Correlates and Turning Points of Adaptive Functioning Trajectories & Longitudinal Associations with Autism Symptoms from Early Childhood to Adolescence

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Background

Heterogenous adaptive outcomes in autism have been observed in previous longitudinal studies.

VABS Trajectory Studies
- Szatmari 2015* (VABS-2 composite)—3 subgroups — Quadratic
- Meyer 2018 (VABS-1 composite or Vineland Social Maturity Scale [1953])
- Flanagan 2015 (VABS-2 composite) — Linear
- Franchini 2018 (VABS-2 composite and four sub-domains) — Linear
- Magiati 2011 (VABS-1 composite [1984]) — Quadratic
- Farmer 2018* (VABS-2 composite)—2 subgroups — Quadratic
- Kover 2016 (VABS-2 composite) — Linear
- Salomone 2018 (VABS-2 composite and three sub-domains)
- McDonald 2020 (VABS-2 composite) — Piecewise
- Estes 2015 (VABS-2 composite) — Current study (VABS-2 three sub-domains)

(Adapted from Gentles et al., Autism)

Gentles et al. (2023). Trajectory research in children with an autism diagnosis: A scoping review. *Autism*.

Evidence Gaps

- *Associated characteristics beyond baseline* (e.g., autism symptoms)
- *Turning points of adaptive functioning trajectories* to inform opportunities for change
- *Family characteristics as covariates of trajectories* (e.g., SES, immigrant status)
- *Global vs. Domain Score as unit of analysis* — Domain-level sources of variance were often ignored.
- *Data Wave vs. Chronological Age as time metrics* — Between-person age differences and within-person change were conflated.

Research Questions

1. What is the **best-fitting shape** of the latent trajectories of VABS subdomains? Are there **turning points** at certain ages?
2. How many **VABS trajectory subgroups** can be identified? Is the subgroup membership associated with **child and family characteristics**?
3. Do these VABS trajectory subgroups differ by **the changes of autism symptoms** from early to late childhood?
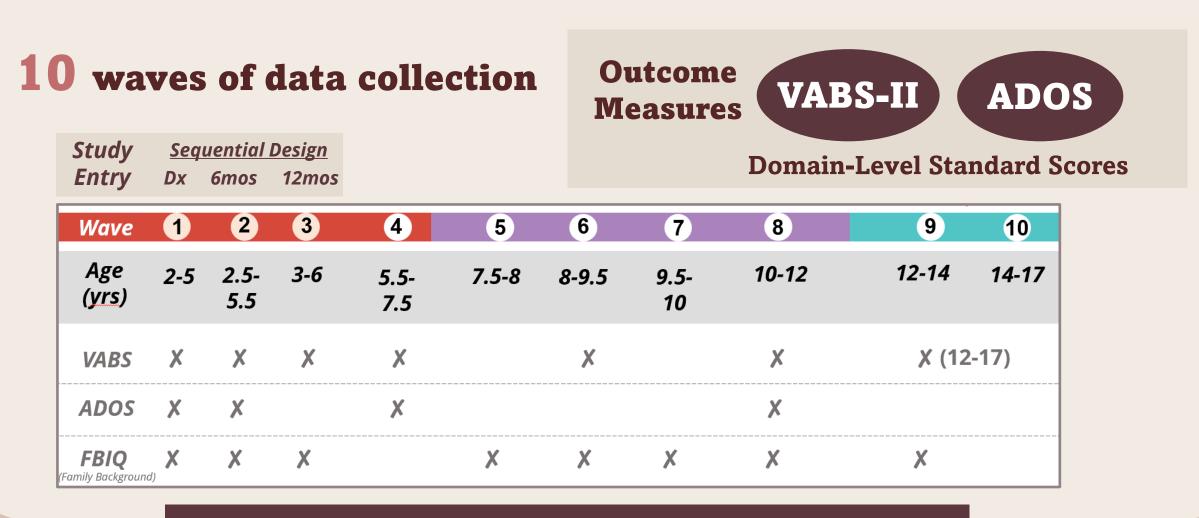
Methods

Across 5 provinces in Canada

pathways in autism spectrum disorder

406 children diagnosed with autism at ages 2-5 (with ≥ 1 timepoint of VABS data available)
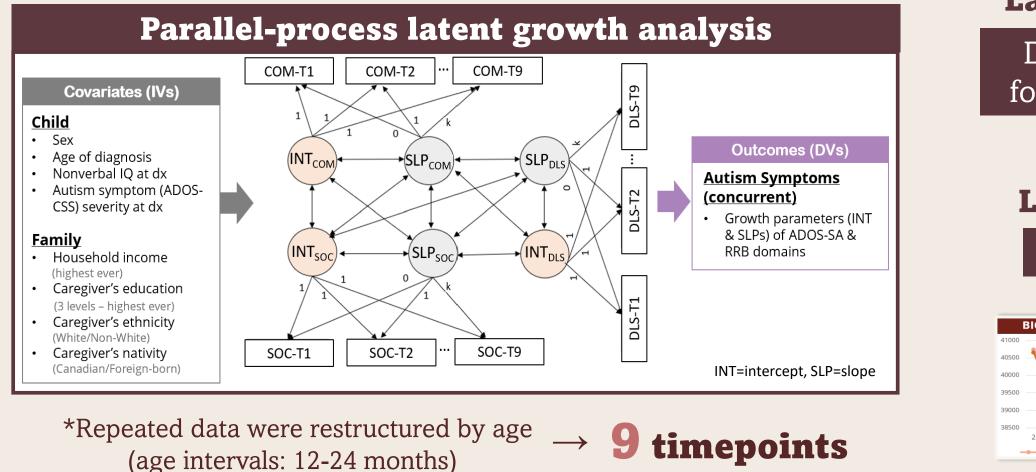
≥ 15 years of follow-up (Y2005-current)

Participants

Measures & Timeline

10 waves of data collection

Outcome Measures: **VABS-II**, **ADOS** — Domain-Level Standard Scores

Study Entry	Sequential Design		
	Dx	6mos	12mos

Wave	1	2	3	4	5	6	7	8	9	10
Age (yrs)	2-5	2.5-5.5	3-6	5.5-7.5	7.5-8	8-9.5	9.5-10	10-12	12-14	14-17
VABS	X	X	X		X			X		X (12-17)
ADOS	X	X		X				X		
FBIQ (Family Background)	X	X		X		X		X		X

Analysis

Parallel-process latent growth analysis

Covariates (IVs):
- Child: Sex; Age of diagnosis; Nonverbal IQ at dx; Autism symptom (ADOS-CSS) severity at dx
- Family: Household income (highest ever); Caregiver's education (3 levels - highest ever); Caregiver's ethnicity (White/Non-White); Caregiver's nativity (Canadian/Foreign-born)

Outcomes (DVs): Autism Symptoms (concurrent) — Growth parameters (INT & SLPs) of ADOS-SA & RRB domains

INT=intercept, SLP=slope

*Repeated data were restructured by age (age intervals: 12-24 months) → **9 timepoints**
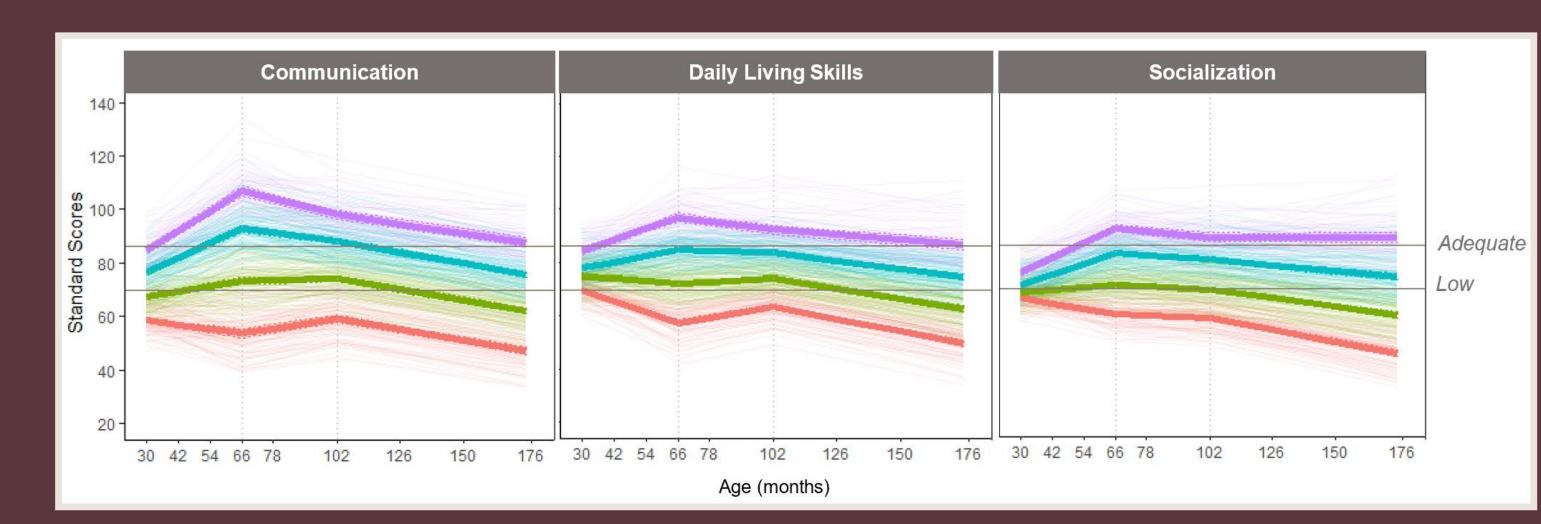
Latent growth curve modeling
Determine best-fitting functional form (linear, quadric, or piecewise) (VABS, ADOS)

Latent class growth analysis
Identify trajectory subgroups (VABS)

Key Findings

4 VABS trajectory subgroups with varying levels & change rates of functioning were parsed among 406 autistic children from ages 2 to 15.

Communication / Daily Living Skills / Socialization — Standard Scores vs Age (months)

Class 1 (n=87, 21%)
- Overall low functioning
- Early decrease + late catch-up after entering school age
- Lower NVIQ at dx
- More elevated autism symptoms at dx
- Lower family SES

Class 2 (n=113, 28%)
- Between low and adequate range
- Overall stable trajectories & autism symptoms until age 10
- Family SES similar to C1

Class 3 (n=140, 35%)
- Nearly adequate range of functioning
- Early improvement across domains
- Later diagnosed
- Autism symptoms at dx & family SES didn't differ from C4

Class 4 (n=66, 16%)
- Above adequate level & early improvement
- More adaptive social outcomes in adolescence
- Higher NVIQ at dx (*1/3 with IQ<70)
- Higher family SES

VABS change patterns
- Class 1: ↓ ↑ ↓ (SOC—)
- Class 2: — — ↓ (COM↑)
- Class 3: ↑ ↓ (COM↓)
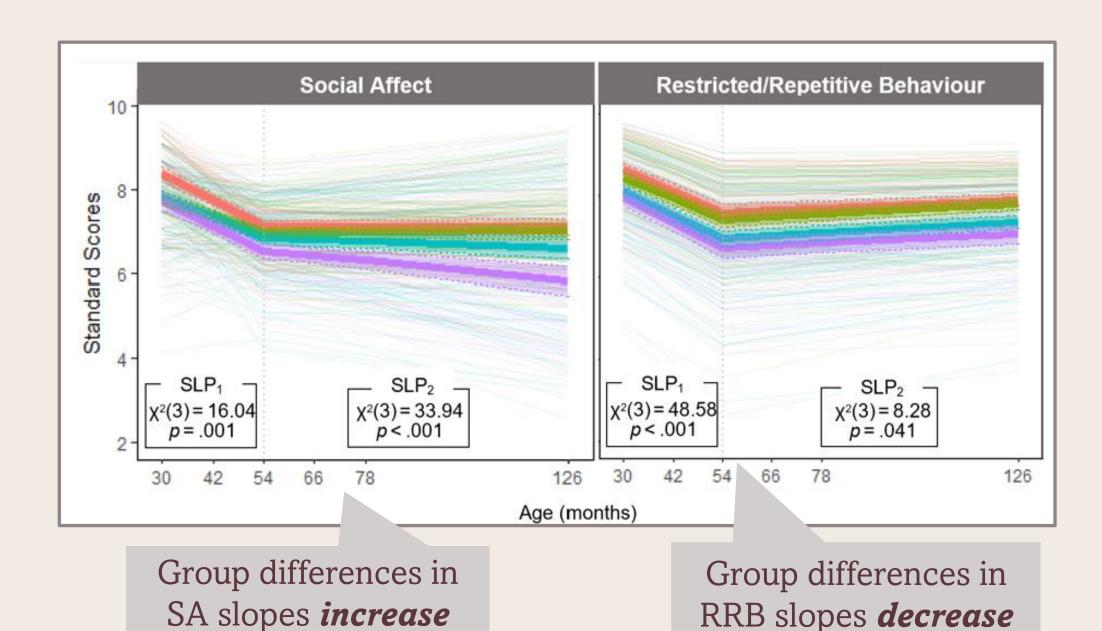- Class 4: ↑ — ↓ (COM↓)(SOC—)

2 turning points at ages 5-6 and 9-10
(*Transitions* into school age and early adolescence).

NVIQ at diagnosis & household income are key correlates of VABS trajectories.

Covariates	C1 (n=87)	C2 (n=113)	C3 (n=140)	C4 (n=66)	Multinomial Logistic Regression
Child Characteristics at Diagnosis					
Male	75 (86%)	92 (81%)	120 (86%)	55 (83%)	No sig. group difference
Age of diagnosis (m)	36.01 (8.69)	37.96 (7.84)	39.89 (9.20)	38.92 (8.67)	C3>C1, C4>C1, C3>C4
NVIQ (Merrill-Palmer-R cog.)	34.85 (15.20)	52.36 (16.84)	65.49 (20.65)	82.54 (25.78)	C2>C1, C3>C1, C4>C1, C3>C2, C4>C2, C4>C3
ADOS-total CSS	8.49 (1.51)	7.30 (1.67)	7.38 (1.67)	7.21 (1.70)	C1>C2, C1>C3, C1>C4
Family Characteristics					
Household Income	8.45 (2.72)	8.56 (2.78)	9.44 (2.41)	10.49 (1.27)	C3>C1, **C4>C1**, C3>C2, **C4>C2**, C4>C3
Caregiver's Education (Bachelor's Degree+)	30 (34%)	42 (37%)	75 (54%)	38 (58%)	C3>C1, C4>C1, **C3>C2**, C4>C2
Caregiver's Race (White)	51 (59%)	68 (60%)	111 (79%)	51 (77%)	C3>C1, C3>C2, C4>C2
Caregiver's Nativity (Canada-born)	48 (55%)	69 (61%)	108 (77%)	50 (76%)	C3>C1, C4>C1, C3>C2, C4>C2

Bolded beta coefficient values represent significant effects (*p* < .05) in the adjusted model.

Differential associations with ADOS domains were observed across time.

Social Affect / Restricted/Repetitive Behaviour — Standard Scores vs Age (months)

- Social Affect: SLP_1 $\chi^2(3) = 16.04$, $p = .001$; SLP_2 $\chi^2(3) = 33.94$, $p < .001$
- Restricted/Repetitive Behaviour: SLP_1 $\chi^2(3) = 48.58$, $p < .001$; SLP_2 $\chi^2(3) = 8.28$, $p = .041$

Group differences in SA slopes *increase* over time.

Group differences in RRB slopes *decrease* over time.

Intervention targets may vary across developmental stages for better supporting autistic children's functional needs.

Implications

"Doing Well"

Who
- **~16%** of our autistic participants showed good social adaptive outcomes by adolescence.
- **~21%** were in the low-functioning range and more likely from a **low-SES** family. — Support for **early access to services**

When
- **Entering school age** is associated with **challenge *or* opportunities** for improvement in functioning.
- **Various responses to transitions**
- Overall **decreasing trends** in adaptive functioning were observed in **adolescence** *despite* stable or decreasing ADOS-SA scores. — **Environmental supportiveness**