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Temporal and spatial perception of heartbeat sensations in autistic adults

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Introduction

Autistic individuals may differ in sensory processing with both hyper- and hypo-sensitivities documented in exteroceptive modalities.

Additionally, divergent sensory processing of interoceptive (internal bodily) signals may commonly occur, but empirical research detailing interoceptive perception in autistic people is mixed.

Using an interoceptive Method of Constant Stimuli task, we investigated heartbeat perception in autistic and comparison adult participants, both categorically and along a transdiagnostic spectrum of alexithymia.

In accordance with the theory that autistic participants have altered interoception, we hypothesised that autistic participants, relative to comparison individuals would (1) show a reduced ability to judge heartbeat timings precisely, and (2) that autistic participants would display a shifted heartbeat timing perception relative to non-autistic individuals.

Results

Task performance measure	Autistic	Comparison group		
Task performance measure	Mean (± SD)			
Simultaneity precision (IQR; ms)	287.19 (± 33.35)	283.25 (± 33.42)		
Inter-beat interval (ms)	795.39 (± 123.57)	822.11 (± 116.86)		
Mean reported delay interval (ms)	243.15 (± 17.81)	243.60 (± 23.40)		
Median reported delay interval (ms)	236.54 (± 47.60)	241.07 (± 46.81)		
Mode reported delay interval (ms)	207.69 (± 173.60)	183.93 (± 161.56)		
Confidence of simultaneity judgement	42.47 (± 24.54)	49.65 (± 23.02)		



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Methodology

Participants

N = 111 participants:

- 55 autistic (25 females; mean age 35.3 (±12.76) years
- 56 comparison (33 female) participants; mean age 30.84 (±12.82) years

Autistic participants were recruited from patients (both current and previous) of the Sussex Partnership NHS Foundation Trust Neurodevelopmental Service, and through community and third-sector organizations. Autistic participants had a DSM/ADI-R or equivalent confirmed diagnosis of an Autism Spectrum Condition. Comparison participants had the exclusion criteria of no history of neurological or psychiatric conditions, and no formal autism diagnosis.

Method of Constant Simulus Task

Simulus: Five successive tones presented at six delay intervals relative to the ECG R-peak across 120 trials.

Measure (per trial).

- Binary judgement (yes/no) of the simultaneity of the auditory tones and participant heartbeat sensation.
- Confidence in judgement report on a scale from 0 ("I was guessing") to 100 ("I was completely sure").



Heartbeat location sensation

No group difference in perceived distance of heartbeat sensation from heart between autistic (mean_{A.U.} = 95.48, SD = 74.77) and comparison individuals (mean_{A.U.} = 96.23, SD = 98.47); t(106) = 0.04, p = 0.965, CI = [-32.80, 34.30], b = -0,75, SE = 16.92, $B_{C(0, 93.40)} = 0.15$, RR_{B<1/3}[38.67, ∞].



• Location rating of heartbeat sensation (mouse click on grey body map).

Precision of heartbeat judgement (simultaneity precision) was indexed as the interquartile range (IQR) of cumulative percent distribution of reported simultaneity across all six delay intervals:
IQR = Q3 (75th percentile) – Q1 (25th percentile)



Identifying heartbeat detectors

- A chi-square was calculated from a 6x2 contingency table between SOA (Oms, 100ms, 200ms, 300ms, 400ms, and 500ms) by judgements (simultaneous, non-simultaneous), with an alpha level of 0.05 being used to classify heartbeat detectors.
- A Bayes factor (B) was calculated for each participant, which estimated the evidence for their simultaneity precision (IQR) being different from chance performance (i.e., where chance performance would show a flat distribution of simultaneity judgement,

Subclinical scores

			Autistic	Comparison group		
			Mean	(± SD)	t(df)	CI
		AQ	35.67 (± 8.13)	16.77 (± 6.73)	-13.15(105)	[-21.75, -16.05]
		STAI				
		State	46.31 (± 11.68)	33.21 (± 8.91)	-6.56(105)	[-17.06, -9.14]
		Trait	57.54 (± 11.16)	41.02 (± 10.08)	-8.08(106)	[-20.57, -12.47]
	QuestionnaireTAS-20scoresTotal					
		Total	60.92 (± 13.72)	42.59 (± 12.71)	-8.68(104)	[-23.04, -14.47]
		Difficulty describing feeling	17.59 (± 3.79)	12.13 (± 4.62)	-6.59(104)	[-6.59, -3.66]
		Difficulty identifying feelings	24.20 (± 5.82)	14.54 (± 6.19)	-8.23(104)	[–11.66, –7.13]
		Externally-oriented thinking	20.33 (± 4.79)	15.93 (± 4.28)	-4.96(104)	[-5.76, -2.47]

represented by an IQR of 300ms). Predictions of the alternative hypothesis (H1) for each participant were modelled as a half-Cauchy distribution with a scale factor of x where x is calculated through a room-to-move heuristic as the maximum room to move (300ms, i.e., from random, 300ms, to the bottom of the scale, 0ms) divided by seven.

Heartbeat location sensation

- To investigate group differences in where in the body heartbeats were most frequently perceived, location cluster reports were compared between the groups in terms of number of endorsements of each cluster. A Pearson chi-square test was performed to quantify whether there was a group difference in the endorsement per body location. These results can be found in the Supplementary material.
- Perceived distance of heartbeat sensation from the heart was calculated to control for the possibility of heartbeat location sensation affecting perceived heartbeat timing.
 Subclinical questionnaires
- All participants completed a battery of subclinical questionnaires:
- the Autism Quotient (50 items)
- Spielberger State-Trait Anxiety Inventory (40 items)
- Toronto Alexithymia Scale (20 items).

Conclusion

Results do not confirm either the presence or absence of a group difference in MCS task performance between autistic and comparison participants in terms of heartbeat detection ability, no difference in terms of perceived heartbeat timing, and no difference in heartbeat sensation location in terms of perceived distance from the heart.

Furthermore, results suggest a possible floor effect in task performance in the Comparison group, suggesting the MCS task to be unsuitable for evaluating heartbeat perception differences in autistic individuals.

In conclusion, this study suggests the need for more nuanced evaluation of interoceptive ability within the context of autism, considering other aspects beyond autism as a diagnosis.