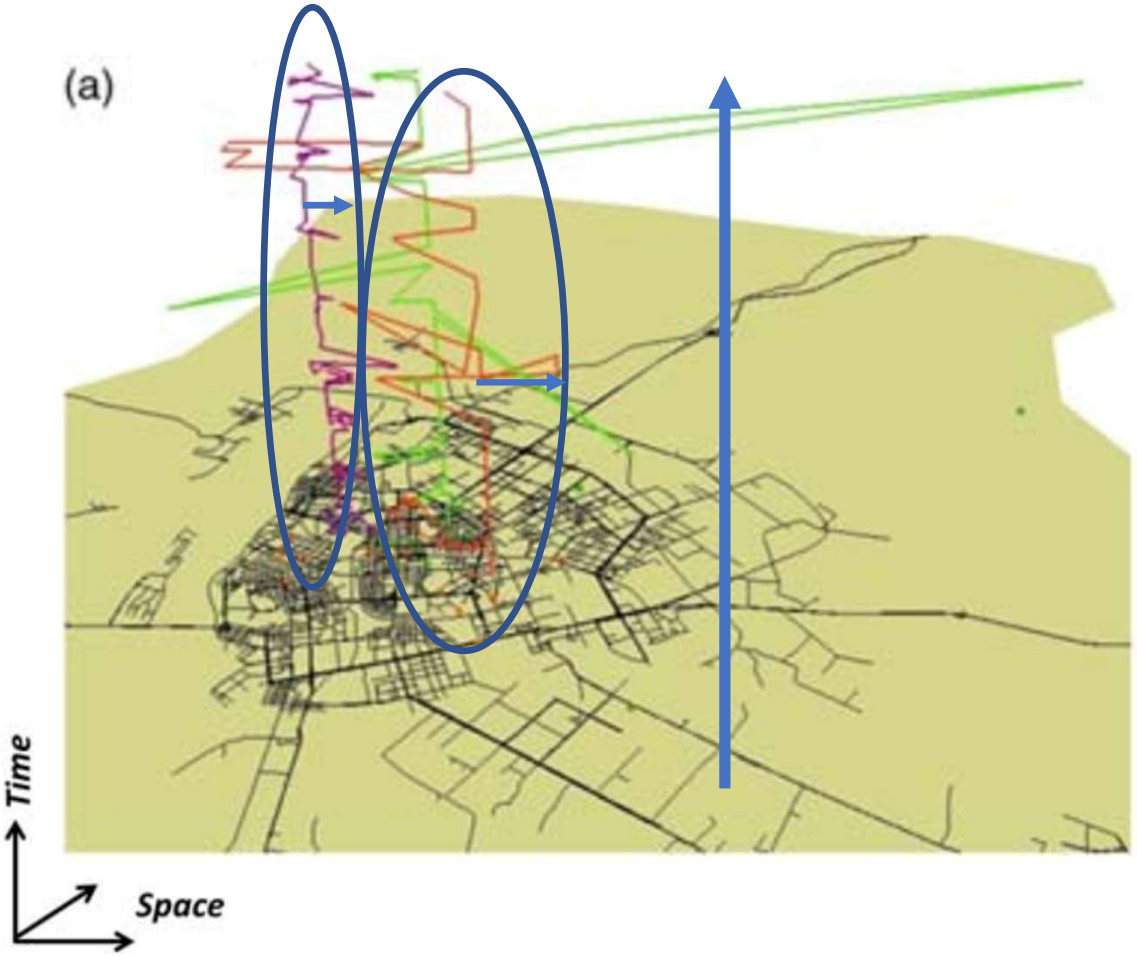
Modeling Personality and Daily Spatial Behavior: A Longitudinal Study in Adolescent Twins

Yuan Zhou, Oct 20, 2021

Spatial Behavior and Individual Differences

- Number of places visited
- Distance traveled
- Activity space
- Entropy (or predictability)



Space: x-axis and y-axis are latitude and longitude

Gao, 2015

Daily Spatial Behavior and Personality are Related

	Places Visited	Distance Traveled	Activity Space (Range)	Entropy
Extraversion	+	+	+	+
Openness	+	+		
Conscientiousness	-/+			-
Agreeableness			+	
Neuroticism	-			-

Ai, Liu, & Zhao, 2019; Alessandretti et al., 2018; Chorley, Whitaker, & Allen, 2015; de Montjoye et al., 2013; Mønsted, Mollgaard, & Mathiesen, 2018

Our Research Questions

1. How does spatial behavior develop in adolescence?

2. How are these behaviors related to personality?

3. What are the respective roles of genes and environment in spatial behavior?

Colorado Online Twin Study (CoTwins)

- Intensive longitudinal assessment
- 110 MZ and 225 DZ twin pairs (670 total participants, 400 addt'l twins being recruited now)
- 77.1% non-Hispanic white, 14.7% Hispanic, ~8% other
- 55% percent female
- Intake assessment at age 14-17 and during which smartphone app is installed
  - The mean age at intake was 16.1 (SD=1.1)
- Follow-up intensive longitudinal assessments for 2 years (now extended to 4 years)

Personality Data Description

Big Five Inventory scale	Cronbach's Alpha		Mean (SD)	
	CoTwins	Normative Sample	CoTwins	Normative Sample
Extraversion	0.85	0.85	3.3 (.82)	3.9 (.61)
Agreeableness	0.75	0.82	4.0 (.56)	3.6 (.61)
Conscientiousness	0.75	0.84	3.7 (.62)	3.3 (.67)
Neuroticism	0.81	0.85	2.7 (.76)	1.8 (.67)
Openness	0.72	0.80	3.5 (.56)	3.5 (.59)

John, & Srivastava, 1999; Lounsbury, Tatum, Gibson, Park, Sundstrom, Hamrick, & Wilburn.,2003

Location Data Collection and Description

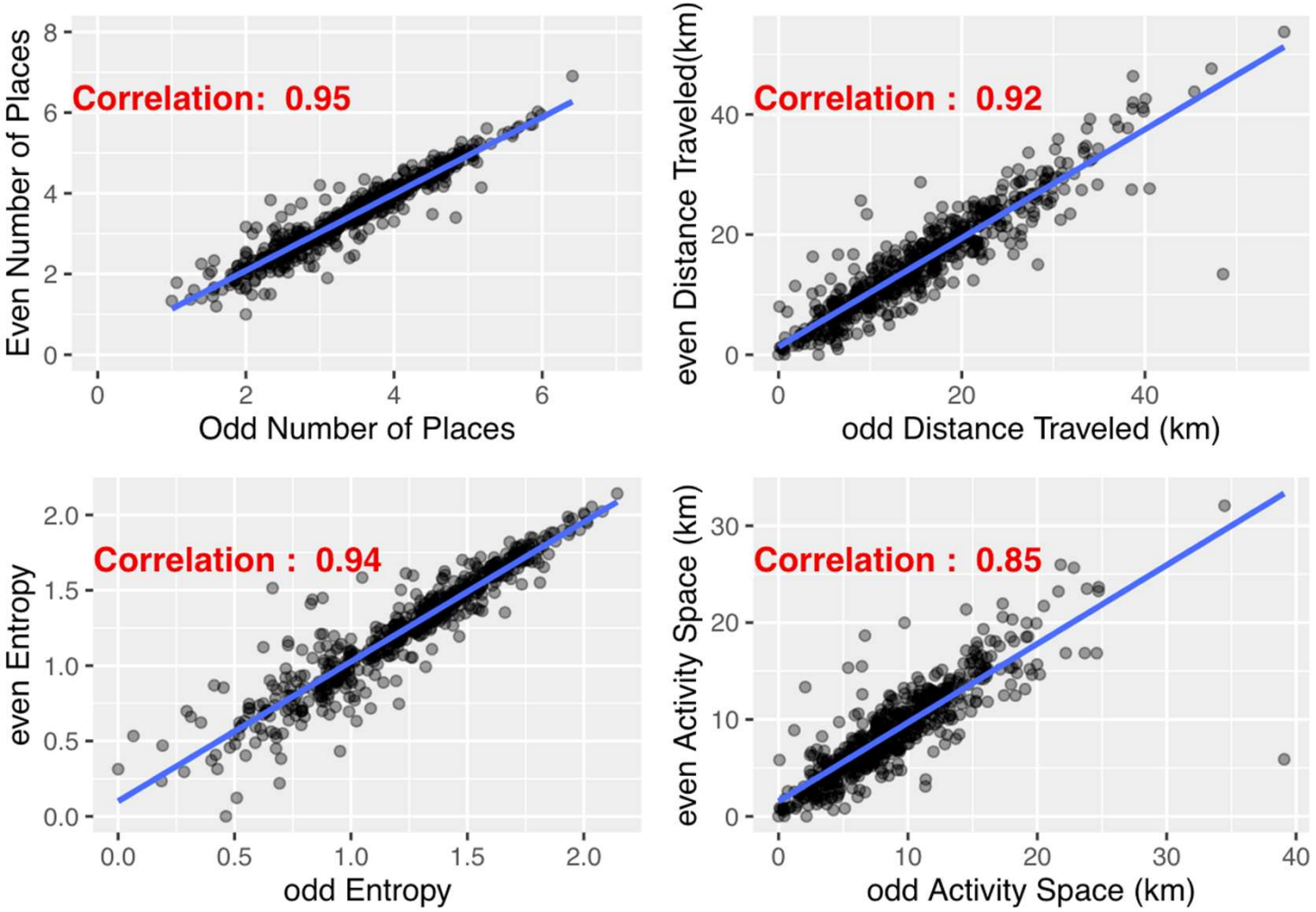
- 21,016,920 location points collected via smartphone app
  - Extracted 604,261 Stay Point

- Derived four daily spatial behaviors based on stay points
  - Number of places visited each day
  - Daily distance traveled
  - Daily activity space
  - Daily entropy

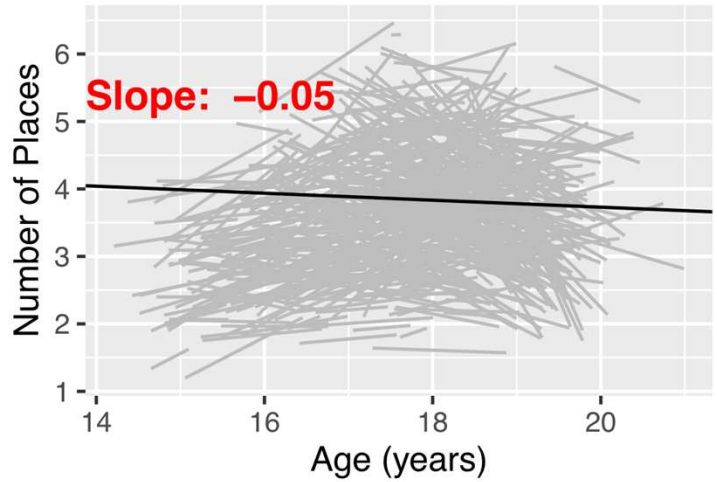
Daily Spatial Behavior is Highly Reliable

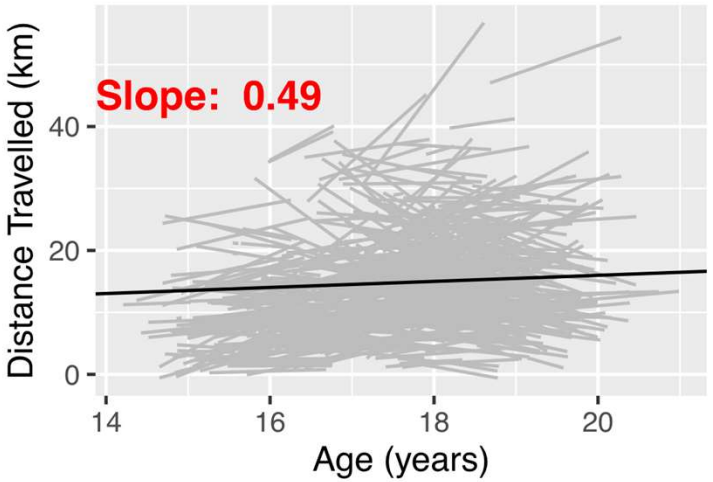
Daily Spatial Behaviors	Mean	Standard Deviation	Split-Half Reliability
Number of Places	3.66	2.06	0.95
Distance Travelled (km)	17.60	26.86	0.92
Activity Space (km)	9.86	17.56	0.94
Entropy	1.34	0.8	0.85

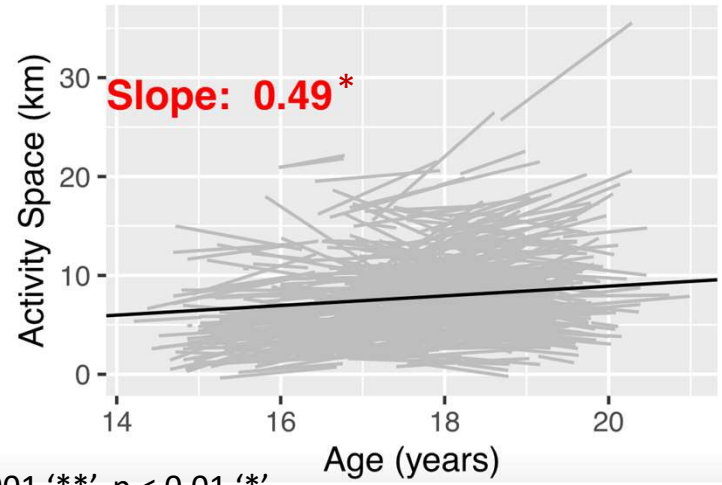
Daily Spatial Behavior is Highly Reliable

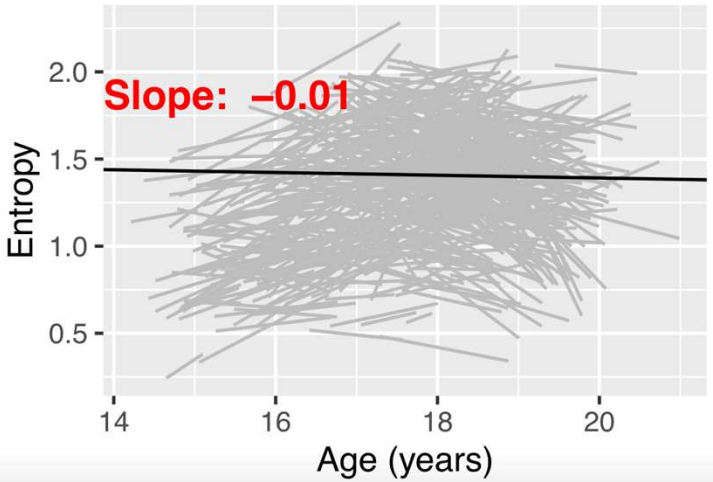


Daily Spatial Behavior is Stable over Time









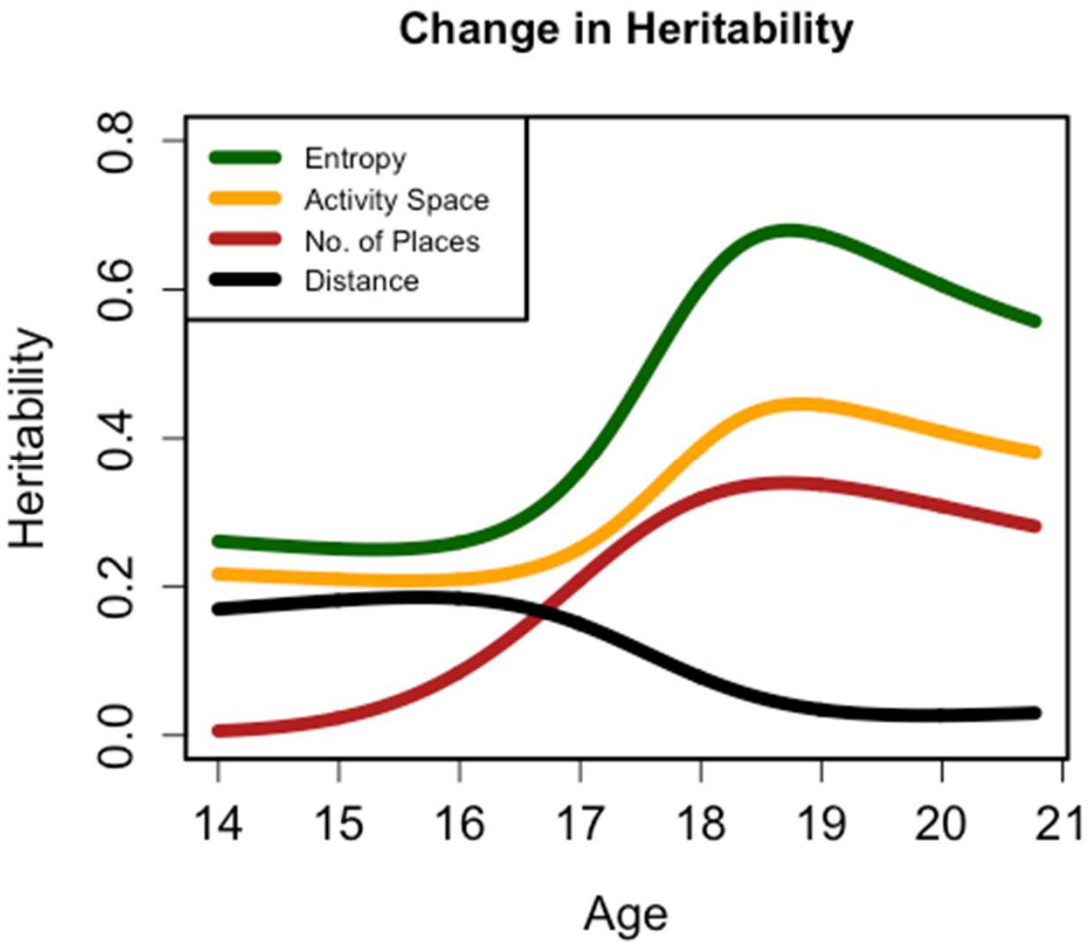
p < 0.001 '***', p < 0.001 '**', p < 0.01 '*'

Personality and Spatial Behavior are Correlated

	Number of Places	Distance Travelled	Activity Space	Entropy
Openness	-0.09*	-0.13**	-0.14**	-0.1*
Conscientiousness	0.07	0.13**	0.14**	0.08
Extraversion	0.1*	0.07	0.09*	0.1*
Agreeableness	~0.00	-0.02	~0.00	0.01
Neuroticism	-0.02	-0.07	-0.1*	-0.02

$**p < 0.01$, $*p < 0.05$

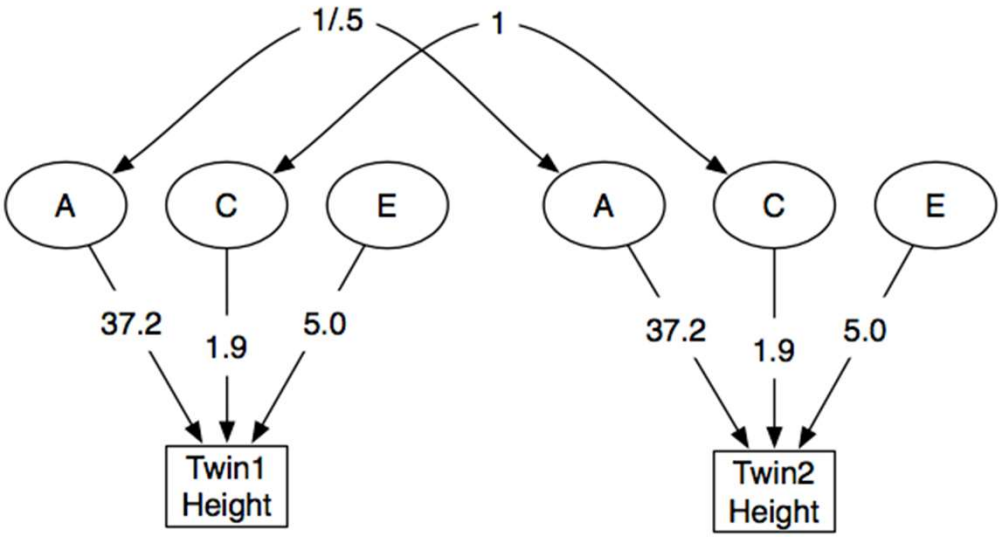
Daily Spatial Behavior is Influenced by Genes and Environment



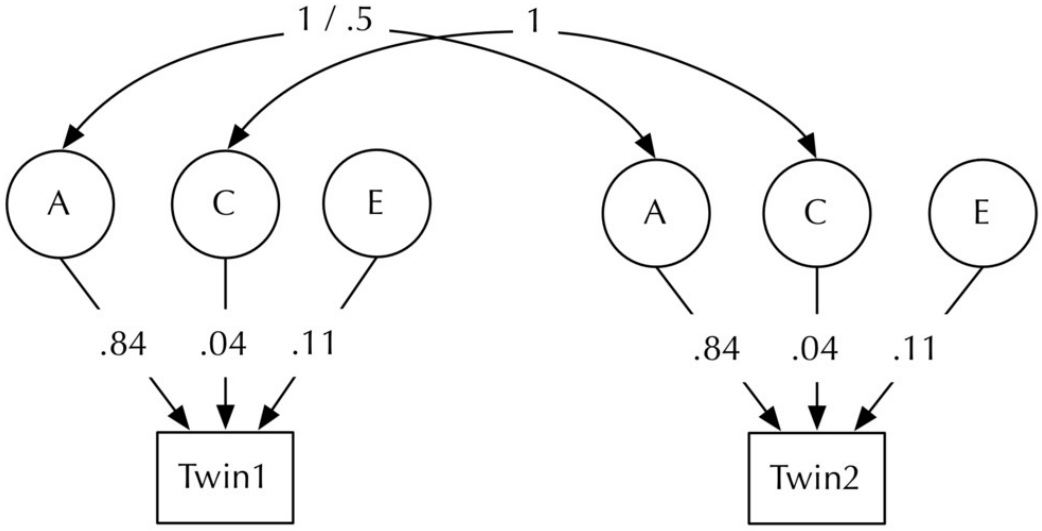
Summary and Conclusion

- Daily spatial behavior is stable over time
- Personality correlates with daily spatial behavior
- Heritability of daily spatial behaviors increases substantially between age 16 and 18

ACE Twin Model Explained



ACE model showing raw (non-standardised) variance coefficients



ACE model showing standardised variance coefficients

* Credit from Wikipedia *(Twin Studies)*