Age-Related Changes in Interpersonal Trust Behavior

Can Neuroscience Inform Public Policy?

Vijeth Iyengar, PhD, Administration on Aging/Administration for Community Living; **Dipayan Ghosh, PhD,** John F. Kennedy School of Government, Harvard University; **Tyler Smith, BS, CFE, CAMS,** Federal Deposit Insurance Corporation; **Frank Krueger, PhD,** School of Systems Biology, George Mason University

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An Evolving Global Age Distribution and New Implications for Social Cognition and Interpersonal Trust

In the years to come, there will be a significant global increase in the number of older adult persons. Some projections indicate that by 2030, there will be a higher number of adults age 60 or over than those between the ages of 10 to 24 [1]. It is critical to proactively address the novel challenges that societies will face with a shifting demography. In particular, understanding the neuropsychological changes that take place with advancing age and the effects these changes have on how older adults function and engage with their surroundings will become increasingly important in designing products, programs, and services to support the global population in the face of these inevitable new challenges.

In this paper, we link empirical findings from neuroscientific investigations of interpersonal trust behavior in older adults to incidences of financial exploitation, health care fraud, and digital deception—consumer harms for which older adults are preferentially targeted by bad actors.

Financial exploitation schemes include efforts to persuade older adults to provide access to personal financial accounts through mail, in-person, over-the-phone, or online spoofing. These schemes result in the theft or embezzlement of money or other property, and while the damage is difficult to estimate, some have reported that older adults lose about $36.5 billion each year to such financial abuse [2]. Similarly, health care fraud tactics exploit older adults through fraudulent billing via Medicare, private insurance, or personal funds. These older adults can also be subjected to unnecessary or unsafe medical procedures, resulting in compromised medical records. Lastly, digital disinformation, a more novel form of online victimization, takes advantage of social media platforms to spread misleading information that can affect a myriad of public interest concerns.

There are common problems across these forms of victimization. The potential victim faces the challenge of assessing the trustworthiness of the group or individual with which they interact. It can be difficult to judge the veracity and credibility of various sources of information. Finally, assessments of trust occur over different timelines: via one-time (e.g., unsolicited robocalls) or continuous (e.g., close friends or family members) engagement with individuals or groups harboring bad intentions. Determining the underlying reasons for these faulty evaluations of trust may prove useful in developing tools to combat these forms of victimization.

Emerging evidence from neuroscientific investigations of interpersonal trust behavior is revealing how the capacity to evaluate and subsequently act on untrustworthy agents with potentially nefarious intentions changes as we age. Interpersonal trust encompasses a person's willingness to be vulnerable to the risk of treachery based on the expectation that the actions of another will produce some future positive outcome due to the possibility of reciprocity. Available evidence from both cross-sectional and longitudinal survey studies has shown age-related changes in this behavior [3].

For example, older adults are less concerned with information that contradicts their first impressions about the trustworthiness of others, resulting in poor evaluations of the trustworthiness of other people [4].

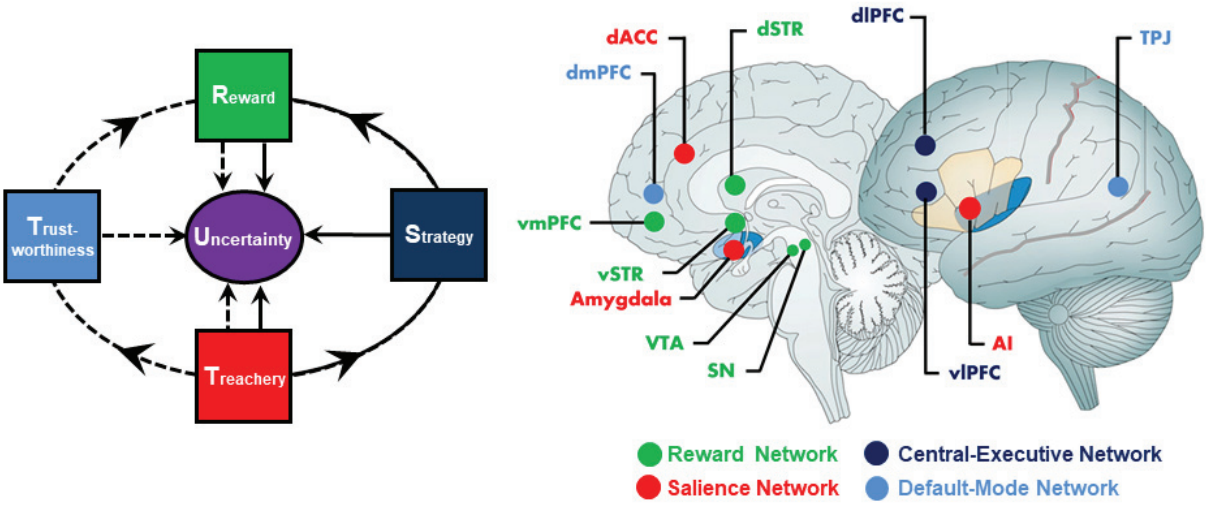
Further, in experimental economic exchange paradigms, wherein players assume the role of an investor (i.e., trustor) and responder (i.e., trustee), older adults engaged as trustors have been shown to be likelier to invest in trustees with an untrustworthy reputation (although the evidence is mixed) [5].

Complementing these behavioral findings, research in social cognitive affective neuroscience has linked age-related alterations in brain circuitry with changes in trusting behavior potentially leading to heightened susceptibility to financial fraud [6].

Collectively, these results—in older adults presenting with no neurological, medical, or mental conditions—suggest new public interest mechanisms may need to be developed to protect older adults from nefarious interactions. Recently, a neurobiological trust framework has been proposed in which the psychological components of trust (i.e., affect, cognition, and motivation) are linked to brain networks (see *Figure 1*) [7].

Mapping the Neurobiological Components of Interpersonal Trust

Making individual designations of trust in a social interaction—whether in the physical world or through an online interface—is the practice of successfully evaluating the potential benefits and costs when interacting with entities. Trusting an entity creates uncertainty, which results from the cost of potential treachery weighed against the anticipation of benefits after being trusted. Evidence suggests that older adults weigh costs and benefits differently from their younger counterparts [8]. Whereas older adults resemble younger adults in exhibiting increases in neural activity (in the brain's reward network) during the anticipation of benefits, they do not resemble younger adults in exhibiting increases in activity in the anterior insula (a component of the brain's salience network associated with evaluating the anticipation of costs and betrayal aversion). In fact, older adults have lower neural activity in this



Legend: AI, anterior insula; **dACC**, dorsal anterior cingulate cortex; **dlPFC**, dorsolateral prefrontal cortex; **dmPFC**; dorsomedial prefrontal cortex; **dSTR**, dorsal striatum; **SN**; substantia nigra; **TPJ**, temporoparietal junction; **vlPFC**, ventrolateral prefrontal cortex; **vmPFC**, ventromedial prefrontal cortex; **vSTR**, ventral striatum; **VTA**, ventral tegmentum area.

FIGURE 1 | Neurobiological Framework of Trust
SOURCE: Adjusted and reprinted with permission from Krueger, F., and A. Meyer-Lindenberg "Towards a model of interpersonal trust drawn from neuroscience, psychology, and economics," *Trends in Neurosciences.*
NOTE: Trust arises through the interplay of factors (t-r-u-s-t: treachery, reward, uncertainty, strategy, and trustworthiness)—linked to psychological components (i.e., affect, cognition, and motivation)—that engage key brain regions (circles) anchored in large-scale brain networks. Vulnerability from trusting another person builds uncertainty (purple ellipse) due to risk of treachery (red rectangle, affect, salience network), instead of anticipation of reward (green rectangle, motivation, reward network). To remove the uncertainty, the salience network engages either the central-executive network (dark blue rectangle) to adopt a context-based strategy, or the default-mode network (light blue rectangle) to evaluate trustworthiness for trusting a partner.

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region when trying to recognize faces that displayed selfishness rather than cooperation—suggesting a tendency in older adults to overestimate the trustworthiness of others [4].

With these behavioral differences established, we return to the neurobiological trust framework [7]. Two different types of cognitive systems are crucial to the removal of uncertainty that comes with trusting another person: the social cognition system (default-mode network), to evaluate the trustworthiness of a partner, and the cognitive control system (central-executive network), to employ context-based strategies for trusting a partner. The social cognition system is essential in assessing whether to trust an individual or group and supports the ability to infer and attribute the intentions and traits of others. Trustors with higher perspective-taking tendencies not only show greater trust toward others but also reduce their trust more drastically after betrayal by others. Age-related changes in the default-mode network may negatively affect how older adults navigate their social environments, exposing them to nefarious actors.

Complementing this first system, the cognitive control system allows one to adopt goal-directed behavior under changing contexts. Accumulating evidence indicates that although some cognitive functions are affected as we age, others are spared. Specifically, whereas crystallized cognitive abilities (e.g., conceptual knowledge) are preserved, fluid cognitive abilities (e.g., executive control, working memory, and attention) steadily decline with age [8]. Consequently, older adults may experience particular difficulties when faced with trust decisions involving the simultaneous processing and evaluation of disparate pieces of information—a scenario that taps into *fluid cognitive abilities.*

In summary, based on the neurobiological trust framework, age-related findings in studies of interpersonal trust behavior are likely driven by the impairment of the affective component of trust in the salience network (but not in the motivational component in the reward network), which therefore can impact the socio-cognitive components of trust in default-mode network and central-executive network.

This conclusion about age-related changes in interpersonal trust behavior is in accordance with the general assumption of socioemotional selectivity theory [9], which proposes an increase of positive emotional and social experiences in ways that foster well-being with advancing age and narrowing time horizon. According to this theory, older adults demonstrate a positivity bias that enhances the salience of more positive than negative valanced information, increases attention to socioemotional cues, and improves memory for positive stimuli or events in later life [10]. While these changes are associated with emotional and mental well-being, this bias may lead to greater likelihood of victimization due to *excessive trust* afforded to individuals and groups. Although the present commentary specifically focuses on changes in trust behavior across the life span that could potentially lead to various forms of victimization, we do acknowledge other factors, such as declines in functional capacity and mental well-being, that may also contribute to an overall greater risk of victimization [11].

A Case for Policy to Combat Public Interest Harms Related to Changes in Interpersonal Trust Associated with Age

Mounting evidence from neuropsychology is uncovering the mechanisms by which older adults engage in interpersonal trust behavior. The development of predictive neural markers building on individual brain differences associated with age-related changes in this behavior may permit the identification of neural phenotypes that in turn serve as targets for interventions. Such approaches may inform the development of more targeted behavioral and neural interventions that incorporate cognitive capacities that are preserved across the life span. Understanding the mechanisms and conditions under which older adults differ from younger adults in their processing and evaluations of interpersonal trust behavior can also impact features of programs and policies. For example, law enforcement and regulatory entities operating in financial and healthcare industries can collect trust-related-behavior-based fraud indicators and incorporate relevant data into loss prevention internal controls in the service of protecting vulnerable older adults.

Further exploration into the various mechanisms through which older adults process different forms of fraudulent behavior may prove helpful. Indeed, while such fraud-related incidents as the digital disinformation problem have been shown to affect older adults more than others, there is scant analysis that charts how cognitive processes relating to disinformation in older adults differ from processes including financial exploitation. While both financial exploitation and disinformation are activities instigated by nefarious actors, they occur in divergent ways—e.g., in motivation, platform, and demands placed on the victim—which

may affect how older adults respond to such instigations. Furthermore, ongoing policy, programmatic, and research efforts have not—to our knowledge—integrated the relative degrees of social pressure these various forms of fraud might instigate. Financial exploitation, for example, often involves an individual target, whereas the disinformation problem occurs on internet platforms and is disseminated to large classes with one mouse click.

Ultimately, we see this commentary as starting a conversation among stakeholders in the academic, public, and private sectors to identify how findings from neuropsychology can potentially inform and shape future public policies around issues that have touchpoints with interpersonal trust behavior. Greater engagement among these stakeholders has the benefit of cultivating an environment in which scientific investigators design questions that readily allow for translation of their findings to practice, the development of programmatic and policy interventions that incorporate the latest advances from research and practice, and, in the neuroscientific research community, the advancement of the importance of viewing their findings from a public health and policy lens.

References

1. *World population ageing 2017: Highlights.* 2017. New York: United Nations. https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf (accessed April 28, 2019).
2. Huang, Y., and A. Lawitz. 2016. *The New York State cost of financial exploitation study.* Rensselaer, NY: Office of Children and Family Services. https://ocfs.ny.gov/main/reports/Cost%20of%20Financial%20Exploitation%20Study%20FINAL%20May%202016.pdf (accessed April 28, 2019).
3. Poulin, M. J., and C. M. Haase. 2015. Growing to trust: Evidence that trust increases and sustains well-being across the life span. *Social Psychological and Personality Science* 6(6):614-621. https://doi.org/10.1177/1948550615574301.
4. Suzuki, A., M. Ueno, K. Ishikawa, A. Kobayashi, M. Okubo, and T. Nakai. 2019. Age-related differences in the activation of the mentalizing- and reward-related brain regions during the learning of others' true trustworthiness. *Neurobiology of Aging* 73:1-8. doi:10.1016/j.neurobiolaging.2018.09.002.
5. Ruffman, T., J. Murray, J. Halberstadt, and T. Vater. 2012. Age-related differences in deception. *Psychology and Aging* 27(3):543-549. doi:https://doi.org/10.1037/a0023380.
6. Castle, E., N. I. Eisenberger, T. E. Seeman, W. G. Moons, I. A. Boggero, M. S. Grinblatt, and S. E. Taylor. 2012. Neural and behavioral bases of age differences in perceptions of trust. *Proceedings of the National Academy of Sciences of the United States of America* 109(51):20848-20852. doi:https://doi.org/10.1073/pnas.1218518109.
7. Krueger, F., and A. Meyer-Lindenberg. 2019. Towards a model of interpersonal trust drawn from neuroscience, psychology, and economics. *Trends in Neurosciences* 42(2):92-101. doi:https://doi.org/10.1016/j.tins.2018.10.004.
8. Samanez-Larkin, G. R., and B. Knutson. 2015. Decision making in the ageing brain: Changes in affective and motivational circuits. *Nature Reviews Neuroscience* 16(5):278-289. doi:10.1038/nrn3917.
9. Mather, M., and L. L. Carstensen. 2005. Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences* 9(10):496-502. doi:https://doi.org/10.1016/j.tics.2005.08.005.
10. Reed, A. E., and L. L. Carstensen. 2012. The theory behind the age-related positivity effect. *Frontiers in Psychology* 3:339. doi:https://doi.org/10.3389/fpsyg.2012.00339.
11. Lachs, M. S., and S. Duke Han. 2015. Age-associated financial vulnerability: An emerging public health issue. *Annals of Internal Medicine* 163(11):877-878. doi:10.7326/M15-0882.

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Author Information

Vijeth Iyengar, PhD, is Brain Health Lead and Technical Advisor to the Deputy Assistant Secretary for Aging at the Administration on Aging/Administration for Community Living, US Department of Health and Human Services. **Dipayan Ghosh, PhD,** is Pozen Fellow at the Shorenstein Center on Media, Politics, and Public Policy, John F. Kennedy School of Government, Harvard University. **Tyler Smith, BS, CFE, CAMS,** is Special Agent in Charge of the Electronic Crimes Section, Office

of Inspector General at the Federal Deposit Insurance Corporation. **Frank Krueger, PhD,** is Associate Professor of Systems Social Neuroscience, School of Systems Biology at George Mason University.

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Correspondence

Questions or comments should be directed to Frank Krueger at fkrueger@gmu.edu.

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