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*Celebrating 60 Years of Social Science in the Public Interest*

## Cognitive Function in the Community Setting: The Neighborhood as "Cognitive Reserve"




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## Cognitive Function

- Cognitive impairment (dementia, AD, mild cognitive impairment)
- Prevalence (~20%) increases with age
- Prevalence of AD expected to triple by 2050
- Costs, caregiver burden



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## Cognitive Function and Individual Risk Factors

- Hypertension, diabetes, heart disease, obesity (chronic inflammation and oxidative stress)
- Physical activity, diet (Prohaska, 2009; Scarmeas, 2009)
- Social integration/social interaction (Seeman, 2001)
- Socioeconomic status (income, wealth, education) (White, 1994; Huppert, 2006; Cagney, 2002; Gallagher, '99)
- Education as "cognitive reserve" (synaptic density, mental stimulation, access to resources)

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## Cognitive Function and the Environment

- Low neighborhood education is associated with lower cognitive function, particularly among older adults (Wight et al., 2006).
- Neighborhood socioeconomic deprivation is associated with decreased cognitive function in older people in the UK (Liang, et al., 2008).
- Neighborhood socioeconomic advantage is associated with slower rates of cognitive decline among older Mexican Americans (Sheffield & Peek, 2009).
- Highly educated and socioeconomically advantaged neighborhoods may promote cognitive function and buffer cognitive decline (physical resources, social resources)

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## Cognitive Function

NB SES → NB social and physical resources → Physical and social activities → Cognitive function



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## Data

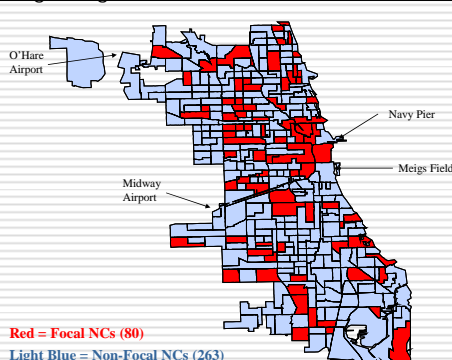
- Chicago Community Adult Health Study (CCAHS) (House, Morenoff, Diez-Roux)
- 3,105 individuals
  - aged 18 and over living in the city of Chicago
- Face-to-face interviews (72% response rate)
- Field period: May 2001- March 2003
- Analyses restricted to age 45+ (N=1225)

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## Data

- Builds on the Project on Human Development in Chicago Neighborhoods (PHDCN) (Earls, Sampson, Raudenbush)
- 343 "neighborhood clusters" (NCs) defined by PHDCN
  - NCs are combinations of Census tracts (roughly 8,000 people)
- CCAHS sample
  - 13-14 respondents per focal NC (35% of sample)
  - 7-8 respondents per non-focal NC (65% of sample)

## Chicago Neighborhood Clusters



## Measures of Urban Environment

- Archival Data
  - 2000 Census
  - Police crime statistics
  - InfoUSA business data
  - Park service data
  - Business licenses
  - Land use data
  - Vital statistics

## Measures of Urban Environment (NC level)

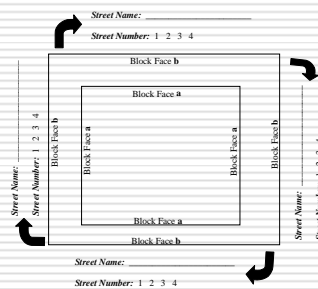
- Archival Data (2000 Census)
  - Neighborhood Socioeconomic Disadvantage (% families in poverty; % income <\$10K; % public assistance; % unemployed; % female headed)
  - Neighborhood Affluence/Gentrification (% college education; % professional/managerial occupation; % 30-39 years of age)
  - Hispanic/Immigrant (% Hispanic; % foreign born)
  - Older Age (% 50-69 years, % 70+ years of age)
- Reliability (alpha = .78 - .92)

## Measures of Urban Environment

- Systematic Social Observation (SSO) – 1,663 Blocks (Reiss, 1971; Raudenbush & Sampson, 1999)
- Direct observational method
- Capitalizes on interviewer visits to homes: while walking through small respondent-centered neighborhoods, characteristics are documented using a standardized instrument
- E.g. presence of litter, heavy traffic, condition of buildings/streets

## CHICAGO COMMUNITY ADULT HEALTH STUDY Systematic Social Observation Coding Sheet

**VERY IMPORTANT!!!**  
 On the diagram below, please circle the street numbers and write the street names to indicate the starting point of your observations. All of the block faces on the inside of the block will be coded "a", and all block faces on the outside will be coded "b." If this diagram in no way resembles the block under observation, use the space at the bottom of the page to sketch a diagram, identifying streets with both a number and a name.



Urban Environment (SSO)

QUESTION	STREET NUMBER			
	1	2	3	4
6. Which of the following do you see along the street? (CHECK ALL THAT APPLY)				
1) Church/religious center				
2) Store-front Church				
3) Institutions (schools, libraries, etc.)				
4) Recreational center				
5) Other recreational facilities (parks, playgrounds, etc.)				
6) Drug store/pharmacy				
7) Supermarket/grocery store				

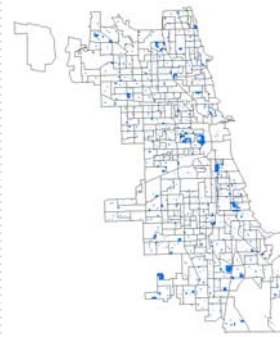
- Ratings typically based on 4 streets per block (inter-rater agreement = .803)
- Aggregated up to characterize wider neighborhood area (e.g. neighborhood cluster)



## Measures of Urban Environment Archival Data – Land Use

- Chicago Metropolitan Agency for Planning (2001)
  - Aerial photography (aerial units)
  - Institutional land use (educational facilities, religious facilities, public services and administration)
  - Linked to survey data using geographic coordinates and geographic information systems (GIS) at the NC level

## Point Locations of Educational Institutions, Chicago 2001



## Cognitive Function

- Mental Status
  - Orientation to day, date, US President, past US President (4 points)
  - Attention/concentration - Serial 3's (1 point)
- Short-term Memory
  - Immediate recall of 10 words (10 points)
  - Delayed recall of 10 words (10 points)
- Refusals coded as incorrect
- Total score range 0-25

## Individual Risk Factors

- Age, gender, race/ethnicity
- Education, Income
- Marital status
- Health conditions, current smoker, BMI,
- Depression (CES-D)

## Individual Mediators

- Any physical activity
  - Light/moderate leisure activity, physical activity, vigorous activity (weekly, over past year)
- Social integration
  - frequency of getting together with friends, neighbors, relatives (never, less than once a month, about once a month, 2 or 3 times a month, once a week, more than once a week)
- Civic engagement
  - Community activities, ethnic activities, local activities in past year

### Statistical Analyses

- Multi-level linear regression at the NC level
  - (3.8 obs/NC, range 1-12)
- Models run in SAS 9.2
- Weighted sample matches the 2000 Census population estimates for the city of Chicago (age, gender, race/ethnicity)

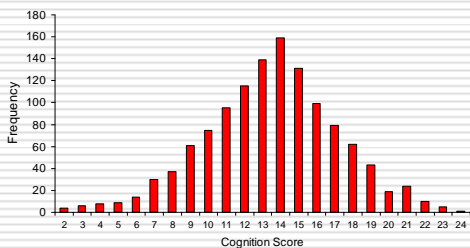


### Descriptive Statistics

Chicago Community Adult Health Study, Age 45+ (N=1225)

	Weighted Mean (SD) or Percent
<b>Sociodemographics</b>	
Age	60.1 (11.3)
Male	43.9
White	42.7
Black	35.8
Hispanic	18.5
Lives alone	24.1
<b>Socioeconomic Position</b>	
Less than high school education	30.4
Income less than \$15,000	20.2
<b>Cognitive and Health Status</b>	
Cognitive function	13.7 (3.8)
Number of chronic health problems	2.0 (1.8)
<b>Neighborhood Context</b>	
Recreational facilities (parks, playgrounds, etc.)	25.1
Recreational centers	4.2
Educational land use (schools, etc)	3.6
Religious facilities	1.0

Histogram of Cognitive Function  
Chicago Community Adult Health Study, Age 45+ (N=1225)



### Multilevel Linear Regression of Cognitive Function

<b>Fixed Effects</b>	
Intercept	13.61***
<b>Individual Factors</b>	
Age 60-69	
Age 70+	
Male	
Black	
Hispanic	
<HS	
HS	
Income <\$15K	
Income \$15-40K	
Sep/Div	
Widowed	
Never Married	
Current Smoker	
BMI	
CES-D	
<b>Variance Components</b>	
ICC	.28

\*p<.05 \*\*p<.01 \*\*\*p<.001

### Multilevel Linear Regression of Cognitive Function

<b>Fixed Effects</b>	
Intercept	13.61***
<b>Individual Factors</b>	
Age 60-69	-.54*
Age 70+	-1.72**
Male	-.63**
Black	-1.56***
Hispanic	-1.15***
<HS	-2.78***
HS	-1.27***
Income <\$15K	-.80**
Income \$15-40K	-.85**
Sep/Div	-.19
Widowed	-.91**
Never Married	-.27
Health Conditions	-.09
Current Smoker	.35
BMI	.03
CES-D	-.42**
<b>Variance Components</b>	
ICC	.28

\*p<.05 \*\*p<.01 \*\*\*p<.001

### Effect of Neighborhood Affluence, Neighborhood and Individual Mediators, on Cognitive Function

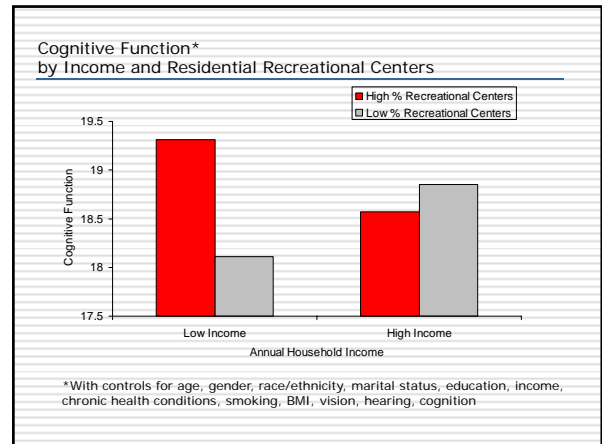
	+ NB Census	+ Rec Facilities	+ Institutions	+ Individual Mediators
<b>NB Census Indicators</b>				
Affluence	.285*			
<b>NB Resources</b>				
Recreational Centers				
x Income<\$15				
x Income\$15-40				
Parks, Playing fields, etc.				
Religious Facilities				
Educational Institutions				
x high school educ.				
x high school educ.				
<b>Individual Mediators</b>				
Any physical activity				
Social integration				
Civic engagement				

Models control for individual risk factors \*p<.05 \*\*p<.01 \*\*\*p<.001

Effect of Neighborhood Affluence, Neighborhood and Individual Mediators, on Cognitive Function

	+ NB Census	+ Rec Facilities	+ Institutions	+ Individual Mediators
<b>NB Census Indicators</b>				
Affluence	.285*	.239		
<b>NB Resources</b>				
Recreational Centers		-.135		
x Income <\$15		.735**		
x Income \$15-40		.148		
Parks, Playing fields, etc.		.071		
Religious Facilities				
Educational Institutions				
x <high school educ.				
x high school educ.				
<b>Individual Mediators</b>				
Any physical activity				
Social integration				
Civic engagement				

Models control for individual risk factors      \*p<.05    \*\*p<.01    \*\*\*p<.001



Effect of Neighborhood Affluence, Neighborhood and Individual Mediators, on Cognitive Function

	+ NB Census	+ Rec Facilities	+ Institutions	+ Individual Mediators
<b>NB Census Indicators</b>				
Affluence	.285*	.239	.239	
<b>NB Resources</b>				
Recreational Centers		-.135	-.135	
x Income <\$15		.735**	.735**	
x Income \$15-40		.148	.148	
Parks, Playing fields, etc.		.071	.071	
Religious Facilities			.058	
Educational Institutions			-.049	
x <high school educ.			.107	
x high school educ.			.367*	
<b>Individual Mediators</b>				
Any physical activity				
Social integration				
Civic engagement				

Models control for individual risk factors      \*p<.05    \*\*p<.01    \*\*\*p<.001

Effect of Neighborhood Affluence, Neighborhood and Individual Mediators, on Cognitive Function

	+ NB Census	+ Rec Facilities	+ Institutions	+ Individual Mediators
<b>NB Census Indicators</b>				
Affluence	.285*	.239	.239	.236
<b>NB Resources</b>				
Recreational Centers		-.135		-.131
x Income <\$15		.735**		.727**
x Income \$15-40		.148		.174
Parks, Playing fields, etc.		.071		.068
Religious Facilities			.058	.033
Educational Institutions			-.049	-.019
x <high school educ.			.107	.068
x high school educ.			.367*	.380*
<b>Individual Mediators</b>				
Any physical activity				-.063
Social integration				.440***
Civic engagement				.473*

Models control for individual risk factors      \*p<.05    \*\*p<.01    \*\*\*p<.001

### Conclusions and Implications

- Neighborhood affluence is associated with higher cognitive function.
- This operates in part through physical and social resources in the neighborhood such as educational facilities and opportunities for recreation (effects vary by income and education).
- The neighborhood may operate as "cognitive reserve" for adults at higher risk of cognitive decline.

### Future Directions

- CCAHS - Preparing for longitudinal follow-up study
  - Gene-environment interactions (saliva samples)

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## Future Directions

### □ Mixed Mode Data Collection - Software Development

- Survey instrument
- SSO
- Geographic coordinates (GPS)
- Digital camera images



## Future Directions

### □ Google Street View

- Indicators of built physical and social environment can be reliably assessed with a virtual audit instrument (agreement = .94,  $K = .49$ ).  
(Clarke, et al. (under review) Using Google Earth to Conduct a Neighborhood Audit: Reliability of a Virtual Audit Instrument)
- Fraction of the cost of an in-person audit

