Longitudinal Development of Cognitive Maps

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Aims

1: Take a longitudinal look at the formation of cognitive maps over childhood into adolescence.

- Build on cross-sectional virtual navigation study of 105 children (8 to 16)[1] showing performance comparable to adults around 12 years

2: Does route representation develop before route integration?

- As seen in the cross-sectional work[1]

3: How longitudinally reliable are navigation measures?

Method

Participants

Age Group	M	F	Total
Lower (T1 age = 8 to 12 yrs.)	13	14	27
Upper (T1 age = 12 to 16 yrs.)	8	11	19

50 of 105 children returned for follow-up 3 years later (min = 1.9 years, max= 4.4 years)

Measuring Navigation:

Silcton Large-Scale Virtual Environment[2]

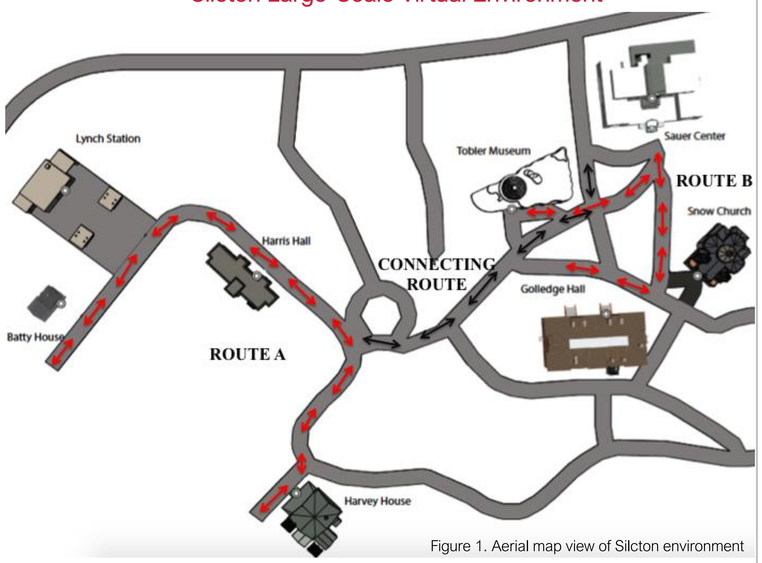

Figure 1. Aerial map view of Silcton environment

Task	Outcome Measure
Within-Route Pointing	degrees of pointing error
Between-Route Pointing	
Model Building	R^2 configurational accuracy

Results

Aim 1: Development of Cognitive Map Formation

Task	Outcome	*Mean* Difference	*t*	df	*p*	Cohen's *d*
Within-Route	Pointing Error	-5.3 °	-3	45	< 0.01	0.438
Between-Route	Pointing Error	-6.4 °	-3	45	< 0.01	0.441
Model Building	Accuracy (R^2)	0.2	4	46	< 0.001	0.583

Aim 2: Longitudinal Improvement by Age

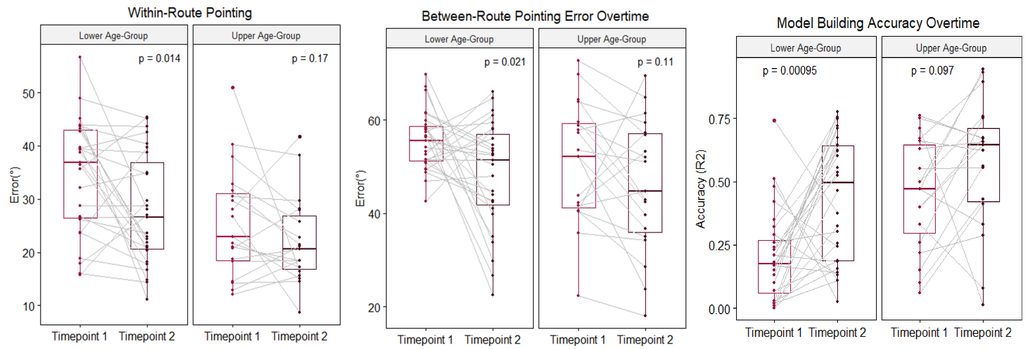

Figure 2. Boxplots of improvement on navigation measures by age ($N_{Pointing}$= 46; N_{Model} = 47)

Rates of Development for Within- & Between-Route Pointing

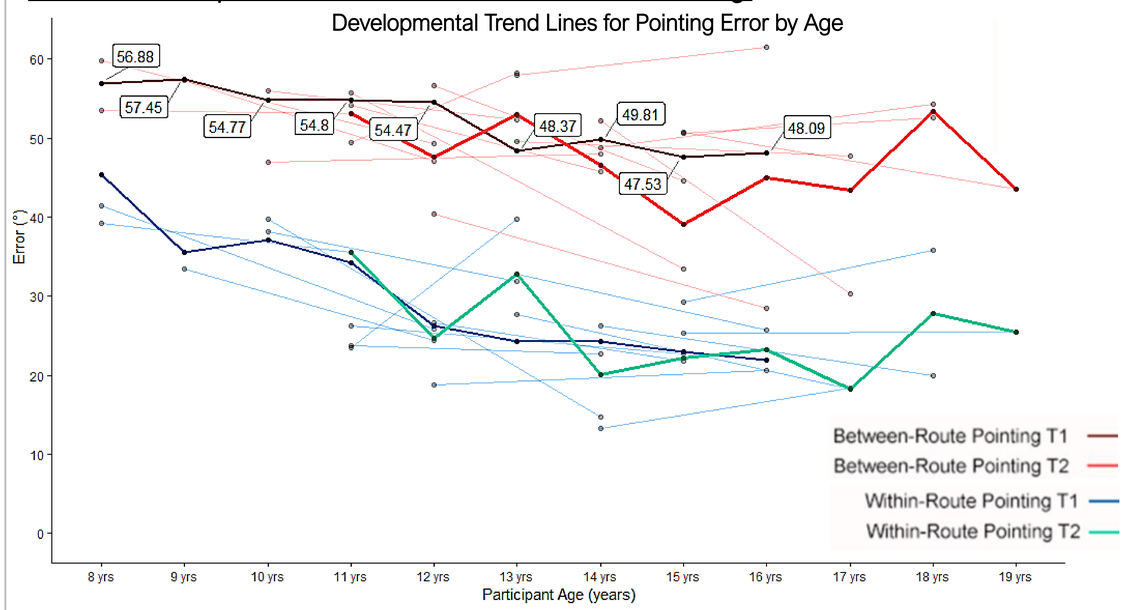

Figure 3. Developmental trend lines of improvement on pointing error by age (N= 46)

Significant differences in slopes at T1 (β = 1.65, p = .02), but not T2 (β = 1.00, p = .58)

Results

Aim 3: Longitudinal Reliability of Virtual Silcton

	Longitudinal Reliability (*r*)	*p*	n
Virtual Silcton			
Pointing Within-Route	0.36	0.014	46
Pointing Between-Route	0.19	0.196	46
Model Building	0.15	0.312	47
Other Measures			
Spatial Orientation Test	0.59	0.00	48
Mental Rotation Test	0.51	0.00	50

Conclusions & Implications

1: Cognitive map formation improves across childhood

- Overall → children improved on all VE navigation measures

2: Longitudinal data confirm cross-sectional findings.

- Within-route knowledge develops more steeply initially.

3: Virtual Silcton shows moderate longitudinal reliability across three years only for within-route pointing task .

- Adolescents "trade places" as they stabilize integration capabilities at adult levels.

References

1. Nazareth, A., Weisberg, S. M., Margulis, K., & Newcombe, N. S. (2018). Charting the development of cognitive mapping. *Journal of experimental child psychology*, 170, 86-106.
2. Weisberg, S. M., Schinazi, V. R., Newcombe, N. S., Shipley, T. F., & Epstein, R. A. (2014). Variations in cognitive maps: Understanding individual differences in navigation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40(3), 669.
3. Weisberg, S. M., & Newcombe, N. S. (2016). How do (some) people make a cognitive map? Routes, places, and working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42(5), 768.