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Decision-Making Deficits in Normal Elderly Persons Associated with Executive Personality Disturbances

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Abstract

Background—The problems that some community-dwelling elderly develop in real-world decision-making may have disastrous consequences for their health and financial well-being. Investigations across the adult life span have identified personality as an important individual differences variable that is related to decision-making ability. The aim of this study was to investigate the relationship between personality characteristics, as rated by an informant, and complex decision-making performance among elders. It was hypothesized that deficits in decision-making would be associated with personality characteristics reflecting weak executive functioning (*Lack of Planning, Poor Judgment, Lack of Persistence, Perseveration, Lack of Initiative, Impulsivity, and Indecisiveness*).

Methods—Fifty-eight elderly persons participated. Their health and cognitive status were deemed intact via comprehensive neuropsychological evaluation. The Iowa Scales of Personality, completed by an informant, was used to assess personality characteristics, and the Iowa Gambling Task, completed by the participant, was used to assess complex decision-making abilities.

Results—Longstanding disturbances in executive personality characteristics were found to be associated with poor decision-making, and these disturbances remained predictive of poor decision-making even after taking into consideration demographic, neuropsychological, and mood factors. Acquired personality disturbances did not add significantly to prediction after

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Conflict of Interest

None

Description of authors' roles

All authors made contributions towards the design, analysis, interpretation of data, and preparation of manuscript. Mr. Nguyen contributed to the design, acquisition, analysis, interpretation, and preparation of manuscript. Mrs. Koenigs contributed to the design and acquisition of data. Drs. Barrash, Bechara, Tranel, and Denburg contributed to the design, analysis, interpretation, and preparation of manuscript.

longstanding disturbances were taken into account. Disturbances in other dimensions of personality were not significantly associated with poor decision-making.

Conclusions—Our study suggests that attentiveness to the personality correlates of difficulties with aspects of executive functioning over the adult years could enhance the ability to identify older individuals at risk for problems with real-world decision-making.

Keywords

aging; decision making; executive function; personality disturbances; Iowa Scales of Personality Change

According to the U.S. Census Bureau, by the year 2030, over 20% of the population will be 65 years of age or older (He *et al.*, 2005). These demographics and their social implications, both positive and negative, have prompted rapidly growing scientific interest in the study of aged individuals. The cognitive neuroscience of aging is a new and burgeoning field (Cabeza *et al.*, 2005), combining the approaches of neuroscience and cognitive psychology in the pursuit of understanding the neural and cognitive changes associated with normal aging in such spheres as memory, decision-making, and affect. The study of decision-making in particular has been the subject of relatively few studies. In one, Denburg and colleagues (2005) compared healthy older adults (aged 56–85 years) to healthy younger adults (aged 26–55 years). Approximately one-third of the older individuals (while no younger adults) exhibited significant difficulty with complex decision-making on the Iowa Gambling Task (IGT; Bechara, 2007) despite fully intact performances on a broad array of neuropsychological instruments. A subsequent study found that these older adults identified as impaired decision-makers were more susceptible to deceptive advertising (Denburg *et al.*, 2007), indicating that poor decision-making among the elderly can result in serious real-world consequences that directly impact individuals' psychological and financial well-being.

Relationship of Personality to Decision-Making Across the Life Span

Investigations across the adult life span have identified personality as an important individual differences variable that is related to decision-making ability. In particular, impulsivity has been associated with poor decision-making, albeit with mixed results. Franken, van Strien and colleagues (2008) examined the relationship of impulsivity to decision-making with the IGT in a sample of 70 undergraduate psychology students with a mean age of 21 years. High impulsivity was associated with decision-making deficits overall, and in particular, with weaknesses in the learning of reward and punishment contingencies; this is assessed by the earlier phase of the IGT when knowledge about the task is acquired implicitly and decisions are made under ambiguous circumstances. Davis and colleagues examined personality characteristics associated with decision-making deficits on the IGT among 245 participants aged 25 to 45 years (Davis *et al.*, 2007). They found that higher levels of impulsivity, sensitivity to reward, sensitivity to punishment, and addictive personality were all significantly associated with deficits in decision-making. By contrast, impulsivity was not associated with decision-making performance on the Cambridge Gamble Task (Rogers *et al.*, 2003), a decision-making task in which there is no learning component to successful performance, and information about the probability of

success or failure for each decision (i.e., “risk”) is provided explicitly. This suggests that impulsivity may be associated with poor decision-making under ambiguous circumstances, but such interference in decision-making may be diminished when the degree of risk is known.

Suhr and Hammers (2010) studied 58 adults, aged 18 to 23 years, to examine the relationship of several variables to decision-making on the IGT, including personality and negative affect, as well as intellect and executive functioning. The authors utilized the Fun-Seeking subscale of the Behavioral Activation Scale (BAS; Carver and White, 1994) to assess impulsive sensation-seeking. In contrast to the aforementioned studies, the hypothesized relationship between impulsivity and deficient IGT performance did not reach significance, although there was a trend in the expected direction along with a moderate effect size (.48). Negative affect was not associated with poor decision-making.

In a follow-up study to the older adult investigations noted above, Denburg and colleagues (2009) examined the relationship of the Big Five personality traits, assessed with the NEO Five-Factor Inventory (Costa and McCrae, 1992), to decision-making on the IGT in 152 healthy adults aged 26 to 85 years. They found that poor decision-making among older adults (but not younger adults) was associated with higher Neuroticism. Of note, impulsiveness is one of the six “facets” constituting the multifaceted Neuroticism score.

Findings by Zermatten and colleagues (2005) indicated that the inconsistency regarding the relationship of impulsivity to poor decision-making might reflect different measures. They assessed four characteristics proposed as distinct components of impulsivity by Whiteside and Lynam (2001) (i.e., urgency, lack of premeditation, lack of perseverance, and sensation seeking), and found that lack of premeditation was the only one of the four measures significantly correlated with performance on the IGT. Overall, the pattern of these findings suggests that personality characteristics, in particular impulsivity, are associated with poor decision-making, but the relationship is complex and the specifics depend to some extent on the particular aspects of personality and decision-making being examined. Other aspects of personality that may contribute to poor decision-making are not well studied.

Aim of Study

In the current study, our objective was to further investigate the nature of the relationship between personality characteristics and decision-making deficits in healthy older adults. Since deficits in decision-making have been associated with damage to the prefrontal cortex (Tranel *et al.*, 1994), and damage to prefrontal cortex has been associated with disturbances in executive personality characteristics—i.e., not momentary behaviors such as a test performance, but tendencies regarding executive functioning that are enduring across real life situations and over years (Barrash *et al.*, 2000), we focused specifically on “executive” personality characteristics: *Lack of Planning, Poor Judgment, Lack of Persistence, Perseveration, Lack of Initiative, Impulsivity, and Indecisiveness*. It was hypothesized that poor decision-making, as assessed by the widely-used IGT, would be associated with: (a) the degree of disturbances developed late in life in these executive personality characteristics, and (b) the degree of longstanding disturbances in these aspects of personality functioning,

but (c) would not be associated with disturbances in other dimensions of personality, such as distress or disturbed social behavior. It was further hypothesized that the role of executive personality disturbances is independent of the (possible) effects of demographic characteristics, neuropsychological factors, and mood on decision-making.

Method

Participants

The participants were drawn from a pool of community-dwelling, independently living, neurologically- and psychiatrically-healthy individuals aged 60 and older involved in a larger, ongoing project investigating the neural correlates of decision-making. Participants' health status was determined via a semi-structured screening interview assessing medical conditions, alcohol/drug consumption, medications, and mood (after Tranel *et al.*, 1997). A sample of 58 adults participated, with a mean age of 76.7 years (standard deviation 7.6, range 60 – 91). Demographic and cognitive characteristics of participants are provided in Table 1.

Measures

Decision-Making—The *Iowa Gambling Task* (IGT; Bechara, 2007) was used to assess decision-making. The IGT is a computer-administered test in which participants make 100 card selections from four decks of cards. Two decks are predetermined to provide relatively high immediate gains but even higher long-term loss, yielding an overall net loss of money (Decks A and B, dubbed “the bad decks”); the other two decks are predetermined to provide relatively lower immediate gains but even lower long-term loss, yielding an overall net gain of money (Decks C and D, dubbed “the good decks”). Participants are not informed of the number of trials or the gain/loss schedule.

Personality—The *Iowa Scales of Personality Change* (ISPC; Barrash *et al.*, 1997) was used to assess personality. The ISPC is a revision of an earlier scale, the Iowa Rating Scales of Personality Change (IRSPC; Barrash *et al.*, 1996) with enhanced reliability and validity (Barrash *et al.*, 2011). The ISPC assesses 30 personality characteristics by way of behaviorally-anchored ratings completed by an informant, typically a family member or close friend. The behavioral rating guidelines for each of the personality characteristics explicitly focuses the rater's attention on enduring behavioral tendencies or characteristics that have been in evidence across a variety of situations, rather than specific instances of behavior at a specific point in time (as would be seen in a test performance). Two ratings are made for each assessed aspect of personality: “Before” (characteristic functioning over the adult years prior to the onset of a neuropathological condition), and “Now” (characteristic functioning over the past several months, after the onset of the neuropathological condition). For the present study with healthy older adults, the ISPC was modified to reflect a developmental perspective in a non-neurologic population (Denburg and Barrash, 2007). In this adaptation, all references to a “neurological condition” were removed, “Before” ratings explicitly reflected characteristic personality functioning over the middle-aged years, and “Now” ratings explicitly reflected personality functioning over the past several months. Ratings were made on an asymmetrical 7-point scale (1–7), with “3” reflecting the usual

amount of the characteristic for a typical adult of the same sex and age, as judged by the informant, and ratings above 3 reflecting increasing disturbance in that characteristic. The “executive” personality characteristics examined in this study — *Lack of Planning, Poor Judgment, Lack of Persistence, Perseveration, Lack of Initiative, Impulsivity, and Indecisiveness* — were identified based on the results of a principal components analysis of the Iowa Scales (Barrash *et al.*, 2011). Several other dimensions of personality disturbances, including disturbed social behavior, diminished motivation/hypo-emotionality, irascibility, and distress, were also examined.

Disturbance Ratings—To address study hypotheses concerning the relationship of poor decision-making to disturbances in personality functioning, ratings of longstanding personality functioning (“Before” ratings) and of current personality functioning (“Now” ratings) were created by collapsing the three ratings in the normal range of the scale (1–3) into one category (while scores of 4, 5, 6, and 7 remained as separate categories), resulting in a five-point scale ranging from 0 (“no disturbance”) to 1 (“mild disturbance”), 2 (“moderate disturbance”), 3 (“moderately severe disturbance”), and 4 (“severe disturbance”).

Acquired Personality Disturbances—For a personality characteristic to be considered an acquired personality disturbance required that: (a) the characteristic was disturbed to some degree (i.e., a Now disturbance rating of 1 or higher), and (b) this level of disturbance represents an increase in disturbance over the longstanding level (i.e., the Now rating was an increase of at least 1 over the Before rating).

Summary Measures—To create a single measure of the degree of “longstanding executive personality disturbance,” the Before disturbance ratings were summed across the seven executive characteristics, and summary measures were calculated for each the other four dimensions of personality disturbance (i.e., disturbed social behavior, diminished motivation/hypo-emotionality, irascibility, and distress). Parallel summary measures were calculated for acquired personality disturbances. These summary measures were the key independent variables of interest in all regression analyses.

Neuropsychological Battery—All participants completed comprehensive neuropsychological testing. The following measures were administered (see Lezak *et al.*, 2012, for further description): Estimated premorbid intellect (Wide Range Achievement Test – III Reading subtest), verbal and nonverbal intellectual functioning (Vocabulary, Block Design, Similarities and Matrix Reasoning subtests of the Wechsler Abbreviated Scale of Intelligence), general mental status (Folstein Mini Mental State Examination), attention and working memory (Digit Span, Arithmetic, Letter-Number Sequencing subtests of the Wechsler Adult Intelligence Scale – Third Edition), language (Boston Naming Test 20-Item Short Form [Barrash *et al.*, 1999]; and Controlled Oral Word Association Test), visuoperception (Benton Facial Recognition Test), learning and memory (including (a) sum of trials 1-5, and (b) 30-minute delayed recall from the Rey Auditory Verbal Learning Test), processing speed (Trail Making Test, Part A), executive functioning (Trail Making Test,

Part B; and perseverative errors on the Wisconsin Card Sorting Test), and self-reported mood (Beck Depression Inventory-II).

Procedure

The Institutional Review Board at the University of Iowa approved the study protocol, and all participants provided informed consent. Participants were tested individually in a quiet and comfortable laboratory room. Overall, the protocol, including interview, took approximately 4 hours to complete. To ensure that fatigue would not affect neuropsychological performance, the protocol was divided into two sessions. The IGT was administered immediately after the informed consent process. All participants were financially compensated for their involvement at the rate of \$15 per hour.

Statistical Analysis

Preliminary analysis examined data for the presence of outliers and the appropriateness of assumptions of normality, linearity, and homoscedasticity. Assumptions were supported and parametric analyses were employed unless otherwise noted. The relationship of continuous measures of demographic characteristics, neuropsychological scores and mood to decision-making was tested with Pearson's correlation tests, and by chi-square test for the categorical variable, sex.

Hierarchical regression analyses were conducted to examine the relationship between executive personality disturbances and decision-making, with attention to their unique contribution over and above the effects of demographic characteristics, relevant neuropsychological factors, and mood. The first regression analysis examined the relationship the five personality dimensions to decision-making. In the first step, the longstanding disturbance scores for each of the five personality dimensions were allowed to compete for stepwise entry into the predictive model to address the primary study hypothesis that deficits in decision-making are associated with weak executive personality characteristics. All longstanding disturbances entering the predictive model in the first step at the .05 level of significance were retained. In the second step, acquired disturbances in the five personality dimensions were allowed to compete for stepwise entry into the model to determine whether acquired disturbances could account for significant variance in decision-making over and above prediction based on longstanding personality disturbances retained in the model after the first step.

In the second hierarchical regression analysis, demographic variables (age, sex, and years of education), neuropsychological factors (those found to be significant in univariate analyses), and mood (BDI-II score) were entered into the regression equation in the first step. In the second step, longstanding or acquired personality disturbances predicting decision-making, as indicated in the first regression analysis, were entered into the model to determine whether the unique contribution of personality disturbances remains significant after accounting for variance predictable by demographic characteristics, neuropsychological factors and mood.

Results

As shown in Table 1, age, education, and sex were not significantly associated with decision-making. Neuropsychological performances were not significantly associated with decision-making, with two exceptions: Weaker performances on the WASI Matrix Reasoning subtest was associated with poor decision-making on the IGT ($p < .02$), as were more perseverative errors on the WCST ($p < .002$). The lack of association of most conventional neuropsychological instruments to decision-making on the IGT is something we have found previously (see Denburg *et al.*, 2005, 2006), adding credence to the notion that some older adults who display defects in real-world decision-making are not simple “demented” or “on the road to dementia” (such as Alzheimer’s disease).

In the first step of the first regression analysis, longstanding executive personality disturbance entered the model, accounting for an adjusted 8.1% of the variance in decision-making ($p = .027$). No other longstanding personality disturbances entered the model. In the second step, with longstanding executive personality disturbance retained in the model, no acquired disturbances in any of the five personality dimensions were able to predict significant incremental variance in decision-making. A post hoc analysis showed that had it been allowed to enter the equation in step 2, recently acquired disturbances in executive personality disturbance would only contribute a non-significant 1.5% of incremental variance in decision-making performance. However, even after controlling for variance that could be accounted for by acquired personality disturbances, the contribution of longstanding executive personality disturbances would remain significant in predicting decision-making outcome ($\beta = -.30$, $p = .024$).

The second regression analysis, presented in Table 2, showed that demographic variables, neuropsychological factors, and mood, collectively, accounted for a significant 20.9% (adjusted) variance in decision-making performance ($p = .006$). After accounting for variance predicted by those variables, adding longstanding executive personality disturbances to the predictive model increased the amount of decision-making variance accounted for by a significant 8.6% (adjusted), $p = .012$.

Discussion

The present study supports the conclusion that certain personality characteristics are related to complex decision-making in elderly persons. More specifically, the results supported the hypothesis that disturbances in executive personality characteristics—Lack of Planning, Poor Judgment, Lack of Persistence, Perseveration, Lack of Initiative, Impulsivity, and Indecisiveness—were significantly associated with decision-making deficits on the Iowa Gambling Task (Bechara, 2007) in healthy, independently living persons ranging in age from 60 to 88 years. Although it was expected that deficits in decision-making would be most highly related to acquired disturbances of these personality characteristics developed in later years, results revealed that it was actually longstanding disturbances in these characteristics that were significantly associated with poor decision-making, and once the latter were taken into account, acquired disturbances did not add appreciably to prediction. Further, the results of multiple regression analyses showed that it was not personality

disturbances generally, but disturbances in executive personality characteristics specifically, that were related to compromised decision-making. Demographic characteristics, neuropsychological factors, and mood, collectively, were also significantly associated with decision-making performance. However, hierarchical regression demonstrated that, as hypothesized, after taking into account the relationship of these variables to decision-making, executive personality disturbances continued to predict a significant portion of unique variance in decision-making performance.

In interpreting our findings, it is important to take into consideration other neuropsychological abilities. We examined performances from an array of cognitive domains and found that participants with weak performances on the decision-making task (IGT) performed more poorly on a measure of nonverbal reasoning (Matrix Reasoning) and executive functioning (WCST perseverative errors). The former may reflect that subclinical cognitive decline contributes to the weakening of decision-making abilities, consistent with previous research documenting an association between IGT performance and Matrix Reasoning (Suhr and Hammers, 2010) and intelligence more generally (Toplak *et al.*, 2010). Too, perseverative errors on the Wisconsin Card Sorting Test have been shown previously to be associated with IGT performance (Brand *et al.*, 2007). However, this relationship is not found consistently (Suhr and Hammers, 2010), and it has been posited that the relationship between the WCST and IGT is complex and shifts as the decision-making demands of the IGT change over the course of the task (with the strongest relationship occurring during the earlier trials of the IGT; see Brand *et al.*, 2007, for a more in depth consideration of the relationship of the WCST to the IGT). Moreover, the IGT and the WCST have been shown to have different, non-overlapping neural underpinnings in prefrontal regions, with the IGT being supported by structures in the ventromedial prefrontal sector and the WCST being supported by more dorsolateral prefrontal sectors (Gläscher *et al.*, 2012).

The societal and public policy ramifications of early identification of older adults with decision-making impairments are considerable given the importance of preserving the autonomy and protecting the welfare of this population. Older adulthood is frequently a time when individuals are faced with critical life decisions such as medical care and housing choices, investment of retirement income, and allocation of personal wealth. A poor decision in any of these domains can lead to detrimental outcomes to one's physical condition, finances, and/or psychological health. To make matters worse, older adults are frequently the targets of misleading and fraudulent scams as illustrated by a survey conducted by the nonprofit group *Investor Protection Trust* in which 20% of Americans aged 65 or older reported having been taken advantage of financially (Investor Protection Trust, 2010). Even with the increasing awareness of consumer fraud, some seniors believe fraudulent pitches and experience difficulty identifying fraud when it is present. In addition, older adults are often reluctant to seek advice about financial matters.

Elderly people with decision-making impairments are in need of support from family, friends, and health care practitioners, as they are frequently unaware of their own problems. One of the hallmarks of frontal lobe dysfunction is impaired self-awareness regarding acquired cognitive deficits (*anosognosia*). The individual with *anosognosia* is unaware of

their cognitive deficits, therefore they also lack insight into the ways in which real-life functioning will be compromised and the problems that may cause. Such patients may deny that they have anything wrong with them, even though their deficits are patently obvious to everyone around them. They are particularly liable to place themselves in harm's way, as noted above with regard to consumer fraud. This makes it all the more important for family and friends and, importantly, practitioners, to be able to detect a person's potential compromise, and assist in the effort of raising awareness to an individual and encouraging help-seeking behaviors. Fortunately, our study suggests that spouses and family members can indeed identify and quantify executive deficits in their loved ones. Given this, clinicians (e.g., physicians, nurses, social workers, psychologists) should inquire into executive personality characteristics with collateral informants when screening for decision-making impairments among their older adult clients.

Several limitations of this study warrant mention. The participants in the study, on average, had close to a college education, which is relatively high for an older adult sample; the 2010 Census data indicated that only approximately 20% of the population 65 years of age and older had earned a bachelor's degree or higher (U.S. Census Bureau, 2010). Too, the present study had a fairly small sample size, and the sample was relatively homogenous in terms of socioeconomic background and race. These issues may limit generalizability of our findings.

It is also acknowledged that the clinical implications of a disturbance rating of 1 ("mild disturbance") or a 1-point change in disturbance level can be questioned, and data are not available to address this. However, it is noted that a similar definition of "acquired personality disturbance" in a prior study (Barrash et al., 2000) was both sensitive and specific to hypothesized differences between patients with prefrontal brain damage (patients with real-life personality disturbances) vs. patients with damage elsewhere. The less stringent disturbance criterion in this study may be justified by the fact that the population in this study does not have neuropathological or psychiatric conditions and they are independent, community-dwelling individuals. Therefore, it is expected that maladaptive personality characteristics that hypothetically contribute to declining decision-making would be more subtle. It is not clear that the limited prior data on the clinical implications of ratings of "mild disturbance" diminishes the fact that, as hypothesized, disturbance ratings of 1 for executive personality characteristics were associated with compromised decision-making in elderly individuals.

An additional limitation of the study is the utilization of a single measure of decision-making. Decision-making is complex multifaceted, and undoubtedly difficult to measure fully with one task. The inclusion of various decision-making tasks would enhance broad-based assessment of individual differences in decision-making.

This investigation has provided initial evidence that identification of healthy, independently-living elderly with decision-making deficits is enhanced by attention to longstanding executive personality characteristics. Future research is necessary to validate study findings in a more heterogenous sample, and to critically evaluate more elaborate prediction models. Further investigation of the optimal set of personality characteristics and other relevant

variables may enhance the ability to identify healthy, independently-living elderly who are at risk for the development of impaired decision-making.

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References

- Barrash, J.; Anderson, SW.; Hathaway-Nepple, J.; Jones, RD.; Tranel, D. The Iowa Scales of Personality Change. Iowa City: University of Iowa, Department of Neurology; 1997.
- Barrash, J.; Anderson, SW.; Tranel, D. The Iowa Rating Scales of Personality Change: Psychometric properties. Iowa City, Iowa: University of Iowa Carver College of Medicine, Department of Neurology; 1996.
- Barrash J, Asp E, Markon K, Manzel K, Anderson SW, Tranel D. Dimensions of personality disturbance after focal brain damage: Investigation with the Iowa Scales of Personality Change. *Journal of Clinical and Experimental Neuropsychology*. 2011
- Barrash J, Cross S, Manzel K. The validity of Boston Naming Test short forms. *Journal of the International Neuropsychological Society*. 1999; 5:118.
- Barrash J, Tranel D, Anderson SW. Acquired personality disturbance associated with bilateral damage to the ventromedial prefrontal region. *Developmental Neuropsychology*. 2000; 18:355–381. [PubMed: 11385830]
- Bechara, A. Iowa Gambling Task (IGT) Professional Manual. Lutz: Psychological Assessment Resources; 2007.
- Brand M, Recknor E, Grabenhorst R, Bechara A. Decisions under ambiguity and decisions under risk: Correlations with executive functions and comparisons of two different gambling tasks with implicit and explicit rules. *Journal of Clinical and Experimental Neuropsychology*. 2007; 29:86–99. [PubMed: 17162725]
- Cabeza, R.; Nyberg, L.; Park, DC. Cognitive Neuroscience of Aging: Linking Cognitive and Cerebral Aging. New York: Oxford University Press; 2005.
- Carver C, White T. Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*. 1994; 67:319–333.
- Costa, PT., Jr; McCrae, RR. Revised NEO Personality Inventory-Revised (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI) Professional Manual. Lutz, FL: Psychological Assessment Resources; 1992.
- Davis C, Patte K, Tweed S, Curtis C. Personality traits associated with decision-making deficits. *Personality and Individual Differences*. 2007; 42:279–290.
- Denburg, NL.; Barrash, J. Iowa Scales of Personality Change: Adaptation for healthy adults. Iowa City, Iowa: University of Iowa Carver College of Medicine, Department of Neurology; 2007.
- Denburg NL, et al. The orbitofrontal cortex, real-world decision making, and normal aging. *Annals of the New York Academy of Sciences*. 2007; 1121:480–498. [PubMed: 17872394]
- Denburg NL, Tranel D, Bechara A. The ability to decide advantageously declines prematurely in some normal older persons. *Neuropsychologia*. 2005; 43:1099–1106. [PubMed: 15769495]
- Denburg NL, et al. Poor decision making among older adults is related to elevated levels of neuroticism. *Annals of Behavioral Medicine*. 2009; 37:164–172. [PubMed: 19350336]
- Franken IHA, van Strien JW, Nijs I, Murus P. Impulsivity is associated with behavioral decision-making deficits. *Psychiatry Research*. 2008; 158:155–163. [PubMed: 18215765]
- Gläscher J, et al. Lesion mapping of cognitive control and value-based decision-making in the prefrontal cortex. *Proceedings of the National Academy of Sciences*. 2012; 109:14681–14686.

- He, W.; Sengupta, M.; Velkoff, VA.; DeBarros, KA. US Census Bureau, Current Population Reports, P23–209. Washington, DC: U.S. Government Printing Office; 2005. 65+ in the United States: 2005.
- Hellevik O. Linear versus logistic regression when the dependent variable is a dichotomy. *Quality and Quantity*. 2009; 43:59–74.
- Investor Protection Trust. IPT Elder Investment Fraud Survey. 2010. Available at <http://www.investorprotection.org/learn/research/?fa=eiffeSurvey>
- Lezak, MD.; Howieson, DB.; Bigler, ED.; Tranel, D. Neuropsychological Assessment. 5. New York: Oxford University Press; 2012.
- Rogers RD, Tunbridge EM, Bhagwagar Z, Drevets W, Sahakian BJ, Carter CS. Tryptophan depletion alters the decision-making of healthy volunteers through altered processing of reward cues. *Neuropsychopharmacology*. 2003; 28:153–162. [PubMed: 12496952]
- Suhr J, Hammers D. Who fails the Iowa Gambling Task (IGT)? Personality, neuropsychological, and near-infrared spectroscopy findings in healthy young controls. *Archives of Clinical Neuropsychology*. 2010; 25:293–302. [PubMed: 20237050]
- Tranel, D.; Anderson, SW.; Benton, A. Development of the concept of “executive function” and its relationship to the frontal lobes. In: Boller, F.; Grafman, J., editors. *Handbook of neuropsychology*. Vol. 8. Amsterdam: Elsevier; 1994. p. 125-148.
- Tranel D, Benton A, Olson K. A 10-year longitudinal study of cognitive changes in elderly persons. *Developmental Neuropsychology*. 1997; 13:87–96.
- Toplak ME, Sorge GB, Benoit A, West RF, Stanovich KE. Decision-making and cognitive abilities: A review of associations between Iowa Gambling Task performance, executive functions, and intelligence. *Clinical Psychology Review*. 2010; 30:562–581. [PubMed: 20457481]
- U.S. Census Bureau. National Population Projections. 2010. [Data file]. Retrieved from <http://www.census.gov/population/www/projections/natdet-D1A.html>
- Whiteside SP, Lynam DR. The Five Factor Model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*. 2001; 30:669–689.
- Zermatten A, Van der Linden M, d’Acremont M, Jermain F, Bechara A. Impulsivity and decision making. *Journal of Nervous and Mental Disease*. 2005; 193:647–650. [PubMed: 16208159]

Table 1

Descriptive Statistics and Correlations of Demographic, Neuropsychological, and Mood Characteristics to Iowa Gambling Task Scores of Participants ($n = 58$)

Characteristics	Mean (SD)	Pearson r	P-value
Age (years)	76.7 (7.6)	-.08	.51
Sex (% female)	55%	.62	.43
Education (years)	16.2 (2.7)	.07	.58
MMSE	29.0 (1.1)	.25	.06
WRAT-3 Reading	51.4 (4.0)	.07	.59
WASI Vocabulary	66.0 (6.9)	.14	.29
WASI Similarities	38.7 (4.5)	.10	.29
WASI Block Design	36.2 (11.5)	.21	.12
WASI Matrix Reasoning	22.2 (6.7)	.31	.02
WAIS-III Working Memory Index	112.8 (12.5)	.18	.18
Boston Naming Test - Short Form 20	18.8 (1.6)	.23	.08
COWA	45.2 (12.5)	.21	.12
Benton Facial Recognition Test	47.6 (3.9)	.14	.31
AVLT Trials 1-5	48.6 (7.7)	.21	.12
AVLT 30 min delay	9.9 (2.6)	-.04	.79
Trail Making A	34.0 (11.6)	-.08	.56
Trail Making B	79.6 (28.6)	-.10	.44
WCST Perseverative Errors	12.8 (10.6)	-.40	.002
BDI-II	4.1 (3.4)	-.31	.02

Note. Raw scores are provided for each of the neuropsychological variables, with the exception of those noted. Shown are Folstein Mini Mental State Examination (MMSE); Wide Range Achievement Test - Revision 3 (WRAT-3) Reading subtest (in Standard Scores); Wechsler Abbreviated Scale of Intelligence (WASI) subtests; Wechsler Adult Intelligence Scale - Third Edition (WAIS-III) Working Memory Index (in Standard Scores); Controlled Oral Word Association Test (COWA); Benton Facial Recognition Test; Rey Auditory - Verbal Learning Test sum of trials 1-5 and 30 min delayed recall (AVLT Trials 1-5 and AVLT 30 min Delay); Wisconsin Card Sorting Test (WCST); and Beck Depression Inventory - Second Edition (BDI-II). The significance of continuous measures was tested evaluated by test of Pearson correlation; the categorical variable, gender, was tested by chi-square test.

Table 2

Hierarchical Regression of Decision-Making on Demographic Characteristics, Neuropsychological Factors, Mood, and Executive Personality Disturbances

	R ²	Adjusted R ²	R ² Change	F Change	F Change Sig.	Model Sig.	b	t value	b sig.
Step 1	.294	.209	.294	3.471	.006	.006			
Control Variables**									
Step 2	.380	.292	.086	6.819	.012	.001			
Age							-.044	-.318	.752
Sex							-.128	-.960	.342
Education							-.035	-.280	.781
WCST Perseverative Errors							-.265	-2.083	.042
WASI Matrix Reasoning							.269	2.169	.035
BDI-II							-.251	-2.168	.035
Longstanding Executive/Decision-Making Deficits							-.328	-2.611	.012

Note.

* Age, Sex, Education, WCST Perseverative Errors (raw), WASI Matrix Reasoning (raw), BDI-II.