# Financial Exploitation Risk and the Brain

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USC Judith D. Tamkin Symposium on Elder Abuse
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**“Of course we’ll make a decision …**
**once we have considered the 5243 factors.”**

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# Rationale

If an older adult shows impaired financial decision making or becomes a victim of a scam, the burden is not only experienced by the older adult, but is often displaced upon family members, caregivers, or society.

Reduced scam awareness and poor decision making may be early signs of Alzheimer's Disease (Boyle et al., 2019; Stewart et al., 2019), but can occur without cognitive impairment.

*Understanding poor decision making or susceptibility to scams in older adults is a significant public health concern, as this understanding may inform prevention and intervention strategies.*

- *How can we understand this?*

18008 • The Journal of Neuroscience, November 13, 2013 • 33(46):18008–18014

Neurobiology of Disease

# Changes in Brain Function Occur Years before the Onset of Cognitive Impairment

**Lori L. Beason-Held,[1] Joshua O. Goh,[1,2] Yang An,[1] Michael A. Kraut,[3] Richard J. O'Brien,[4] Luigi Ferrucci,[1] and Susan M. Resnick[1]**

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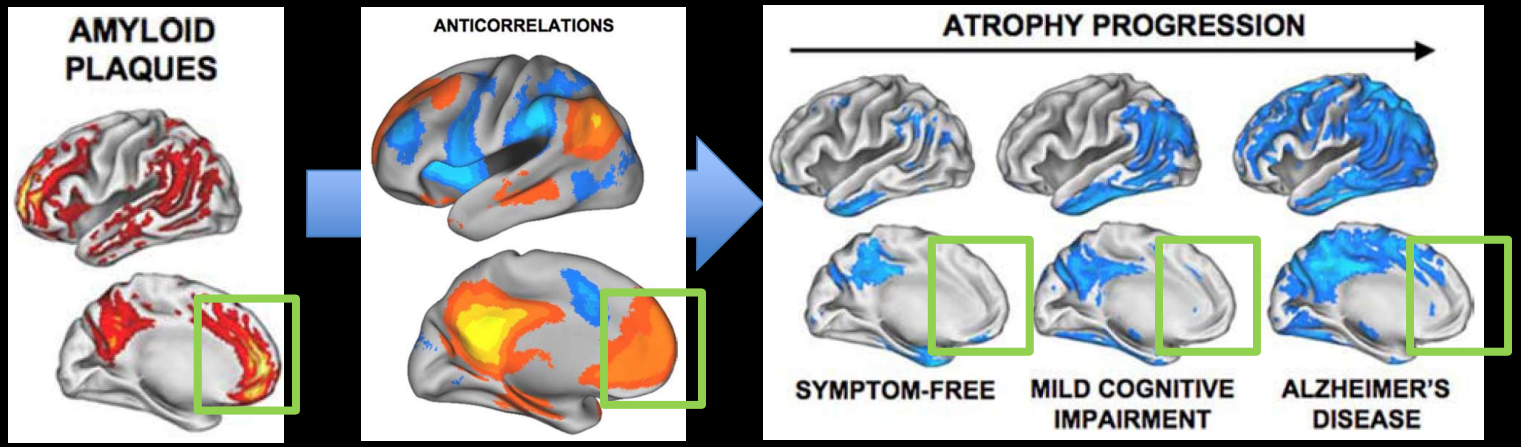
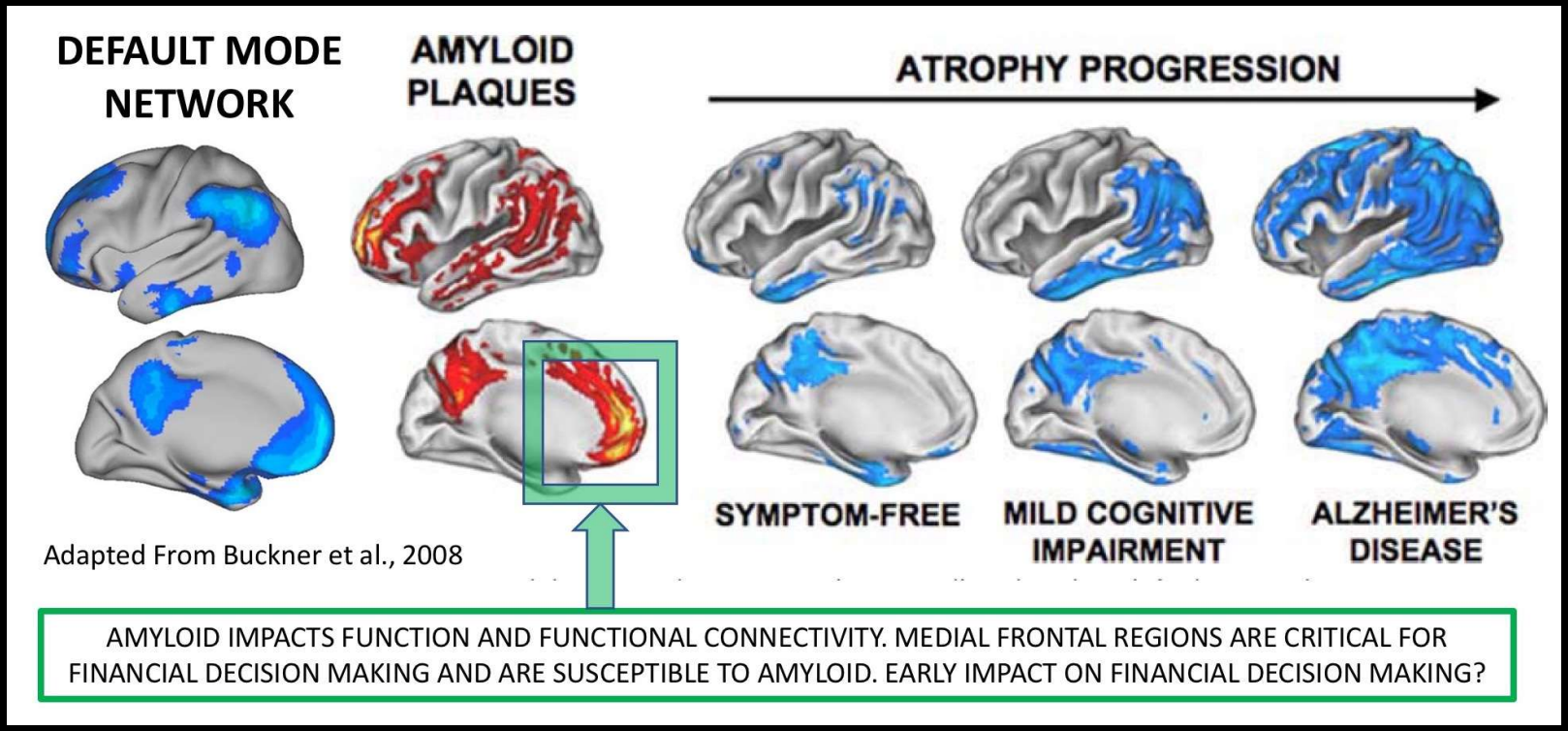
# Age-Associated Neuropathology




Buckner et al., 2008; Buckner et al., 2005; Lustig et al., 2003

# Age-Associated Neuropathology




AMYLOID IMPACTS FUNCTION AND FUNCTIONAL CONNECTIVITY. MEDIAL FRONTAL REGIONS ARE CRITICAL FOR FINANCIAL DECISION MAKING AND ARE SUSCEPTIBLE TO AMYLOID. EARLY IMPACT ON FINANCIAL DECISION MAKING?

# Peters and Buchel, 2011
# + Age-Associated Alzheimer's Neuropathology

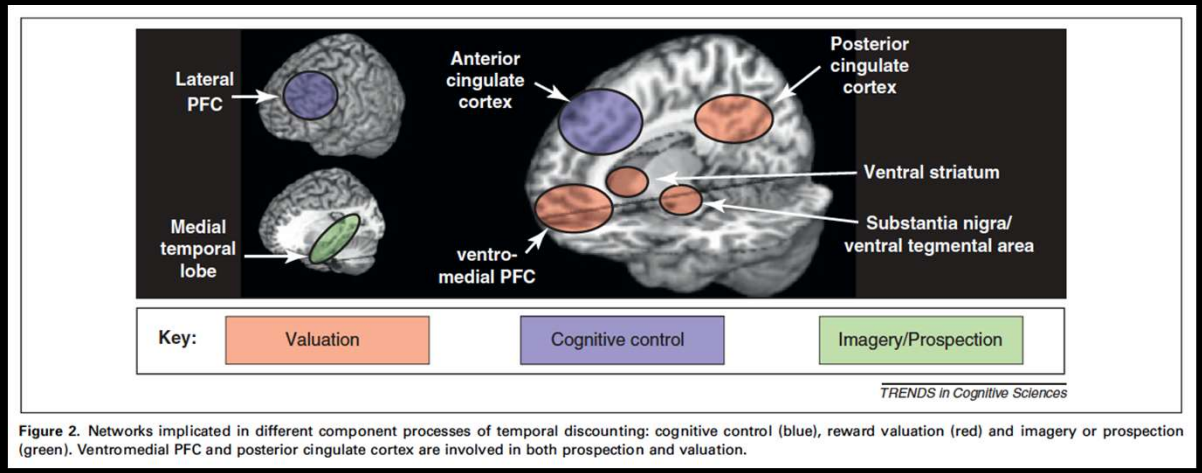
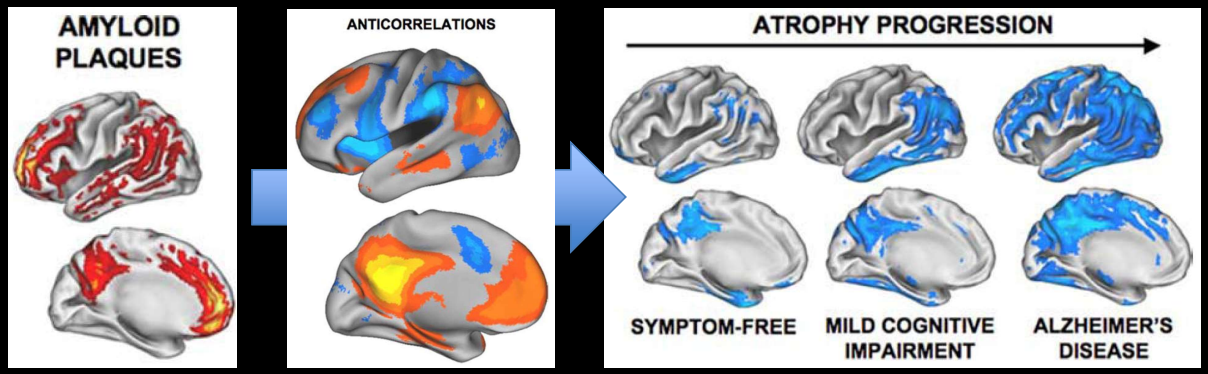



Figure 2. Networks implicated in different component processes of temporal discounting: cognitive control (blue), reward valuation (red) and imagery or prospection (green). Ventromedial PFC and posterior cingulate cortex are involved in both prospection and valuation.

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Buckner et al., 2008; Buckner et al., 2005; Lustig et al., 2003

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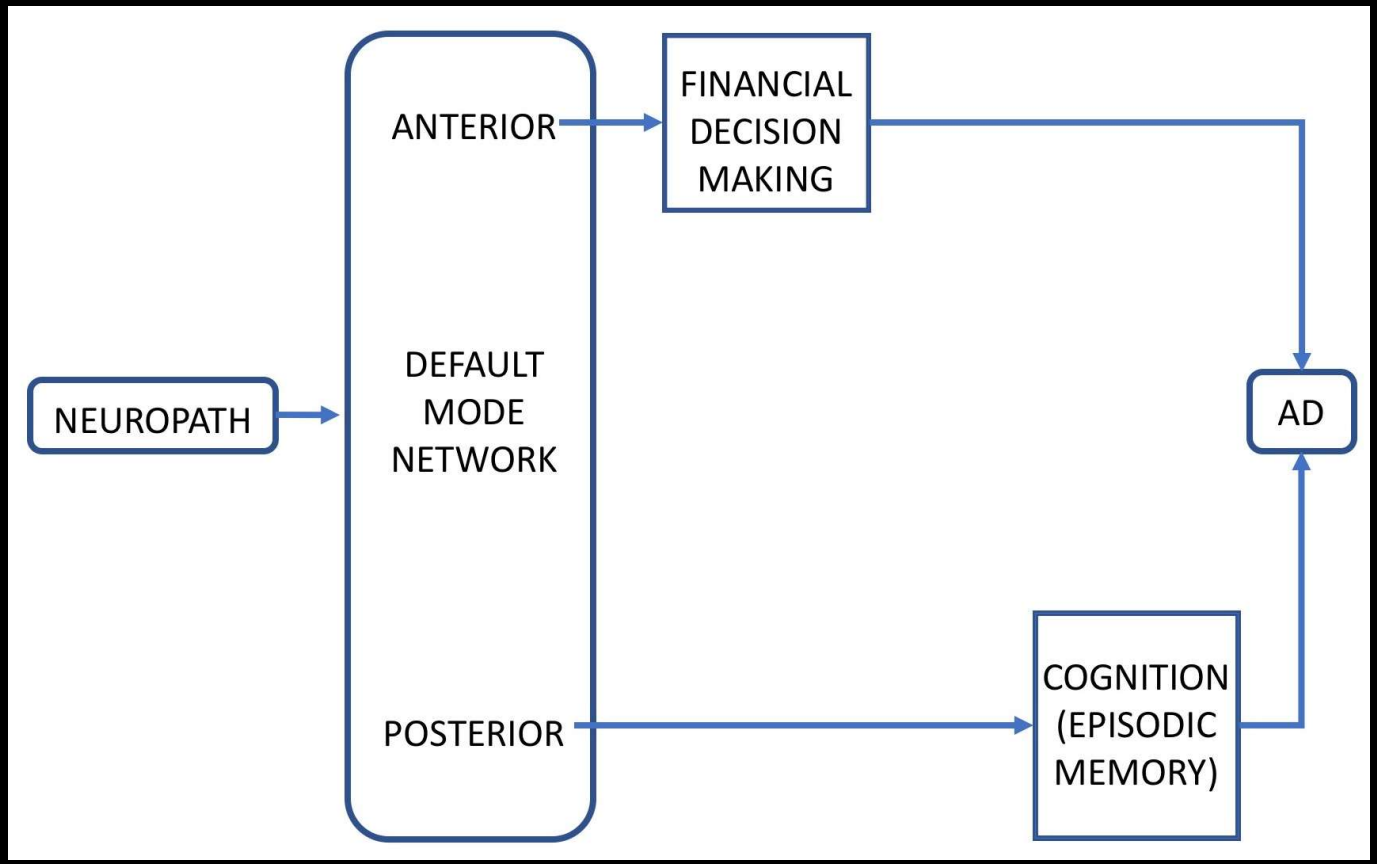
# Current Working Model



# Neuroimaging Work to Date

Archives of Gerontology and Geriatrics 59 (2014) 429–438

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Financial literacy is associated with medial brain region functional connectivity in old age

S. Duke Han [a,b,f,*], Patricia A. Boyle [a,b], Lei Yu [b,c], Debra A. Fleischman [a,b,e], Konstantinos Arfanakis [b,d,e], Sue Leurgans [b,c], David A. Bennett [b,c]

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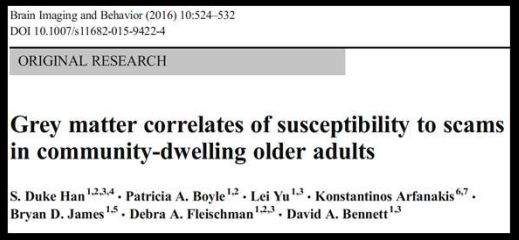
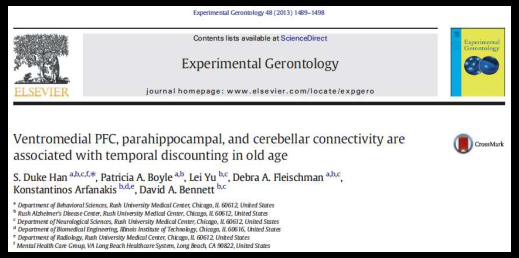


Brain Imaging and Behavior (2016) 10:524–532
DOI 10.1007/s11682-015-9422-4

ORIGINAL RESEARCH

Grey matter correlates of susceptibility to scams in community-dwelling older adults

S. Duke Han [1,2,3,4] · Patricia A. Boyle [1,2] · Lei Yu [1,3] · Konstantinos Arfanakis [6,7] · Bryan D. James [1,5] · Debra A. Fleischman [1,2,3] · David A. Bennett [1,3]



Experimental Gerontology 48 (2013) 1489–1498

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

Ventromedial PFC, parahippocampal, and cerebellar connectivity are associated with temporal discounting in old age

S. Duke Han [a,b,c,f,*], Patricia A. Boyle [a,b], Lei Yu [b,c], Debra A. Fleischman [a,b,c], Konstantinos Arfanakis [b,d,e], David A. Bennett [b,c]

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Brain Structure and Function
https://doi.org/10.1007/s00429-018-1712-3

ORIGINAL ARTICLE

White matter correlates of temporal discounting in older adults

S. Duke Han [1,2,3,4,10] · Konstantinos Arfanakis [5,6,7] · Debra A. Fleischman [6,8,9] · Lei Yu [6,9] · David A. Bennett [6,9] · Patricia A. Boyle [6,8]

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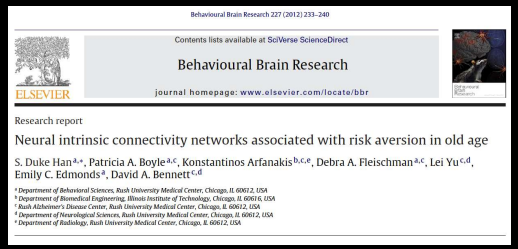

Behavioural Brain Research 227 (2012) 233–240

Contents lists available at SciVerse ScienceDirect

Behavioural Brain Research

journal homepage: www.elsevier.com/locate/bbr

Research report

Neural intrinsic connectivity networks associated with risk aversion in old age

S. Duke Han [a,*], Patricia A. Boyle [a,c], Konstantinos Arfanakis [b,c,e], Debra A. Fleischman [a,c], Lei Yu [c,d], Emily C. Edmonds [a], David A. Bennett [c,d]

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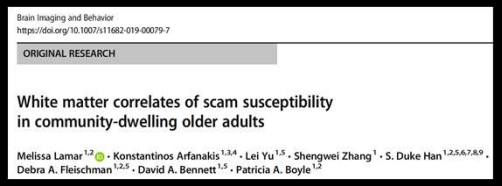

Brain Imaging and Behavior
https://doi.org/10.1007/s11682-019-00079-7

ORIGINAL RESEARCH

White matter correlates of scam susceptibility in community-dwelling older adults

Melissa Lamar [1,2] · Konstantinos Arfanakis [1,3,4] · Lei Yu [1,5] · Shengwei Zhang [1] · S. Duke Han [1,2,5,6,7,8,9] · Debra A. Fleischman [1,2,5] · David A. Bennett [1,5] · Patricia A. Boyle [1,2]

NeuroImage 130 (2016) 223–229

Contents lists available at ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg

Financial literacy is associated with white matter integrity in old age

S. Duke Han [a,b,c,e,*], Patricia A. Boyle [d,e], Konstantinos Arfanakis [d,h,i], Debra Fleischman [d,e,f], Lei Yu [d,f], Bryan D. James [d,g], David A. Bennett [d,f]

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ORIGINAL RESEARCH article

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Functional Connectivity Correlates of Perceived Financial Exploitation in Older Adults

Gali H. Weissberger[1,2], Laura Mosqueda[1,3], Annie L. Nguyen[1], Jenna Axelrod[1], Caroline P. Nguyen[1], Patricia A. Boyle[4,5], Nathan Spreng[6,7,8] and S. Duke Han[1,3,4,5,9,10*]

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# Susceptibility to Scams

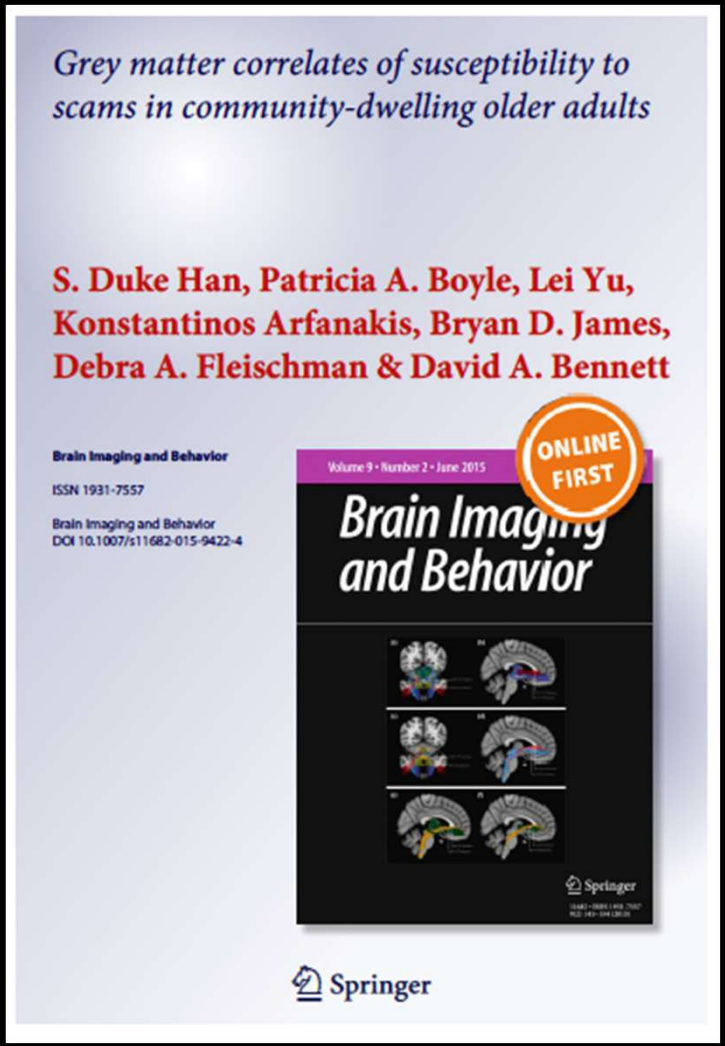
Brain Imaging and Behavior
DOI 10.1007/s11682-015-9422-4

ORIGINAL RESEARCH

## Grey matter correlates of susceptibility to scams in community-dwelling older adults

S. Duke Han[1,2,3,4] · Patricia A. Boyle[1,2] · Lei Yu[1,3] · Konstantinos Arfanakis[6,7] · Bryan D. James[1,5] · Debra Fleischman[1,2,3] · David A. Bennett[1,3]

- Voxel-based morphometry (VBM) to assess grey matter density at the voxel level
- N=348 nondemented older adults
- Mean age=81.55, s.d.=7.25; mean number of years of education=15.30, s.d=2.91; 74.10% female



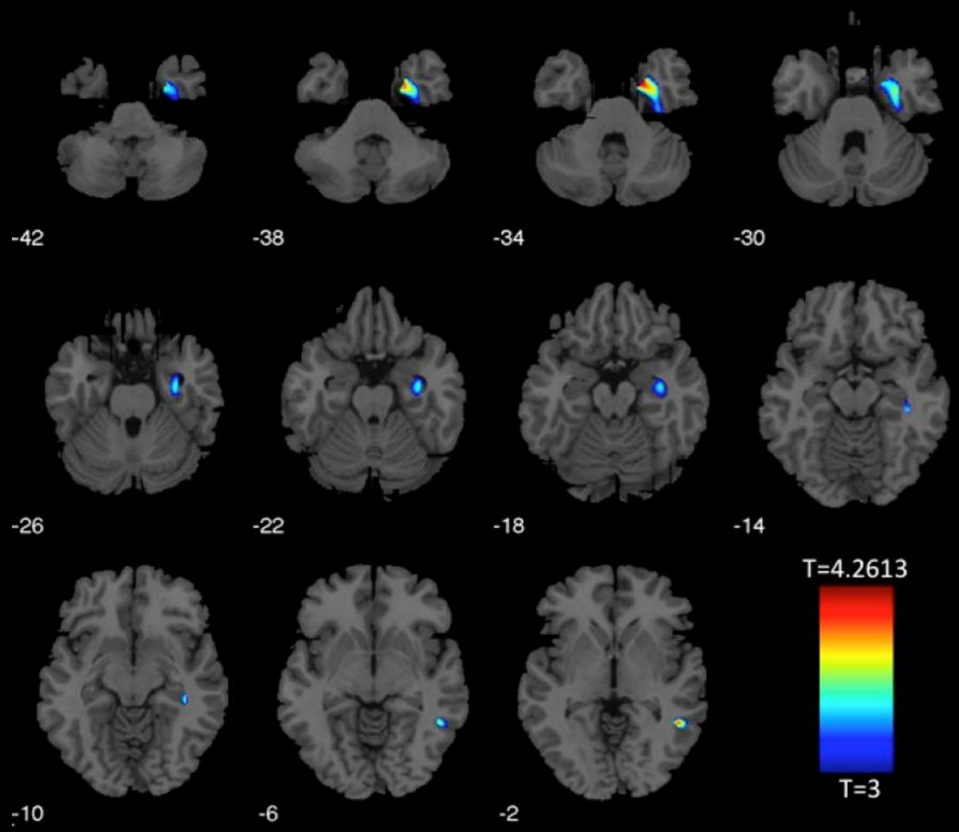

**Assessment of susceptibility to scams**

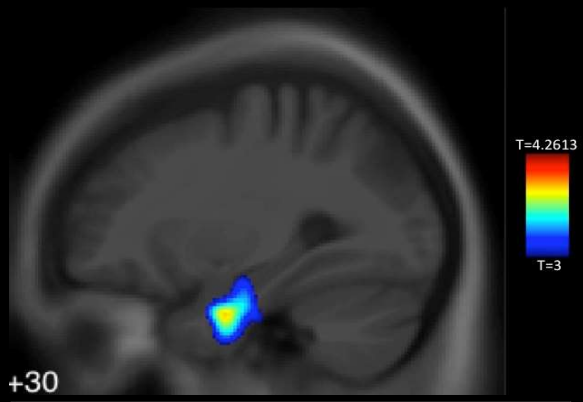
The susceptibility to scams scale is a five-item self-report measure in which participants rated their agreement to a statement according to a 7-point Likert scale (strongly agree to strongly disagree). The five statements included in the measure have been previously reported (James et al. 2014) and address topics such as telemarketing behaviors, older adults being targeted by con-artists, and suspiciousness of claims that seem too good to be true. The statements are:

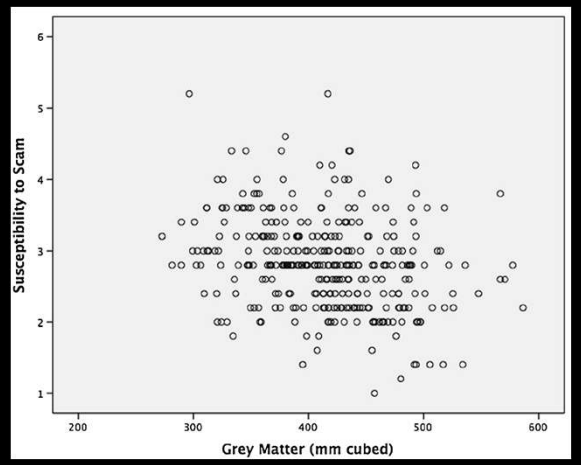
1. I answer the phone whenever it rings, even if I do not know who is calling.
2. I have difficulty ending a phone call, even if the caller is a telemarketer, someone I do not know, or someone I did not wish to call me.
3. If something sounds too good to be true, it usually is.
4. Persons over the age of 65 are often targeted by con-artists.
5. If a telemarketer calls me, I usually listen to what they have to say.

Each question corresponds to a Likert scale and has a total possible range of 1 to 7 (1 = strongly agree, 2 = agree, 3 = slightly agree, 4 = neither agree or disagree, 5 = slightly disagree, 6 = disagree, 7 = strongly disagree). The total score for susceptibility to scams was calculated by averaging the five items (with items 1, 2, and 5 reverse coded). The statements were based generally on findings from the AARP and the Financial Industry Regulatory Authority Risk Meter, a measure of poor and risky financial decision making that is widely used in finance studies (AARP 1999; Financial Industry Regulatory Authority 2013). The intraclass correla-

# Susceptibility to Scams – Grey Matter Density

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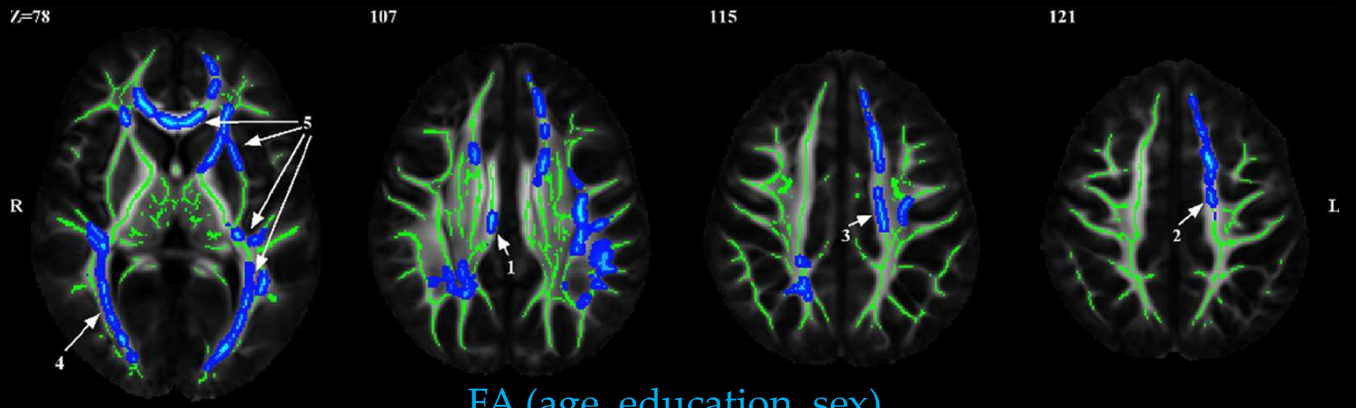
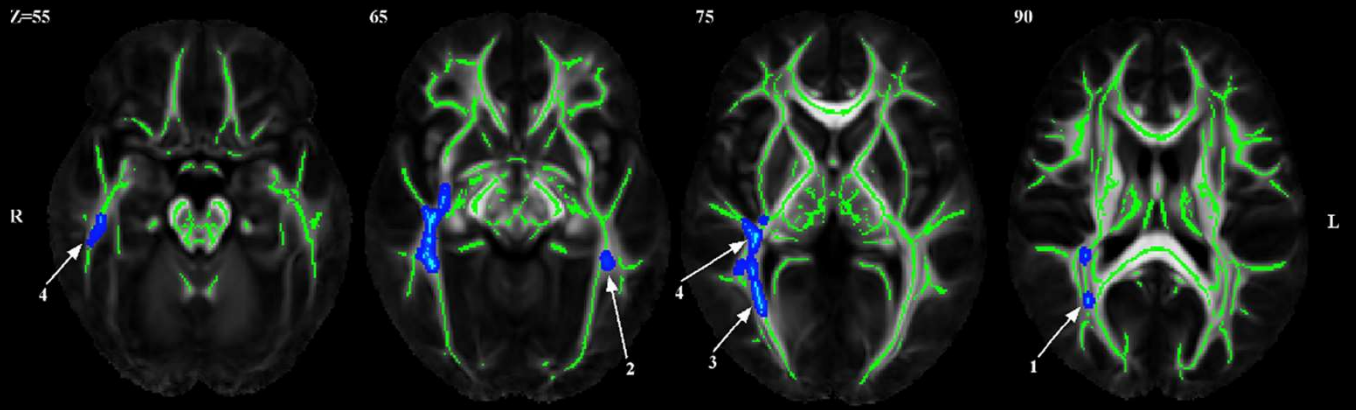
# Susceptibility to Scams – White Matter Integrity




FA (age, education, sex)




FA (age, education, sex, global cognition)

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Melissa Lamar et al., 2018

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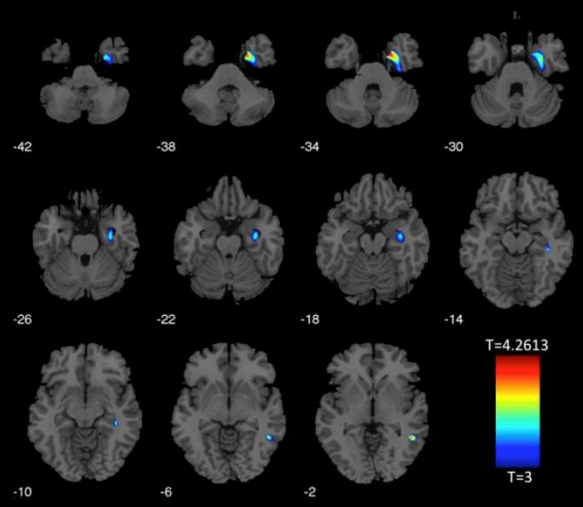
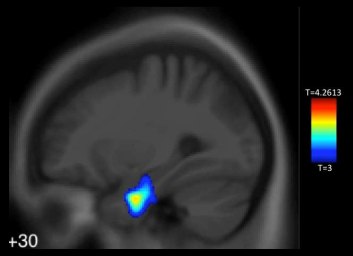
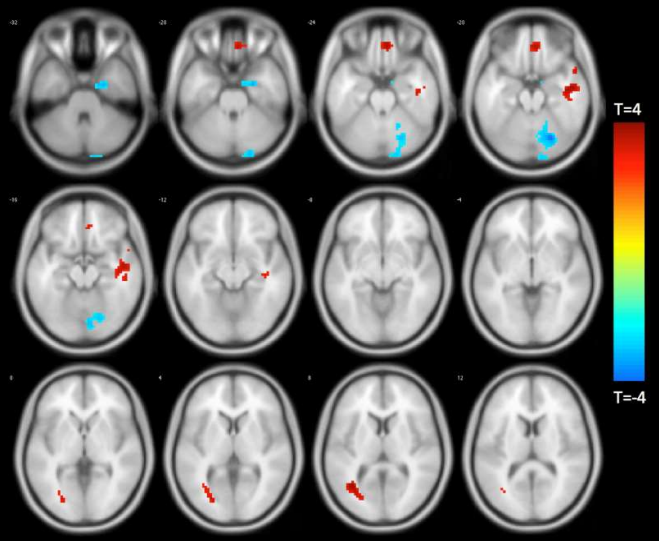
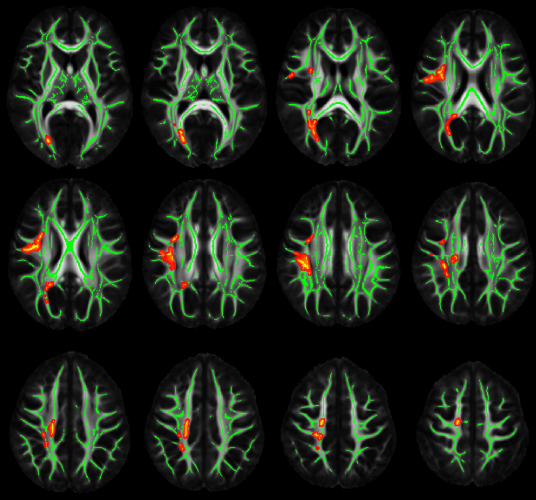
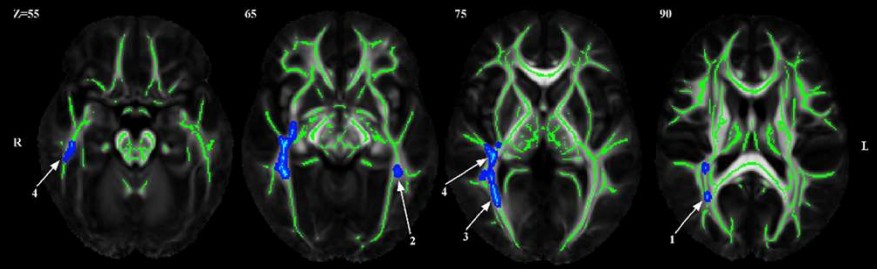
# Right Temporal?
# Right Hemisphere?



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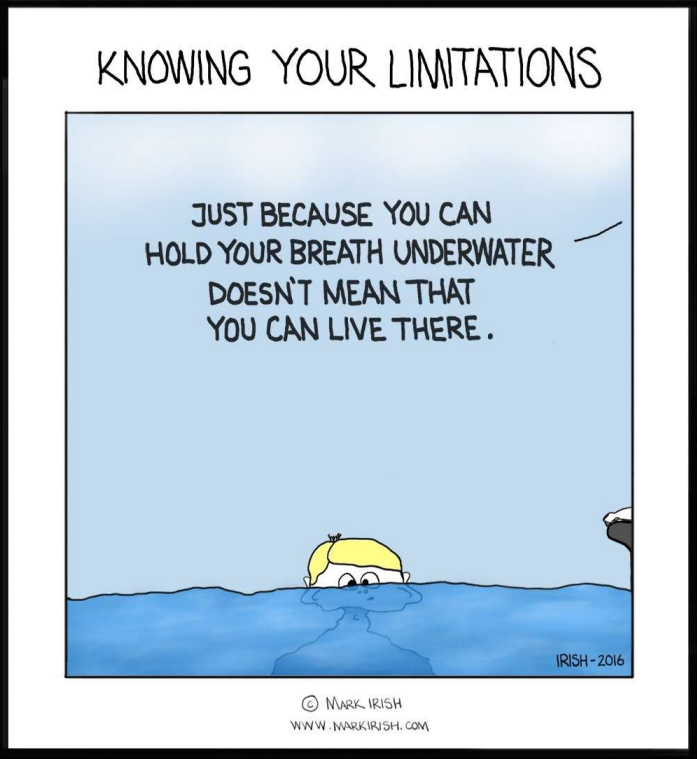
KNOWING YOUR LIMITATIONS
JUST BECAUSE YOU CAN HOLD YOUR BREATH UNDERWATER DOESN'T MEAN THAT YOU CAN LIVE THERE.
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WELL, MY PRAYERS FOR A MIRACLE WERE ANSWERED. UNFORTUNATELY, NOW I CAN'T REPLICATE IT.

# The Finance, Cognition, and Health in Elders Study: Toward Preventing Financial Exploitation of Older Adults

**by Gali H. Weissberger and S. Duke Han**

**February 28, 2018**

Why is financial exploitation so common in the elderly population? Why do some older adults fare better than others when making financial decisions? What factors protect or place one at greater risk of being financially exploited? These are just some of the questions that a multidisciplinary team of investigators hope to answer through the Finance, Cognition, and Health in Elders Study (FINCHES) being carried out through USC's Department of Family Medicine.

**Blogs Series:**

- NCEA Blog
- WEADD Blogs
- Victim Services (Spanish)
- Diversity and Inclusion (Spanish)
- USC Davis School of Gerontology

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**ORIGINAL RESEARCH article**

Front. Aging Neurosci., 12 November 2020 | https://doi.org/10.3389/fnagi.2020.583433

# Functional Connectivity Correlates of Perceived Financial Exploitation in Older Adults

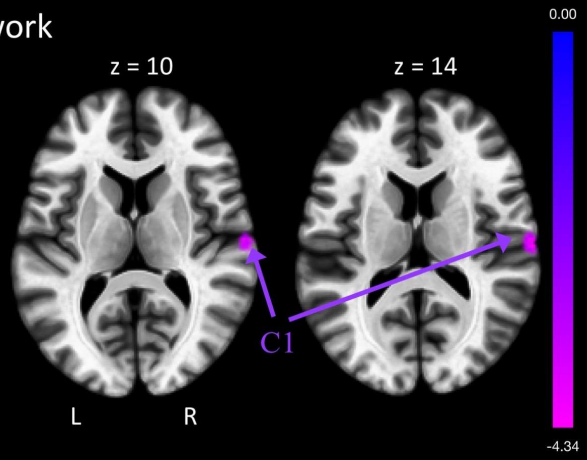
Gali H. Weissberger[1,2], Laura Mosqueda[1,3], Annie L. Nguyen[1], Jenna Axelrod[1], Caroline P. Nguyen[1], Patricia A. Boyle[4,5], Nathan Spreng[6,7,8] and S. Duke Han[1,3,4,5,9,10*]

**TABLE 1** | Sample characteristics of FE ($n$ = 16) and non-FE groups ($n$ = 16).

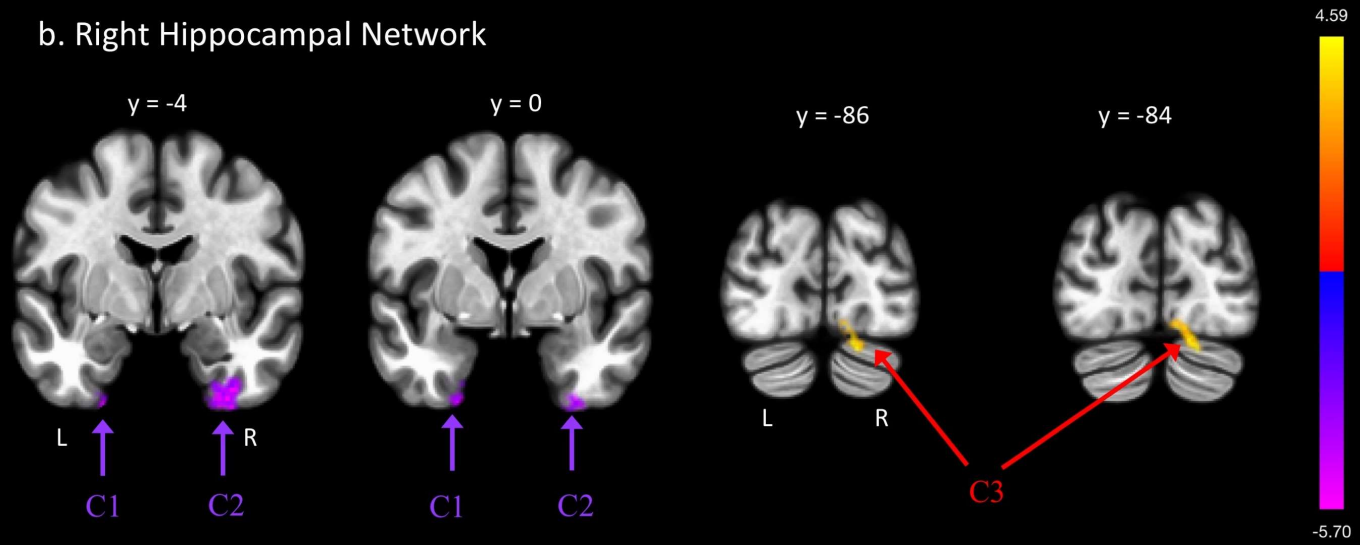
| | FE ($n$ = 16) | | Non-FE ($n$ = 16) | | |
|---|---|---|---|---|---|
| | M (range) | SD | M (range) | SD | $p$-value* |
| Age | 70.50 (53–93) | 12.97 | 65.13 (51–76) | 8.48 | 0.176 |
| Education | 16.00 (12–20) | 2.53 | 15.06 (11–20) | 3.00 | 0.347 |
| Sex (%female) | 62.5% | - | 37.5% | - | 0.157 |
| MoCA | 27.69 (26–30) | 1.40 | 27.63 (26–30) | 1.45 | 0.902 |
| Race (%Non-Hispanic White) | 68.8% | - | 50.0% | - | 0.280 |

*Note: FE, financially exploited; M, mean, SD, standard deviation; *p-values reflect the results of two-sample independent t-tests or Fisher's Exact Tests comparing FE and non-FE groups.*

a. Left Hippocampal Network




b. Right Hippocampal Network

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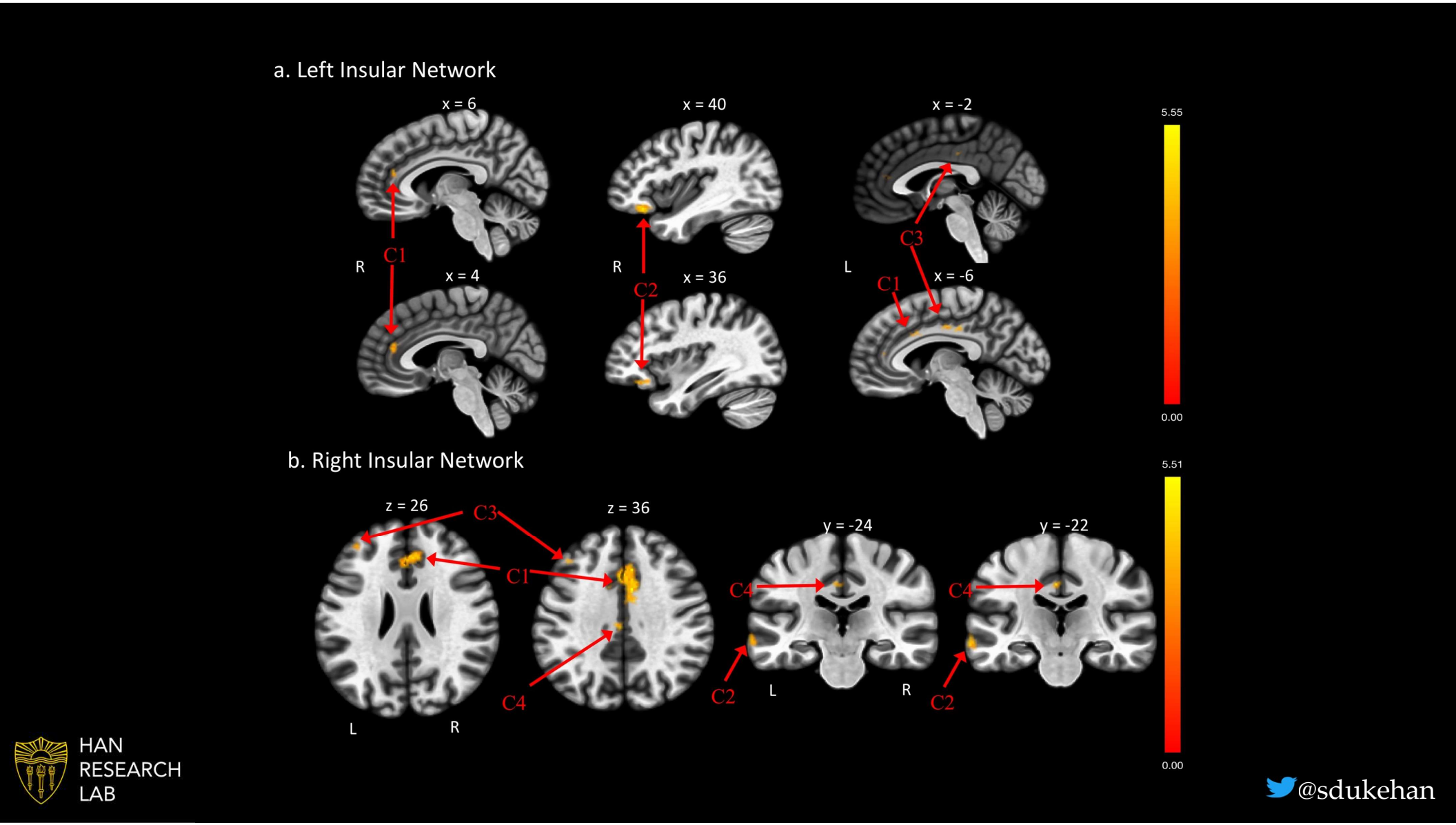


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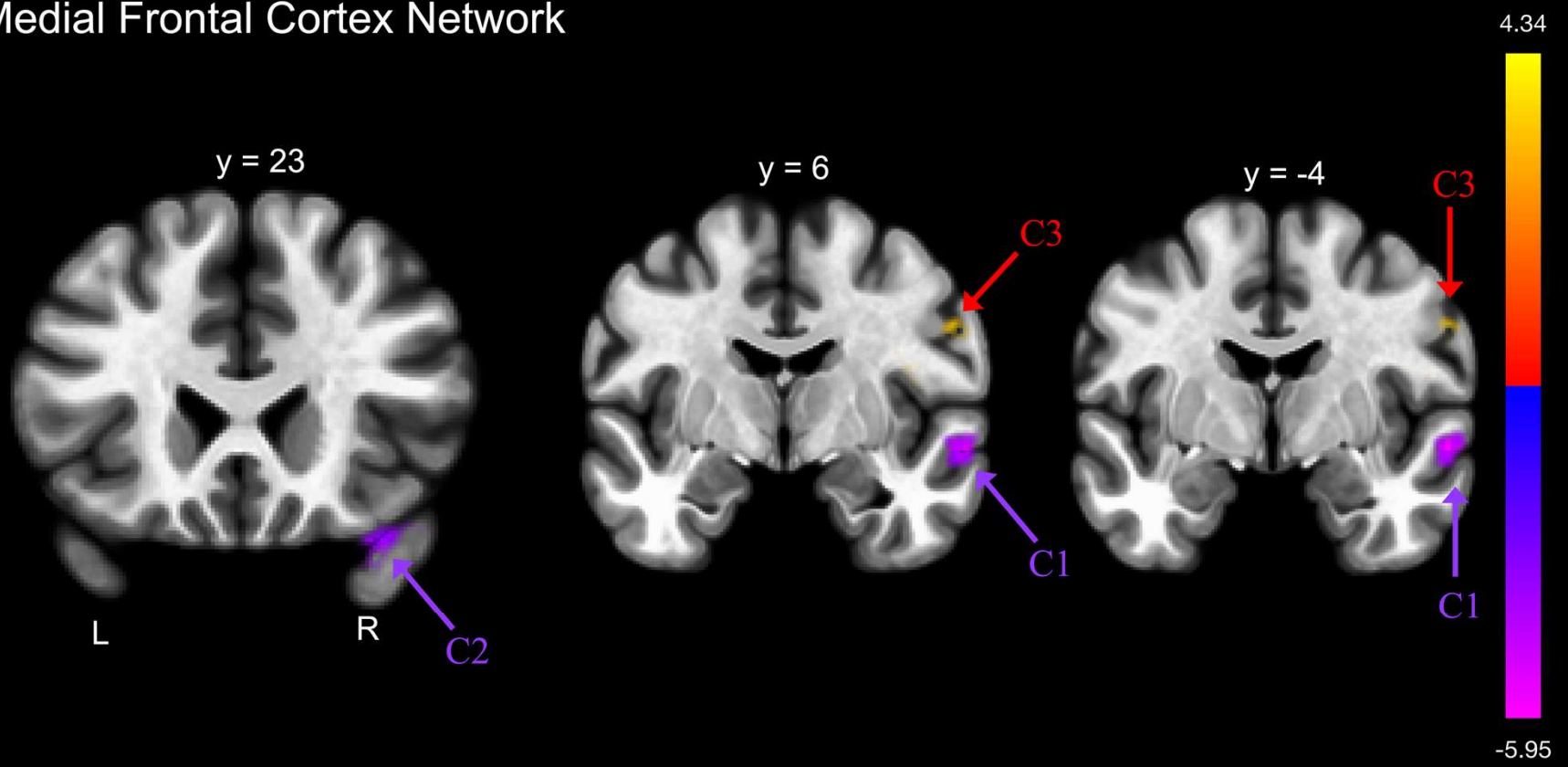
# Medial Frontal Cortex Network

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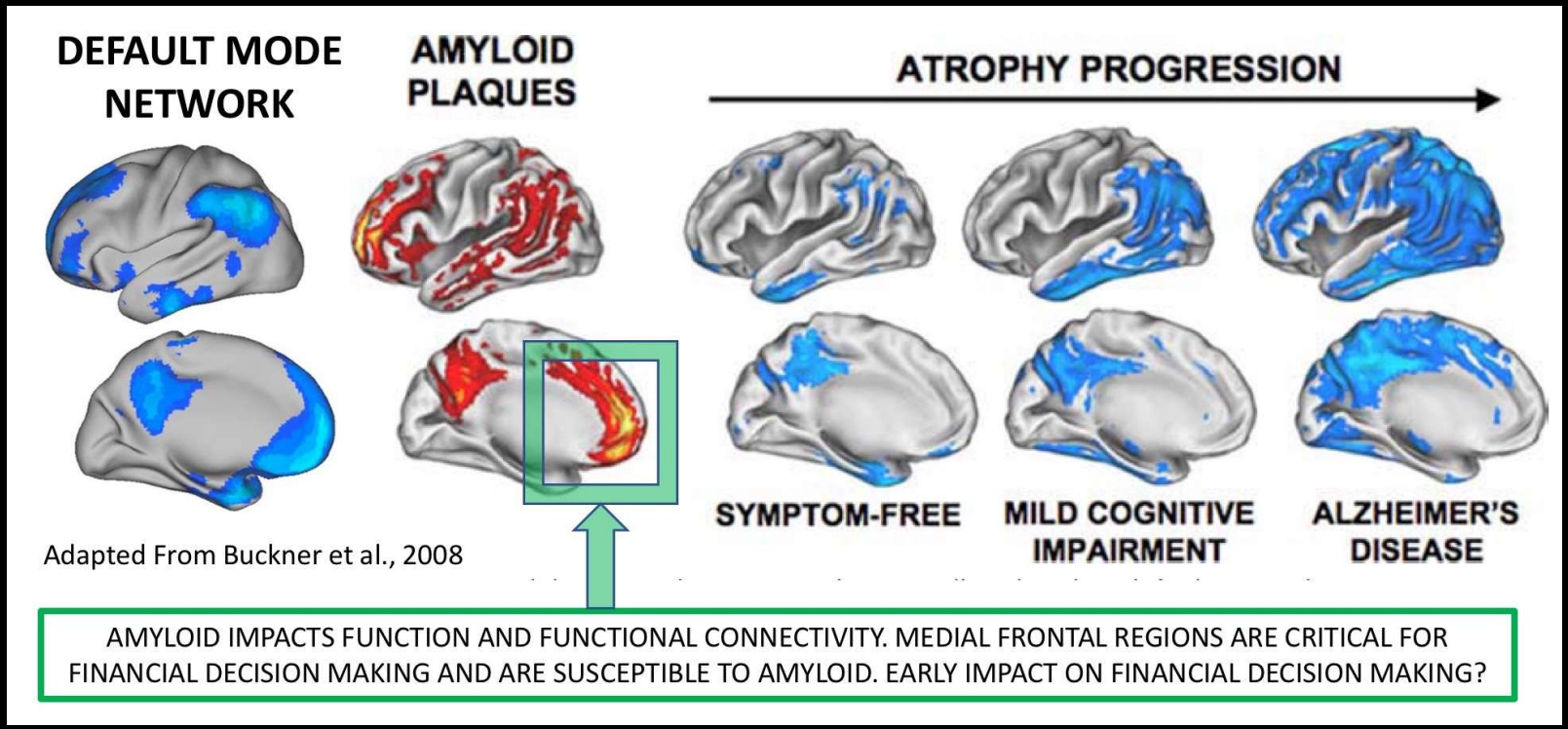
# Summary

- There are multiple factors (cognitive, emotional, medical, social, etc.) that are involved in poor financial decision making and susceptibility to scam in old age.

- A complex network of brain regions susceptible to age-related neuropathology may be involved in financial vulnerability in older age.
  - Whole-brain functional connectivity differences involving the hippocampus, insula, and medial frontal cortex, consistent with models implicating age-associated changes in decision making and social cognition.

- These studies need to be replicated in other samples and cohorts.

# Future Directions




Finance, Cognition, Default Network in Aging (FCDNA)
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- Namhee Kim, PhD
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WEILL CORNELL COLLEGE

- Mark Lachs, MD

HARVARD UNIVERSITY

- Randy Buckner, PhD


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