spatial agreement across studies *(Eickhoff et al., 2009, 2012; Turkeltaub et al., 2012).* Analyses computed using *GingerALE v3.0.2.*

1. "**Complex" perception:** Non-social sensory perception tasks including higher-level executive function paradigms, such as learning, reward anticipation, and response inhibition.
2. **"Basic" sensory processing** (sub-analysis): Simple sensory stimulation tasks, visuospatial reasoning, visual search, target detection, oddball tasks, and attention paradigms.

Distinct sensory-related brain activity in autism

1. Complex perception

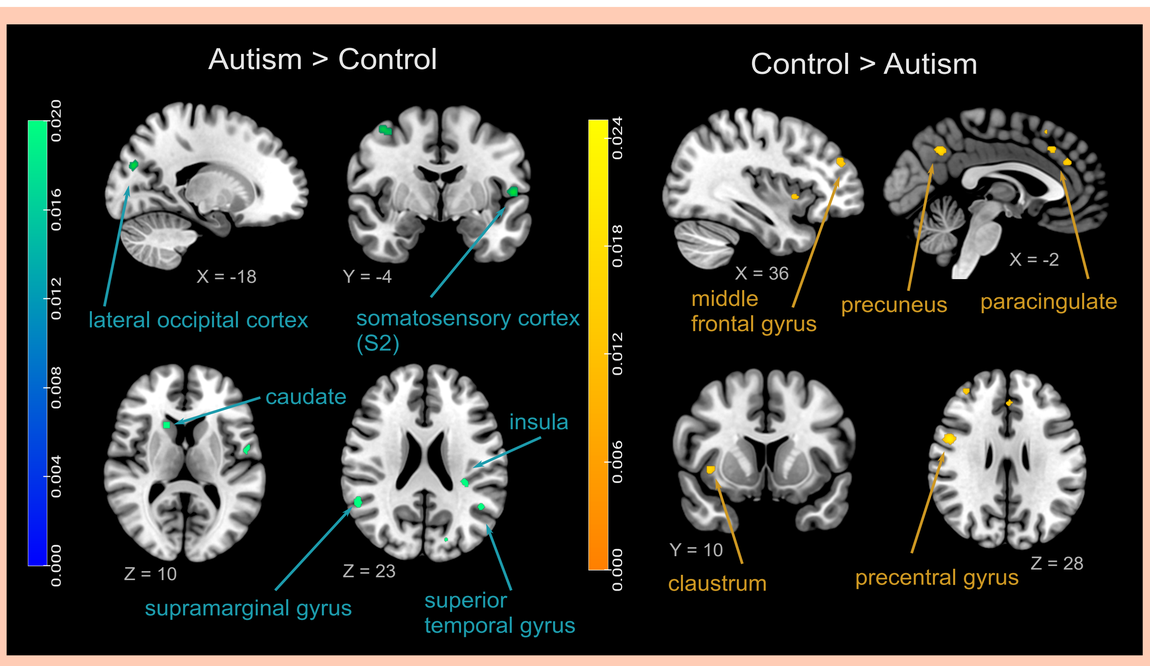

Fig 2. **ALE results of 52 Autism vs Control complex perception fMRI studies** (p<0.001, min. cluster size 100mm^3). Significant clusters are from 25 and 22 studies contributing 307 foci and 369 foci, encompassing 417 autistic and 606 control participants for the comparisons *Autism>Control* and *Control> Autism* respectively.

2. Basic sensory processing

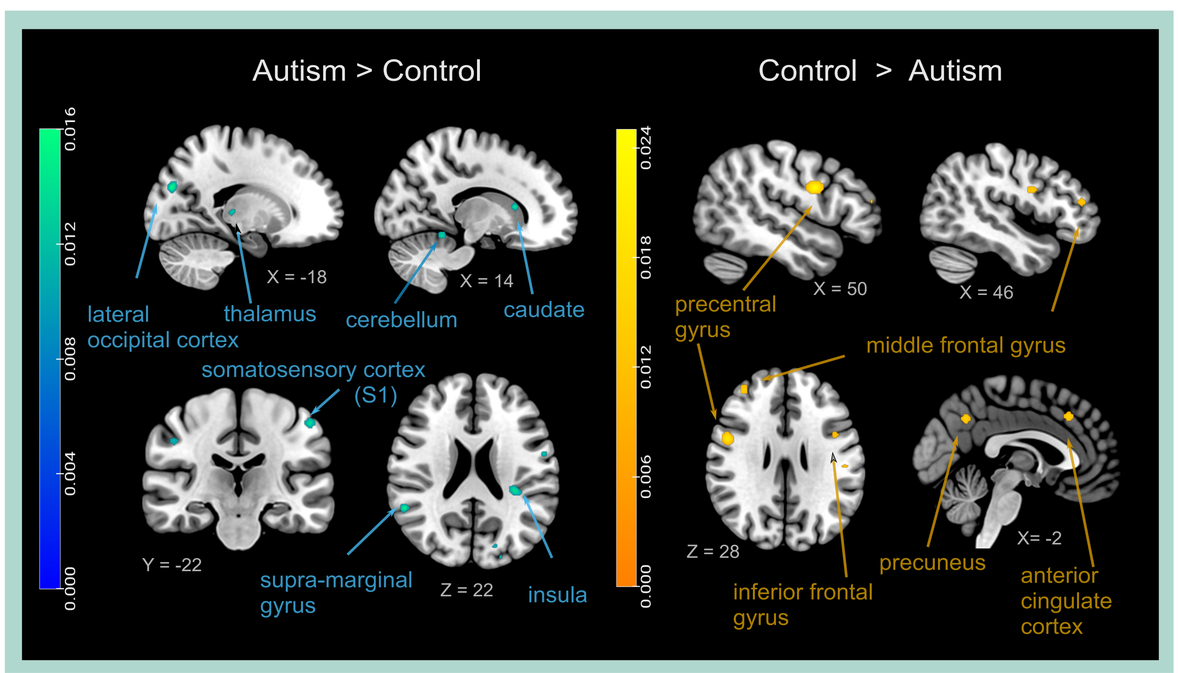

Fig 3. **ALE results of 34 Autism vs Control basic sensory processing fMRI studies** (p<0.001, min. cluster size 100mm^3). Significant clusters are from 20 studies contributing 229 foci and 233 foci, encompassing 357 autistic and 369 control participants for the comparisons *Autism>Control* and *Control> Autism* respectively.

Coordinates are in MNI space. Colour bars represent the ALE values.

Summary

- Distinct sensory perception is a core feature of autism.
- Using ALE, we meta-analysed 52 task fMRI studies of non-social sensory perception in autistic (n=891) vs control (n=967) participants.
- Autistic groups show more activity in somatosensory cortices, caudate, and insula, while controls recruit frontal, pareital and cingulate cortices more.
- Sensory-related neural differences extend to both basic and complex levels of perceptual processing.
- During basic sensory processing tasks, autistic groups show greater engagement of low-level primary sensory areas.

References:

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Full-text preprint & data available!

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