

# **Social Cognition and Metacognition in Alzheimer's Disease**

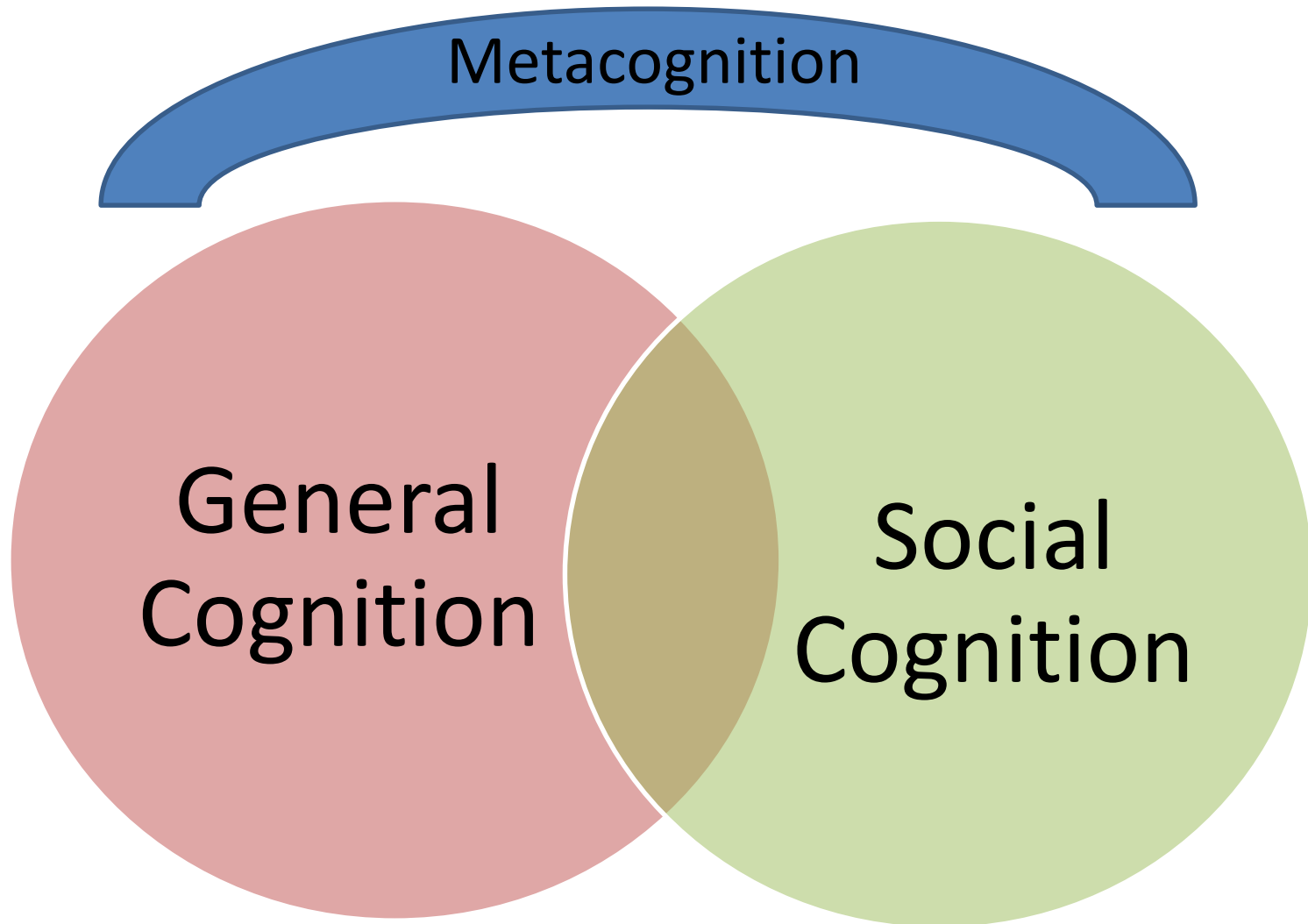
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# Cognitive Constructs



Metacognition

General  
Cognition

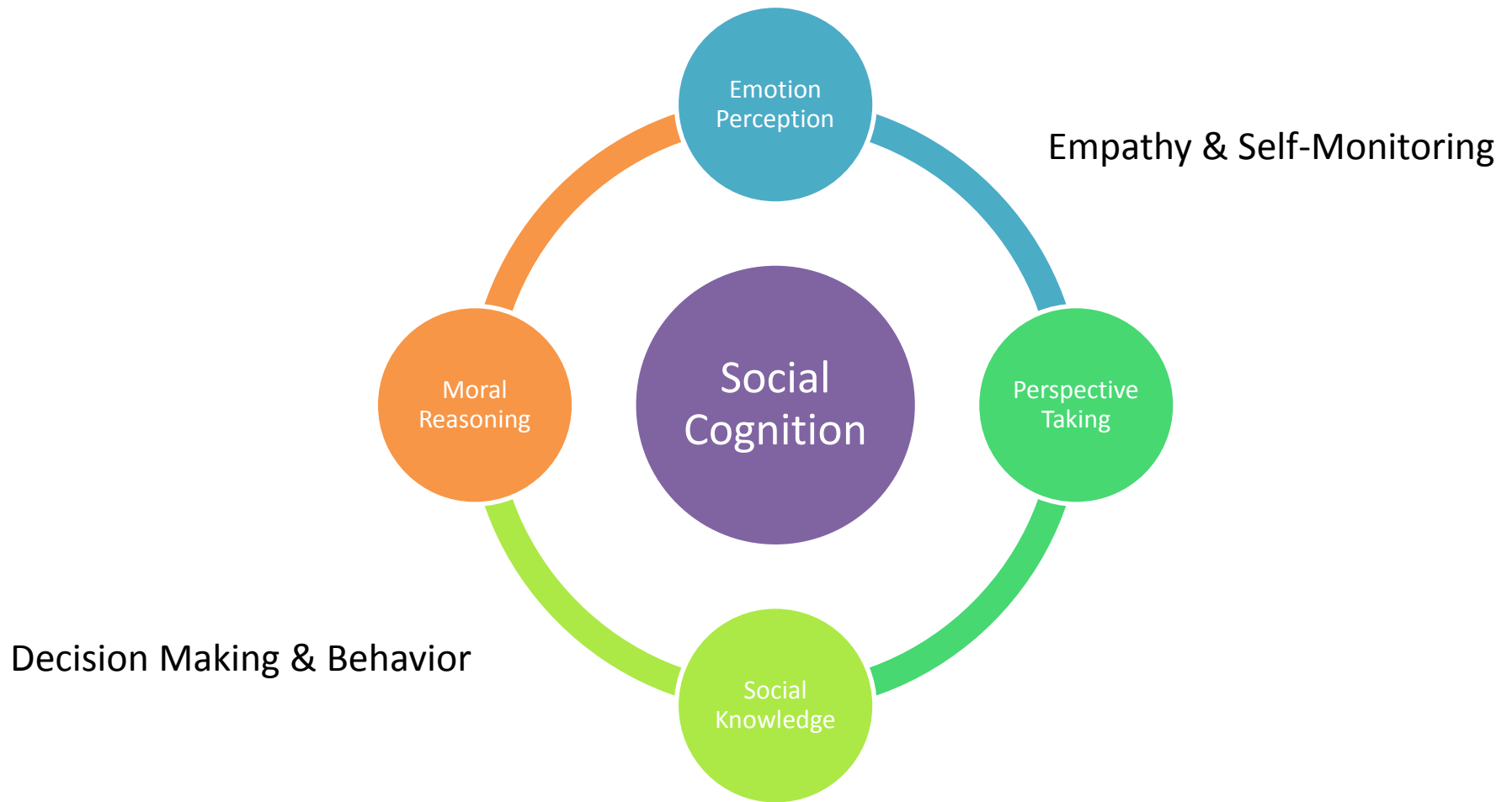
Social  
Cognition

# Social Cognition



- The means by which we make sense of ourselves in relation to others and the environment in which we live (Fiske, 1993)
- Any cognitive process that is engaged to understand or interpret the self in relation to others (Forbes & Grafman, 2010).
- Social cognitive processes form the basis of the complex and dynamic set of behaviors and mutually shared expectations that enable individuals to successfully interact with one another across a range of different scenarios and environments.

# Elements of Social Cognition



# Neuroanatomic Substrates

- Orbitofrontal and ventromedial PFC
- Anterior cingulate
- Insula
- Anterior temporal cortex



Right Sided  
Network

# NACC Measures

## Behavior Inhibition Scale (Carver and White, 1994)

- Subject worries about making mistakes
- Criticism or scolding hurts subject quite a bit
- Subjects feels worried when someone is angry at him/her

## Interpersonal Reactivity Index (Davis, 1983)

- Patient shows tender concerned feelings for people less fortunate
- Patient finds it difficult to see things from another's point of view
- Patient is often quite touched by things he/she sees

## Revised Self-Monitoring Scale (Lennox & Wolfe, 1984)

- Patient has trouble changing behavior to suit different people and situations
- Patient can tell when joke is in bad taste even if people laugh convincingly
- Patient can tell when he/she said something inappropriate by reading people's eyes

## Social Norms Questionnaire (Rankin, 2006)

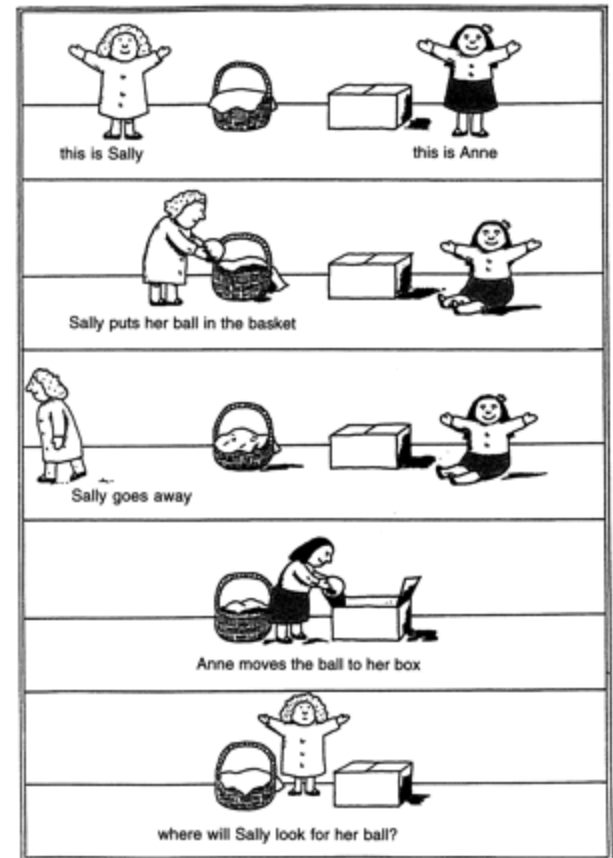
- Would it be socially acceptable to.....

# Social Cognition in AD

- In contrast to behavioral variant frontotemporal dementia (FTD), early AD is frequently characterized by preservation of social cognition ([Rankin, Kramer, Mychack, & Miller, 2003](#)).
- Social cognition often remains intact into the moderate stages of the disease ([Sabat & Gladstone, 2010](#); [Sabat & Lee, 2010](#)).
- However, some individuals with AD evidence marked changes in social cognition early in the disease, sometimes severe enough to elicit misdiagnoses of FTD.
- Even in cases that fit the typical AD profile with amnesic deficits being prominent, individuals have been shown to demonstrate impairment on objective social cognitive tests ([Freedman, Binns, Black, Murphy, & Stuss, 2012](#); [Miller et al., 2012](#)), and in some cases these impairments can be commensurate with those in FTD.

# Theory Of Mind

- The ability to attribute independent mental and emotional states to another individual (TOM; Baron-Cohen et al., 1999).
- **Cognitive TOM:** The ability to appreciate the difference between one's knowledge and the knowledge of another individual (Gregory et al., 2002, Freedman et al., 2012).





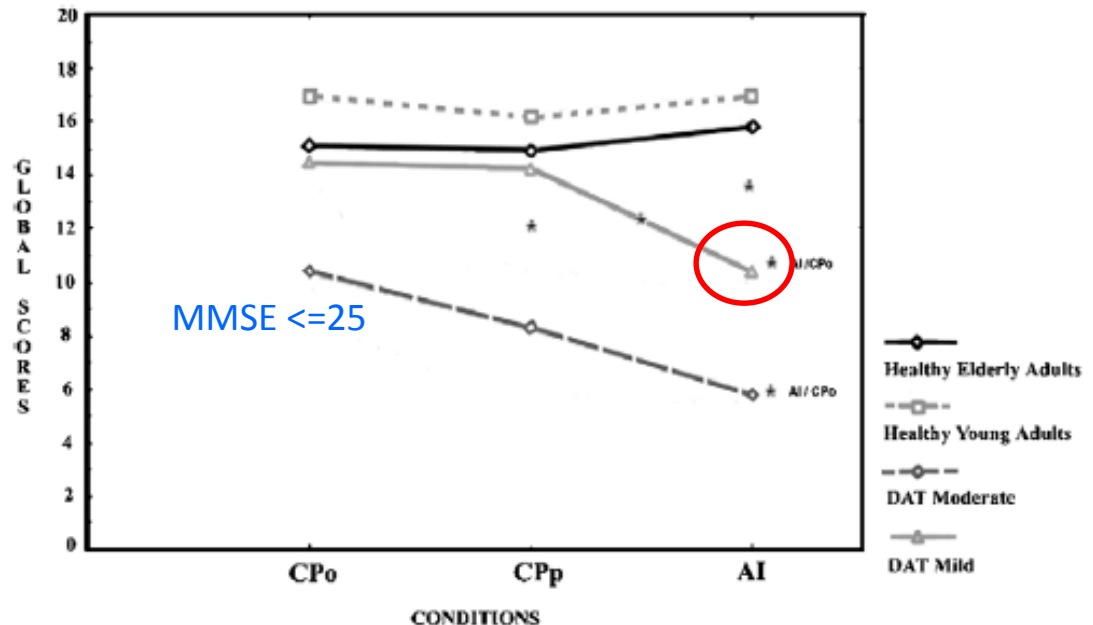
# Attribution of Intention

Verdon et al. (2007): *Is there a specific deficit in reasoning about psychological causality (i.e., intention) versus physical causality?*

**Cartoon Task** (Sarfati et al., 1997): Subjects must identify the appropriate ending to a cartoon story.

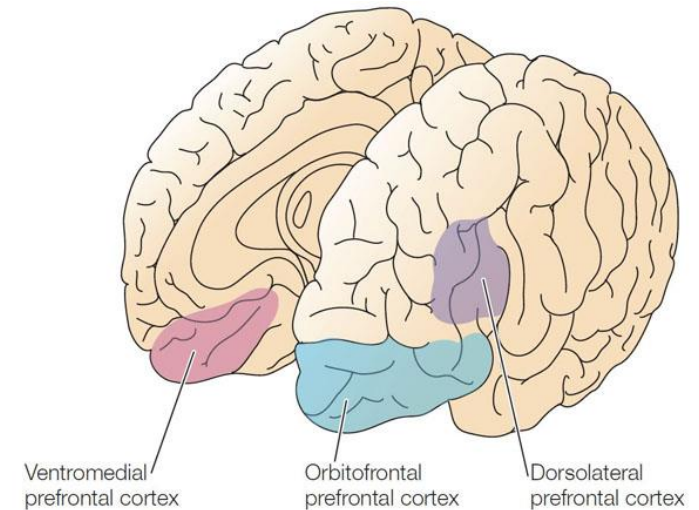
- Psychological Cause
- Physical Cause

*Progressive and pervasive impaired understanding of what causes persons to behave; AD would affect first the understanding of deliberate actions as leading to achieve intended goals, and would later affect understanding of unintentional behavior resulting from unexpected physical circumstances*



# Etiology of Social Cognitive Deficits in AD

- Social cognitive symptoms may represent a specific manifestation of disease pathology that is anatomically and/or behaviorally distinct from general cognitive impairment.



- Alternatively, social cognitive deficits in AD may stem from more general cognitive deficits. For example, it has been suggested that impaired emotion recognition and ToM may reflect deficits in visuoception or executive functioning ([Shany-Ur et al., 2012](#)).



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Alzheimer's  
&  
Dementia

## Social cognition in Alzheimer's disease: A separate construct contributing to dependence

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- 517 participants with Probable AD seen every 6-months for 5.5 years.
- All patients were required to have mild - moderate dementia defined by a Modified Mini-Mental State Exam score  $\geq 30$  (MMSE score  $\geq 16$ ).
- Multivariate latent growth curve models adjusted for sex, age, education, depression, and recruitment site were used to examine cross-sectional and longitudinal associations between social cognition, general cognition, and dependence.

# Dependence

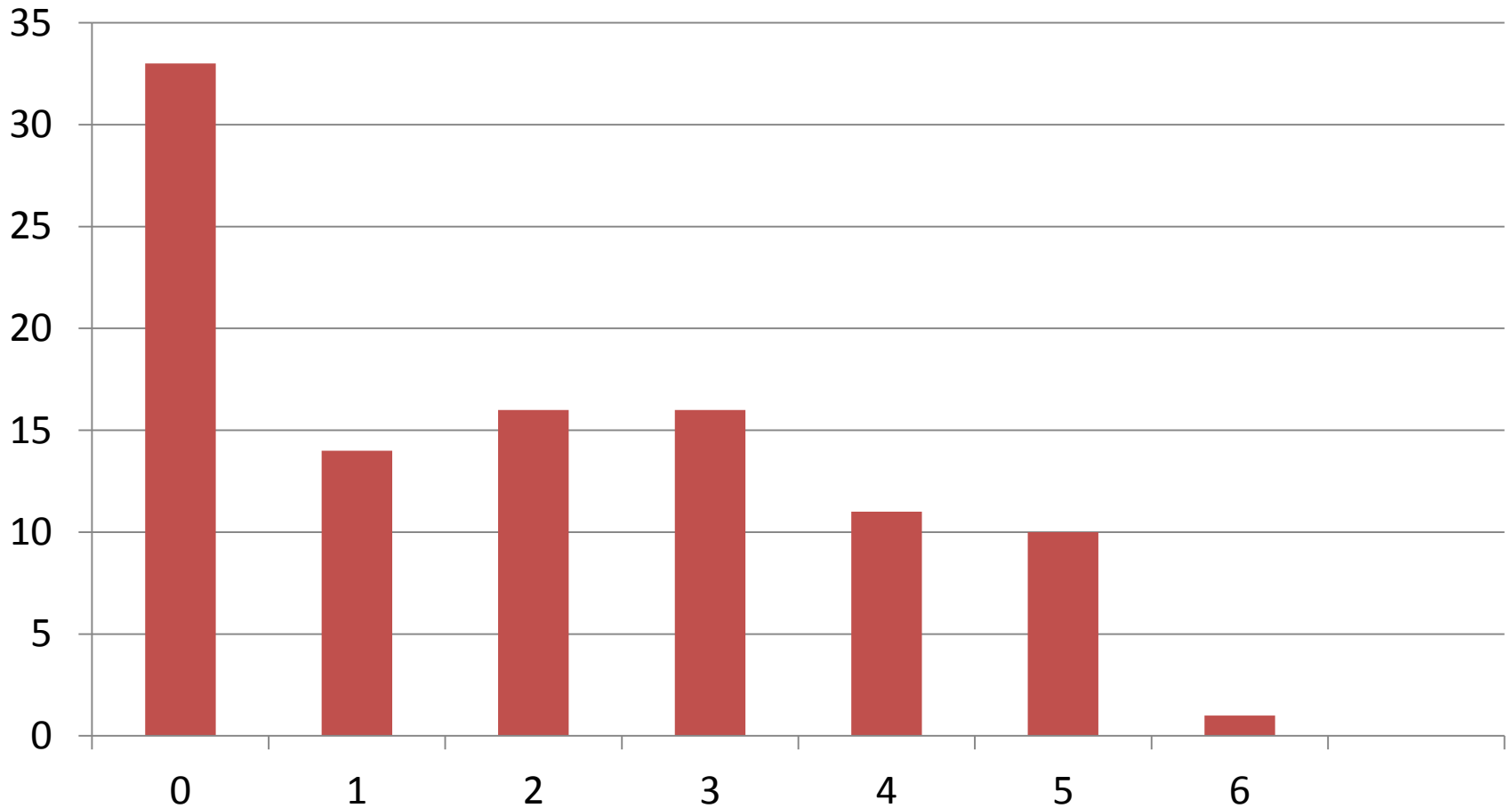
- The Dependence Scale is a 13-item instrument administered to a caregiver ([Stern et al., 1994](#)).
- The DS comprises 11 dichotomous items (e.g., “Does the patient need to be watched or kept company when awake?”) and two items scored on a 3-point Likert-type scale indicating the frequency of need (e.g., “Does the patient need reminders or advice to manage chores, do shopping, cook, play games or handle money?”)

# Social Cognitive Index

- 1) More stubborn than before and less able to adapt to change
- 2) More self-centered than before
- 3) Unconcerned about others' feelings
- 4) Unable to control emotions
- 5) Easily angered
- 6) Likely to make strange jokes or laugh at things that aren't funny

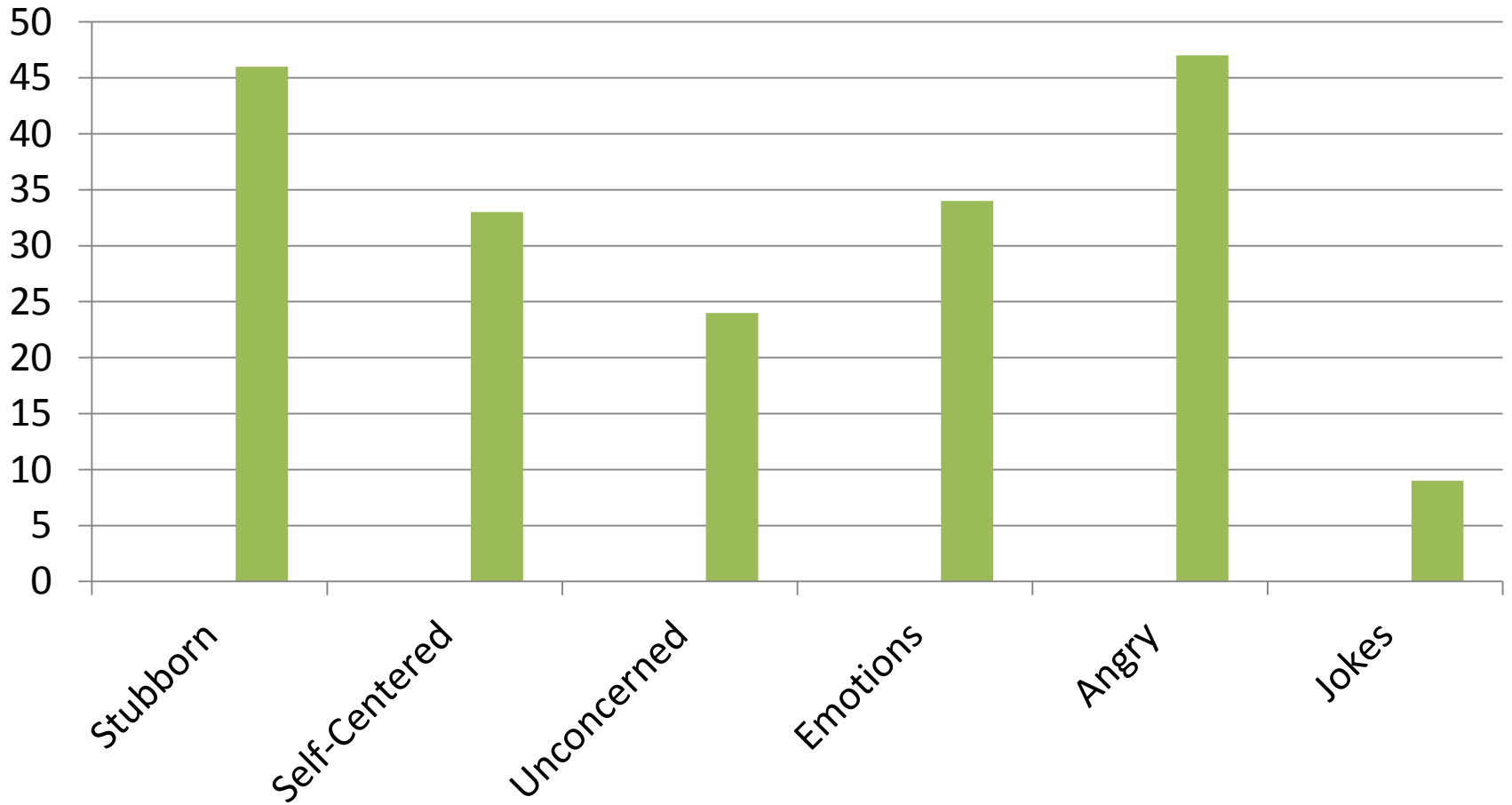
*Blessed Dementia Rating Scale*

# Social Cognitive Symptoms

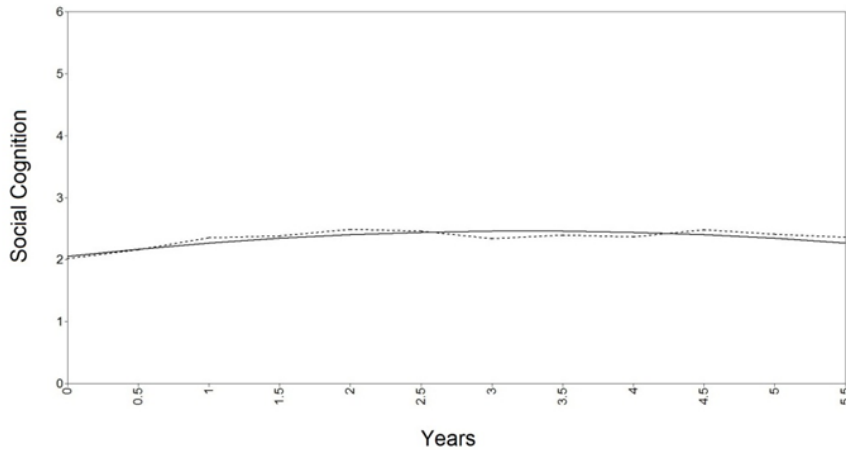
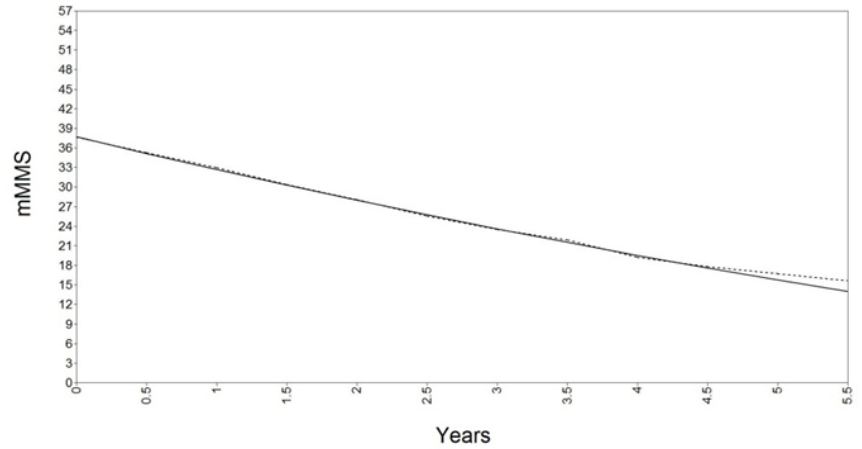
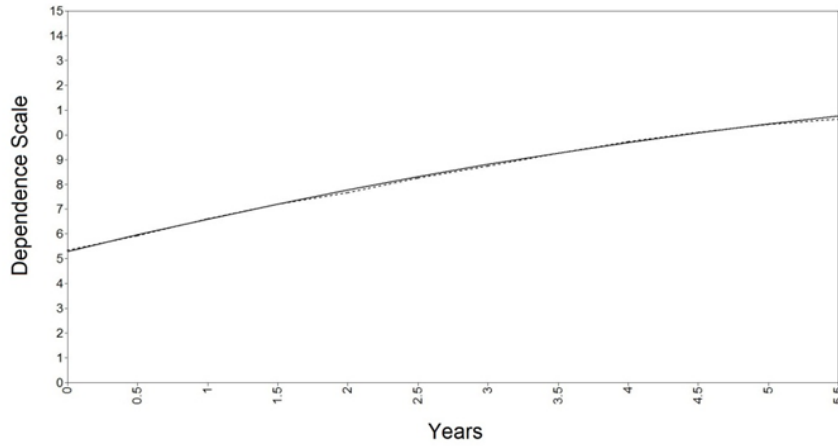


% of Participants with Specific Number of Symptoms at Baseline

# Frequency of Specific Symptoms



# Univariate Trajectories



	Mean (SD)	Range
Social Cognition_B	2.02 (1.66)	0-6
Social Cognition_5	2.99 (1.98)	0-6
mMMSE_B	37.63 (6.37)	14-57
mMMSE_5	21.96 (15.06)	0-56
Dependence_B	5.25 (2.21)	0-12
Dependence_5	9.67 (3.19)	0-15



# Results

- Social cognition and general cognition were unrelated cross-sectionally and over time.
- Baseline levels of each were independently related to dependence, and change values of each were independently related to change in dependence.
- These findings highlight the separability of social and general cognition in AD and underscore the importance of considering social cognition in disease models and measurement.

# Social Cognition in MCI

- Recognizing facial expressions (Teng et al., 2007)
- Theory of Mind (Baglio et al., 2012; Moreau et al., 2015)
- Affective TOM (Poletti et al., 2013)

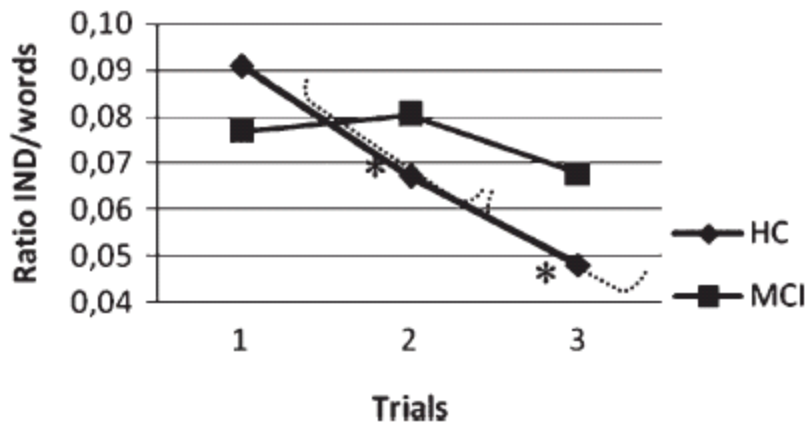
# Referential Communication in aMCI

*N. Moreau et al. / Theory of Mind Impairment in MCI*



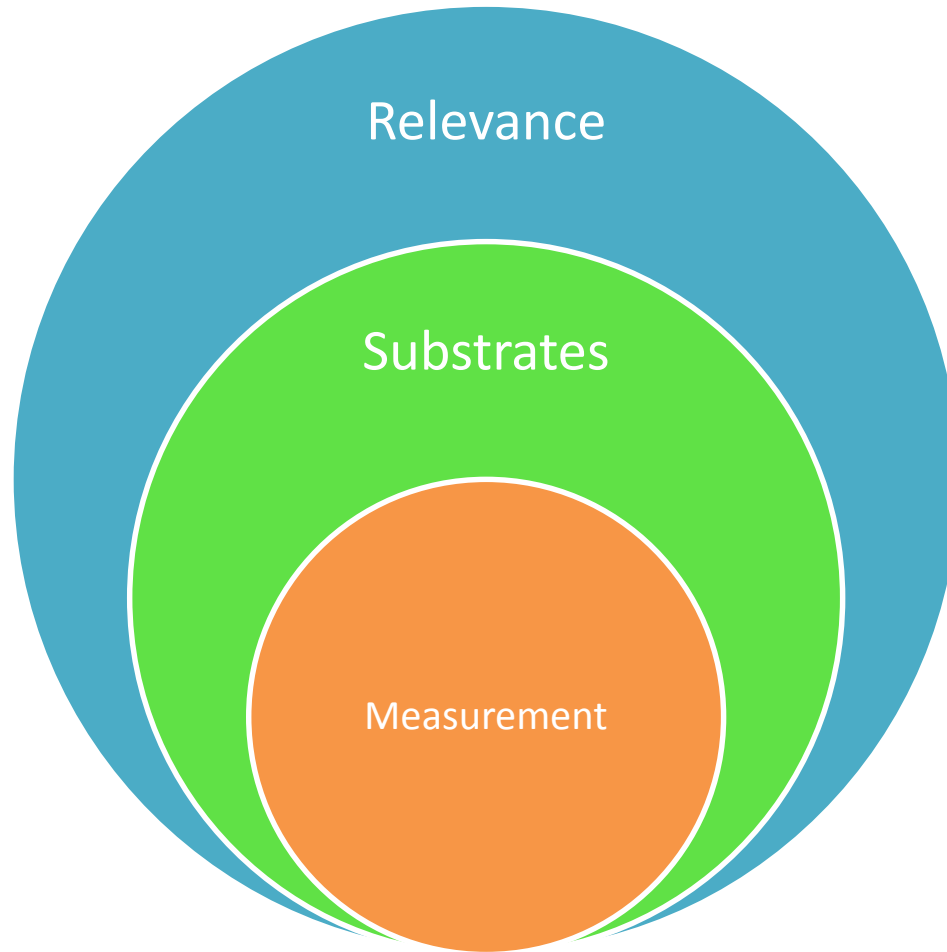
Fig. 2. Tangrams used for the Referential Communication Task.

DV = Evolution of (indefinite words / total number of words) over three trials



*Efficient labelers but decreased capacity to refer to common knowledge developed with examiner concerning the figures; Reflects decreased representation of shared knowledge and perspective in discourse*

# Metacognition in AD



# Spectrum of Awareness in Early AD

- 27 • Nothing is wrong. Not a thing in the world. By some queer circumstances, I was asked to participate in research. I don't know how you got my name, but I do support research.
- 20 • So far, so good. Nothing bothering me about my thinking abilities. My kids think I have dementia – I don't have dementia!
- 22 • It's just old age. Nothing pressing.
- 19 • I came to check on Alzheimer's disease. My mother had it. I've been kind of absent-minded my whole life, I can't remember things. I'm not sure if I have AD.
- 23 • It's terrible, I forget everything, the days of the week, the months. And it's getting worse – it's frightening. AD was diagnosed two years ago.

# Memory Awareness Influences Everyday Decision Making Capacity about Medication Management in Alzheimer's Disease

Stephanie Cosentino,<sup>1</sup> Janet Metcalfe,<sup>2</sup> Mark S. Cary,<sup>3</sup> Jessica De Leon,<sup>1</sup> and Jason Karlawish<sup>4</sup>

	ACED	<i>p</i>
MMSE	.31	.07
Education	.06	.56
Age	-.10	.64
Gamma	-.10	.60
Awareness	<b>.42</b>	<b>.007</b>

	UAD	AAD	<i>p</i>
Understanding	7.52 (2.34)	7.87 (2.06)	.64
Appreciation	<b>5.43 (2.25)</b>	<b>7.19 (1.05)</b>	<b>.007</b>
Comparative Reasoning	2.95 (1.43)	3.69 (0.60)	.06
Consequential Reasoning	2.43 (1.43)	3.00 (1.26)	.22
Choice	4.00 (0.00)	3.81 (0.54)	.12

# Objective Metamemory Test

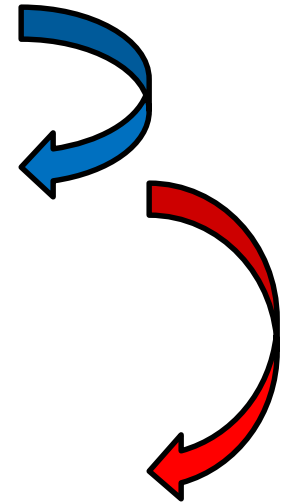
During this task, I will tell you about 5 people. I will tell you their name, and something about their background. Your task is to try to remember the information as best you can. Please listen carefully.

- *Cole Porter attended law school in Chicago.*
- *Wiley Post was employed as a hotel servant in Denver.*
- *Nigel Bruce worked for a magazine company in his youth.*
- *Carl Sandburg traveled to Asia to study philosophy.*
- *Edward Jenner was a student of art history.*

*Presented over the course of 4 learning trials = 20 total items*

# Gamma

Test Item	Prediction	Memory Accuracy
1	Yes	1
2	Maybe	0
3	No	0
4	No	1



Concordances = 2

Discordances = 1

Ties = 3

$$\text{Gamma} = [(C - D) / (C + D)] = (1/3) = .33$$



# OBJECTIVE METAMEMORY TESTING CAPTURES AWARENESS OF DEFICIT IN ALZHEIMER'S DISEASE

Stephanie Cosentino<sup>1</sup>, Janet Metcalfe<sup>2</sup>, Brady Butterfield<sup>1</sup> and Yaakov Stern<sup>1,2</sup>

(<sup>1</sup>Cognitive Neuroscience Division of the Taub Institute, Columbia University Medical Center, New York, NY, USA;

<sup>2</sup>Department of Psychology, Columbia University Medical Center, New York, NY, USA)

## Participants (n = 26)

**MMSE** = 25.13 (2.38)

**Age** = 76.96 (7.12)

**Education** = 15.50 (3.51)

**Female** = 50%

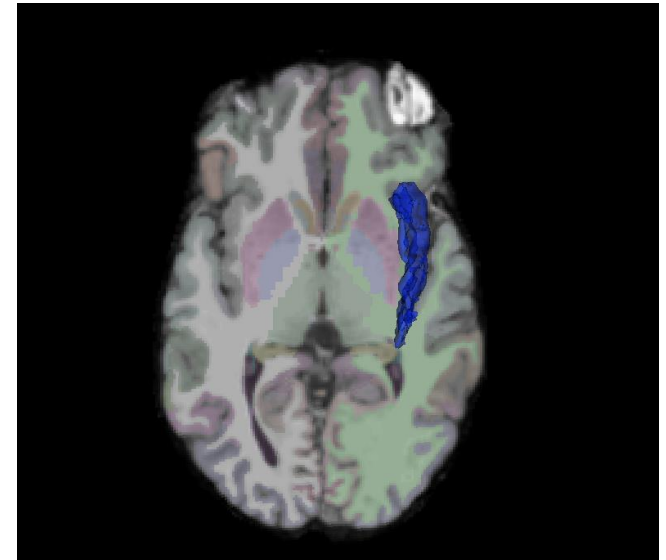
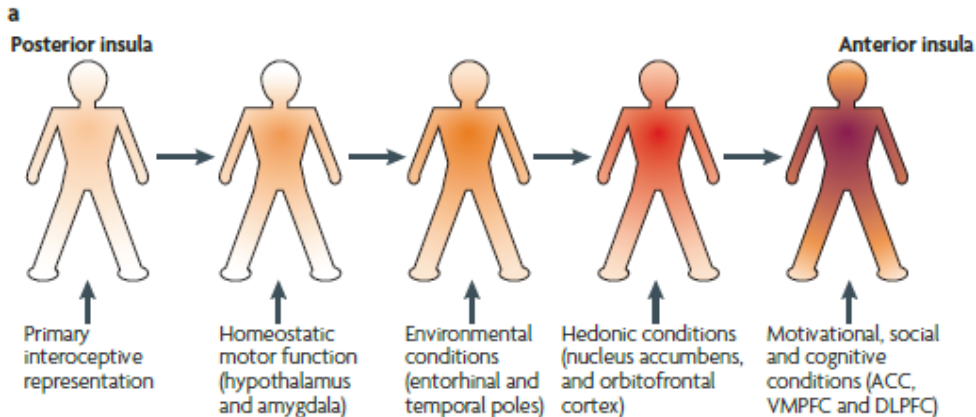
**Caucasian** = 75%

	<u>Gamma</u>
HE	.69 (.66)
AAD	.76 (.36)
UAD	.28 (.83)

	Clinical Rating of Awareness	<i>p</i>
MMSE	.29	.18
Education	-.19	.37
Verbal Memory	.06	.79
<b>Metamemory</b>	<b>.46</b>	.03

# The right insula and self-awareness

This relationship persists when controlling for left insula volume, diagnostic group, memory performance, and total intracranial volume in a linear regression predicting metamemory, ( $R^2 = .64$ ,  $F(4, 28) = 4.91$ ,  $p = .004$ ).



Craig, A.D. (2009). How do you feel – now? The anterior insula and human awareness. *Nature Revs Neuroscience*, 10(1), 59-70.

# Summary

- Aspects of social cognition (particularly objectively measured) appear to be measurable as early as the MCI stage and to deteriorate over the course of the disease.
- Everyday behavioral manifestations of social cognition may be preserved for longer in AD, and may follow different trajectories across individuals.
- Social cognition and metacognition are closely related constructs that are related to, but dissociable, from general cognition and have independent relevance for functional outcomes.

# Moral Judgment

Torrvalva et al. (2000): *Do behavioral symptoms in AD reflect decreased appreciation for the meaning of social situations?*

Moral Judgment Interview (Kohlberg & Colby, 1987): Method for identifying the developmental level of moral judgments using hypothetical moral dilemmas

- **Preconventional** = Avoid breaking rules that are associated with punishment unless it's in person's immediate best interest
  - **Conventional** = Live up to other's expectations and fulfill agreed upon duties
  - **Postconventional** = Behave according to social rules and values, and self-chosen ethical principles
- AD (MMSE = 25)
- HE

