Personality-Informed Prevention and Intervention for Healthy Aging

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Abstract

Based on the metaphor of low Conscientiousness (C) as a public health epidemic, we present a conceptual framework for mounting personality-informed prevention and intervention efforts to enhance healthy aging. The framework discusses theory and evidence along three dimensions: the target of the intervention (global C, personality processes, or behaviors); the system level at which the intervention is mounted (individual, intermediate social systems, or societal/cultural); and the life-course timing of the intervention (early childhood through young adulthood, midlife, and older adulthood). The evidentiary basis for integrating personality considerations into public health and medical practice is mounting, but now requires a shift from basic psychological to translational and interdisciplinary research. We conclude with recommendations for further steps, including the role of personality in the coming era of personalized medicine.
Personality-Informed Prevention and Intervention for Healthy Aging

Low Conscientiousness As A Public Health Epidemic

What if one common factor contributed to smoking, lack of exercise, poor diet, violence, risky driving and sexual behavior, excess drinking, and drug use? What if this factor were linked to premature mortality in study after study? And what if it were present in nearly 16% of the population? One would be hard-pressed to deny the public health impact of such a factor.

Personality and health psychologists have been aware of this factor for sometime. It is called low Conscientiousness. Conscientiousness (hereafter, C) is one axis of the Big 5 personality dimensions linked through meta-analysis to health-damaging behavior (Bogg and Roberts 2004) and premature mortality (Kern and Friedman 2008). Personality in general has emerged as a robust predictor of health outcomes, with meta-analytic estimates placing all-cause mortality posed by maladaptive personality on par with low cognitive ability and low SES (Roberts and Goldberg 2007). More-over, presuming that personality traits are, like other human attributes, normally distributed in the population, roughly 16% of people in the US fall at minus one standard deviation or less in C. No greater public health concern exists than a risk factor with numerous pernicious outcomes and a non-trivial prevalence in the population (Woodward 2005).

How might one reduce the impact of low C on individual and national health via prevention and intervention? This article focuses on a conceptual and research framework for prevention and intervention that may potentially enhance health outcomes. Three aspects relevant to prevention and intervention are the program target, the systemic level at which the program is mounted, and the life span period during which the program occurs. These three areas represent key recommendations for intervention planning from the recent NIH Science of
Behavior Change (SOBC) meeting report (2009), as well as the classic theoretical model of the lifespan intervention cube (Brim and Phillips 1988). Figure 1 schematizes this three-dimensional structure. Table 1 gives examples of specific interventions, both existing and hypothetical, falling in each cell of this cube. Careful consideration of each axis of the cube may inform effective—and cost-effective—construction and deployment of personality and healthy aging prevention and intervention initiatives.

**Prevention and Intervention Targets**

Personality-informed efforts to enhance healthy aging are inevitably confronted with the complexity of processes and variables that link personality to different aspects of health. Figure 2 illustrates several of the known pathways linking C to premature mortality. This schematic underscores the variety of possible targets for personality-informed health programs. One may think of targets as different links in risk chains, or postulated causal sequences connecting a risk factor such as low C to an undesired outcome, such as premature mortality (Ben-Shlomo and Kuh 2002; Kuh, Ben-Shlomo et al. 2003). In epidemiologic lingo, C is a distal or indirect influence on mortality, operating through a series of intermediate factors with increasing causal proximity to death. Not also that Figure 2 is simplified for purposes of presentation: reciprocal associations exist between most factors in the diagram, making risk chain models more like “risk webs”. Moreover the precise mechanism through which a distal risk factor such as personality operates may vary across groups of people, introducing the added complexity of moderated mediation.

Column 1 of Figure 2 indicates the realm of personality as captured by the measurement of personality traits. Paper 1 in this series examines the measurement of traits across time and
their relationship to underlying behavioral, social, psychological and neurobiological mechanisms. Suffice it to say here that traits are somewhat abstract descriptions of the individual’s tendencies to act in certain ways, usually obtained by subject self report. Traits should always be considered in specific environmental circumstances affecting the individual, a topic we discuss broadly and which paper 2 in this series considers in more detail. Column 2 indicates cognitive and affective processes that the individual utilizes to navigate the environment. These processes can be captured in laboratory tasks, or in behavioral observation settings. Column 3 enumerates social/behavioral acts or processes that relate most directly to health, including daily health behaviors, health service use, and social activities that have been found relevant to health/ill health outcomes. Finally, the last column specifies biological outcomes which are dependent on the individual’s personality and related behaviors.

Two aspects of this schematic warrant consideration. First, personality is best conceptualized as an integrated system reflecting relatively stable individual differences (McAdams and Pals 2006). Such a model moves beyond disagreements over whether personality should be studied from trait, process, motivational, biological, or other perspectives by acknowledging that they are all relevant and inter-related aspects of the person (McAdams and Pals 2006). Second, each column differs in conceptual specificity, from broad multicomponent domains of personality to specific behaviors. Based on this, three general classes of prevention or intervention target can be identified: the broad personality domain of C itself, C-related social cognitive or psychophysiological processes; or health behavior with strong personality determinants. We consider each target below.

**Target 1: The Broad Conscientiousness Domain**
Life course epidemiologic theory on risk chains (Ben-Shlomo and Kuh 2002; Kuh, Ben-Shlomo et al. 2003) suggests that reducing or eliminating initial causal factors in a sequence of events can ameliorate the unfolding of negative sequelae. Because C appears to be just such as an early causal factor in the risk chains shown in Figure 2, modifying it directly is an attractive option. If low C can be raised a sufficient amount before it triggers subsequent negative health events, one prevents the ensuing cascade. Such an intervention also affords the advantage of nullifying several complex and interacting causal paths (i.e., clusters of health damaging behaviors, pathogenic stress physiology, and ensuing disease), rather than focusing on a single intermediate link in the risk chain (i.e., a smoking cessation program). This consideration dovetails with recent calls for interventions targeting “bundles of behavior”, in the interest of broad change, cost-effectiveness, and preventing the substitution of one unhealthy behavior for another than has been singly targeted (2009).

Despite this conceptual appeal, at least five challenges exist to targeting global C, or any other broad dimension of personality. First, even though intra-individual change in the Big 5 dimensions—as well as personality disorders (Lenzenweger and Willett 2007)—has been documented, these changes occur over intermediate or long time spans. Would global personality dimensions be likely to change in the short term context of an intervention or experiment? The issue here is not only whether traits change at all, but also the rate of change. Second, interindividual differences exist in personality plasticity. In other words, some persons are more amenable to personality change than others. Personality stability is associated with higher Conscientiousness and Agreeableness, and lower Neuroticism (Caspi, Roberts et al. 2005). In

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1 We note that the etiology of poor health behaviors and disease is almost always multifactorial. In this paper, we are concerned with reducing or eliminating personality risk for these outcomes. As we argue throughout, personality contributes to numerous etiologic factors in the cause of disease so reducing personality risk may have a non-trivial impact on ultimate outcomes despite the multifactorial etiology of these outcomes.
fact, the personality “super factor” composed of these three Big 5 dimensions (Digman 1997) has actually been labeled “stability” (DeYoung 2006; DeYoung 2010). This suggests that while lower C individual are amenable to change, that amenability is also dependent on other axes of personality variation. This underscores the importance of considering all aspects of personality in health risk (a notion we return to shortly). Some also theory suggests that personality change is most likely when environments are stable, rather than in flux (Caspi and Moffitt 1993). Thus, good candidates for C interventions (i.e., those more disagreeable and neurotic) may be more amenable to change when other aspects of their life are relatively stable.

A second challenge is the breadth of Conscientiousness: it is a multifaceted domain of personality, comprising many interrelated traits (Roberts, Chernyshenko et al. 2005). In general, the Big 5 are axes of human dispositional variation intended as classification umbrellas for hundreds of more specific traits. Specific traits, in turn, consist of a number of even more specific behaviors, so that personality structure is organized in a hierarchical system (Digman 1997). Thus, each Big 5 dimension involves a vast landscape of behavioral and psychological tendencies. Child development and long term psychotherapy in adulthood both strive to shape personality on this global scale, but involve considerable time and resources. One might argue then that particular facets of C, rather than the entire domain, should be targeted. For the purposes of the present discussion, we blur the distinction between specific traits within C and personality processes associated with C, and discuss this issue below.

A third challenge of targeting C itself is that such a strategy risks over-focusing on only one Big 5 domain. Indeed, nearly all of the Big 5 appear to affect health outcomes. Therefore,

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2 For reviews of the health relevance of other FFM traits provided in empirical papers, see Weiss and Costa (Weiss, A. and P. T. Costa (2005). "Domain and facet personality predictors of all-cause mortality among medicare patients aged 65 to 100." Psychosomatic medicine 67(5): 724-733. for all-cause mortality; Jerant et al. (in press) for medication compliance; Duberstein et al. (in press) for cognitive function; Brummet et al. (2008) for diet; Chapman...
an individual’s overall personality-health risk profile will involve contributions of many different personality tendencies--some loading exclusively on C, some jointly on C and other Big 5 dimensions, and other still located in non-C regions of personality structure. Some work has begun to address this by analyzing not just subcomponents of the Big 5, but blends, profiles, and interactions of the Big 5 relevant to various health outcomes. For instance, personality styles represent the quadrants of the two-dimensional plane formed by crossing two of the Big 5 (Costa and Piedmont 2003). Conceptually, styles describe a person’s standing on aspects of personality that lie at the intersection of two of the Big 5—that is, specific traits that appear correlated with more than one Big 5 dimension. Graphically, they represent vectors at 45 degree angles to two orthogonal Big 5 axes. Psychometrically, these are not multiplicative products of a person’s standing on two Big 5 vectors (i.e., a typical interaction term), but are the sum of these vectors. This approach allows one to classify persons according to blends of the Big 5 in the same way traits related to multiple Big 5 dimensions can be structurally located in circumplexes of personality space (Hofstee, de Raad et al. 1992). Recently work has shown that these styles appear to have unique implication for both HIV progression (Ironson, O'Cleirigh et al. 2008) and depression risk (Weiss, Sutin et al. 2009). A related approach has used dimensional measures of similarity to particular personality prototypes (see (Donnellan in press) for a review). Such “person centered” analyses have linked some Big 5 profiles in childhood to cardiovascular health in midlife (Chapman & Goldberg, in press) and profiles in older adults to quality of life and chronic health conditions (Chapman and Lyness 2007; Chapman in press).
Target 2: Health-Relevant Personality Processes

Many personality processes constitute potential targets for prevention and intervention. As we discuss later, some are already targeted by existing programs. Two classes of processes are relevant: cognitive-affective, and physiological.

Cognitive-Affective Processes. A large number of personality processes have been discussed in classic (Bandura 1986) and more recent versions (Mischel 2004) of social cognitive theory. These include self-monitoring (cognizance of one’s own behavior and internal states), self-regulation (a general construct involving behavioral restraint and maintenance of goal-directed behavior), and self-efficacy (evaluating one’s chances of obtaining desired goals). Other health-relevant cognitive-affective processes include emotion regulation (controlling one’s emotional experiences), effortful control (maintenance of behavior in the face of challenge), delay of gratification or delay discounting (waiting for larger rewards); and motivational processes such as goal setting (setting desired future outcome states), and achievement striving (maintaining effort toward goals). Self regulatory processes in particular appear very relevant, as they are associated with everything from partner violence (Finkel, DeWall et al. 2009) to obesity (Riggs, Sakuma et al. 2007).

The behavioral economics paradigm serves as an interdisciplinary framework integrating several processes relevant to personality and behavior (Borghans L 2008). As such it is a useful conceptual tool for thinking how personality influences health behavior. From this perspective, people strive to maximize their utility (the economic term for “well-being”). Behavioral strivings are guided by estimates of the utility of different choices, given the interface of situational incentives or constraints, and individual adaptive skills or limitations. Personality traits and cognitive ability both dictate the perceived utility of different actions, the construal of
situational factors, and the nature and effectiveness of “skills” available to an individual for utility maximization (that is, the pursuit of well-being).\(^3\) Some persons perceive greater utility in short-term gratification of hedonic impulses, while others perceive greater utility in exercise of self-restraint for better longer term outcomes. Some persons simply lack the ability to restrain impulses even if they perceive utility in doing so, or are hampered by environmental constraints. Still others chronically misestimate the utility of various choices, so that great discrepancies exist between expected and observed well-being resulting from their actions.

Consider the finding, for instance, that older persons who are lower on C prefer minimal discussion of treatment options with their provider, and prefer that their doctor (rather than they, themselves) make treatment decisions (Flynn and Smith 2007). From a behavioral economic perspective, such persons perceive greater utility in disengaging from active decision making. This raises the immediate issue of potential discrepancies between perceived and realized utility: the Institute of Medicine (IOM) considers patient involvement a critical component of maximizing medical treatment effectiveness (Medicine 2001). Presuming that disengagement compromises health as the IOM suggests, the plight of low-C people would appear doubly difficult: not only will they suffer worse health outcomes, but they actually perceive greater disutility when experiencing the consequences of health conditions (Chapman, Franks et al. 2009).

One set of processes at play in connections between personality and health involve risk perception. In the case of deciding whether to become involved in one’s own health care, one must accurately evaluate not only the risk of a particular health condition, but the risk (vs.

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benefit) of abstaining from active participation in one’s treatment. Lower C is associated with perception of lower risk across several life domains (Soane and Chmiel 2005), including health (Hampson, Andrews et al. 2000; Hampson, Andrews et al. 2006). Moreover, actual risk-reduction behavior in health comes from estimating both higher probability and greater severity of a potential hazard (Weinstein 2000). Perceived severity also involves a forecast of how damaging an event might be, were it to actually be experienced. Low C people may thus underestimate the likelihood of negative consequences from abdicating their role in medical decision making, and may believe the consequences are likely to be relatively minor if they do occur.

Another collection of processes may also contribute to such disengagement from one’s own health care. Lower C individuals tend to procrastinate in general (Steel 2007), and with specific decisions in particular (Milgram and Tenne 2000; Steel 2007; Page, Bruch et al. 2008). Other personality dimensions, such as high Neuroticism and low Openness, may also exacerbate such avoidance (Sorensen, Duberstein et al. 2008). Low C people also lower their allocation of cognitive effort to decisions when they perceive situational factors as overwhelming (Withey, Gellatly et al. 2005), and report lower health-management self-efficacy (Franks P 2009). In other words, they perceive their capacity to effect desired health outcomes as low, so expend minimal effort in making decisions about their health. A more extended analysis would likely reveal numerous other cognitive-affective processes implicated in poor health decision making, each of which could be a target for decision-support interventions.

**Physiological Processes.** Three interrelated streams of research suggest areas for biological intervention research. First, *personality neuroscience,* and neuroeconomics (Brown and Ridderinkhof 2009) examine brain structure and function associated with dispositional
tendencies (see (Canli 2006) and for a review). A comprehensive summary of the neurobiology of personality is beyond this paper (but available in (DeYoung 2009) and (Depue 2005)). However, several specific findings are of interest from the standpoint of personality-informed interventions to enhance health aging. First, one promising hypothesis for organizing neurobiological research on the Big 5 is that the alpha (Digman 1997) or “Stability” superfactor accounting for correlations between Neuroticism, Conscientiousness and Agreeableness—and the beta, or “Plasticity” superfactor accounting for correlations between Extraversion and Openness—are at partially due to shared underlying functional substrates in neuronal systems (DeYoung 2009). The stability factor involves maintaining a stable affective balance (low Neuroticism), maintaining a harmonious social network (Agreeableness), and reliably attending to daily habits and behaviors intended to reach goals (Conscientiousness). Serotonin systems are thought to play a role in the stability superfactor (DeYoung 2009), as serotonin has been implicated in a wide range of self-regulatory behaviors (Carver, Johnson et al. 2009). Brain areas (reviewed in (DeYoung 2009) reportedly associated with aspects of the stability factor include the amygdale, insula, anterior cingulate, and greater right compared to left hemispheric activation (Neuroticism); medial prefrontal context, superior temporal sulcus, and mirror neurons in the inferior frontal gyrus and rostral posterior parietal cortex (Agreeableness); and prefrontal cortex (Conscientiousness).

Plasticity involves social (high Extraversion) and intellectual/behavioral (high Openness) exploration. Dopamine systems, implicated in cognitive and behavioral flexibility and novelty seeking, are posited to partly account for this superfactor (DeYoung 2009). Brain structures reportedly involved are those implicated in reward behavior such as the medial orbitofrontal
cortex, nucleus accumbens, amygdale, and striatum (Extraversion), and those involved in
cognitive flexibility such as the dorsolateral prefrontal cortex (Openness).

Two points are worth noting about the role of personality neuroscience in future
intervention work. First, neurobiological systems reflecting dyscontrol are one important avenue
to poor health and accelerated aging. However, excessive behavioral rigidity (low Plasticity and
high Stability) may also signal difficult in adaptive processes required for healthy aging (Baltes
1997). Thus, from a personality neuroscience perspective, one must consider the adaptive costs
and benefits of altering a biological substrate of personality (see, e.g., (Nettle 2006). A second
important principal in personality neuroscience is the complexity of the links between traits or
processes and brain structure and function. The Big 5 cannot be localized to a particular brain
area, or linked to a single neurotransmitter system; event though the stability and plasticity
superfactors are hypothesized to be linked to serotonergic and dopaminergic systems, a variety of
other neurotransmitter systems are implicated in the Big 5 domains composing each superfactor
(DeYoung 2009). For instance, one integrated model of disturbed personality (Depue 2005)
considers how the functional interplay of multiple neurobehavioral systems leads to
manifestation of different maladaptive tendencies. In general, current personality neuroscience is
predicated on the complexity of links between phenotype and neural substrate, a lesson learned
from the criticism of earlier theories emphasizing one-to-one mappings of basic temperament
dimensions with neurotransmitter systems (Paris 2005). Thus, prevention and intervention

4 These tendencies are sometimes considered an element of the Extraversion domain, but likely reflect
important contributions of Conscientiousness and other FFM dimensions. For instance, in the popular NEO-
Personality Inventory Revised, impulsivity is treated as a facet of Neuroticism, excitement-seeking a facet of
Extraversion, and self-discipline and deliberation facets of Conscientiousness (Costa, P. T. and R. R. McCrae
(1992). Revised NEO Personality Inventory and NEO Five Factor Inventory: Professional Manual. Odessa, FL,
Psychological Assessment. Nevertheless, these traits show some cross-loadings on other FFM dimensions,
underscoring that health-relevant personality processes involve contributions from multiple Big 5 domains.
targeting in the biological domain is currently a complicated issue, although some biological interventions with other targets have noted incidental changes in personality dimensions (discussed below).

In addition to brain structure and function, any consideration of biological personality intervention and prevention targets must consider the role of genetics. Sociogenomic personality theory (Roberts and Jackson 2008) emphasizes the importance of environmental experience in modulating genetic influences on personality phenotype (South 2008). For instance, agreeableness and conscientiousness have their origins in the largely genetic temperamental quality of effortful control (Caspi, Roberts et al. 2005), but the adult phenotypic expression of these Big 5 domains in adulthood is also a function of environmental forces. Most personality traits are polygenic, meaning that no single gene can be identified for low-C or other health-damaging dispositional tendencies (Ebstein 2006). Nevertheless, several molecular genetic studies have begun to tackle dopaminergic and serotonergic systems underlying personality (Ebstein 2006). To the extent that personality phenotype can be modeled not just as additive main effects of specific candidate genes, but as complex interactions discovered through exploration of the genome (South 2008), knowledge from this area may help guide interventions in at least two ways.

First, genetic testing and counseling may help identify children likely to develop low C or other health-damaging personality tendencies. Such children would then require developmental contexts that would ameliorate, rather than exacerbate, their genetic diathesis toward low C. Second, sociogenomic research may help to tailor pharmacologic interventions for an individual based on his or her environmental experience profile and its resulting impact on the expression of particular gene sets governing neurotransmitter systems. This idea is a primary basis for the
movement toward personalized medicine, or the tailoring of health treatments according to personal risk profiles (Hamburg and Collins 2010).

A third and final area of personality biology relevant to healthy aging is psychoneuroimmunology (Rabin 2007). This area focuses on connections between brain areas implicated in stress perception and emotion regulation (i.e., the amygdala), and the endocrine-immune stress-response systems (the Hypothalamic-Pituitary-Adrenal [HPA] and Sympatho-Medullary [SAM] Axes). These stress response systems release cortisol, epinephrine, and norepinephrine, which in turn affect short and long term immune functioning. In general, short term effects are adaptive, but chronic dysregulation of the HPA and SAM axes leads to a variety of problems. Both adaptive immune function (the ability of the body to respond to acute infections) and innate immunity (immune function in the absence of an acute challenge) become compromised. This leads to greater susceptibility to disease (Ader 2007), and chronic wear-and-tear on the immune, endocrine, and cardiac systems called allostatic load (Korte, Koolhaas et al. 2005). Personality dispositions affect these stress responses through perception, coping, and emotional regulation (Segerstrom 2000). Another possibility is that common genetic influences underlie personality development and immune regulation; for instance, Eysenck thought that personality developed in tandem with the HPA axis (Eysenck and Eysenck 1985). All FFM dimensions except Openness have been linked to markers of adaptive or innate immune function (Miller, Cohen et al. 1999; Cohen, Doyle et al. 2003; Cohen, Doyle et al. 2003; Suarez 2003; Suarez 2004; Doyle, Gentile et al. 2006; Chapman, Khan et al. 2009; Sutin, Terracciano et al. 2009), and ongoing work from our group also suggests that the O domain may be linked to inflammatory markers (a sign of chronically compromised innate immune function and allostatic load) in older persons. While some of the links between personality and inflammatory markers
are partly explained by poor health behaviors and chronic medical conditions (both of which cause inflammation), controlling for these factors does not completely explain the associations (Sutin, Terracciano et al. 2009)). This underscores the importance of viewing the psychophysiological stress response as a possible target for personality-informed health aging interventions. Below, we discuss an intervention program targeting psychoneuroimmunological pathways linking personality to accelerated aging.

**Target 3: Specific Behaviors**

The behavioral conception of personality has a long history and is rooted in the concept that personality can be identified by “act frequency”, or how often various actual behaviors are performed (Gosling, John et al. 1998). Recent data also confirm that Big 5 profiles are powerful predictors of behavior in daily life (Fleeson and Gallagher 2009). One might therefore argue that behavioral manifestations of low C and/or general pathogenic personality configurations represent more focused and measurable targets for personality-informed prevention and intervention.

Two types of behavior are relevant: that with obvious health implications, such as smoking a pack of cigarettes a day or eating a chocolate cake for dinner, and behaviors with indirect relevance to health. The latter are likely to be overlooked, but bear consideration because habits related to general success in life may contribute to health aging. A recent study by the Roberts group developed a taxonomy of 11 behavioral clusters identifying the C domain (Jackson 2010). Chapman and Goldberg are using a genetic expression analysis paradigm to conduct a “behavioral expression analysis” of the Big 5, mapping the specific frequencies with which 400 candidate acts were performed in the last year to the 25th, 50th, and 75th percentiles of Big 5 dimensions. Table 2 shows specific behaviors from both studies associated with
Conscientiousness. While these behaviors are not directly related to health, they constitute daily habits that may indirectly increase health risk. Indolent behavior is likely to carry over into poor maintenance of preventive health behaviors such as exercise; poor hygiene may invite opportunistic infections such as gum disease; chronic uncleanliness invites disease-bearing pests; habitual tardiness, inexactitude, and disorganization impedes receipt of and compliance with health care; and sloth impedes educational and socioeconomic gains related to knowledge and material resources promoting health. These tendencies and others encapsulated by behaviors in Table 1 are already targeted in formal and informal prevention and intervention programs which strive to promote general life skills. Day-to-day parenting, in fact, promotes such behaviors under global rubrics of “responsibility” and “good manners.” These efforts may defensibly be considered as influences on the behavioral tier of the Conscientiousness trait hierarchies.

The public health community, however, is likely to be more interested in behaviors with more direct causal influence on health. There are three main advantages to targeting these behaviors. First, multiple intercorrelated behaviors can be targeted simultaneously. This has the effect of neutralizing clusters of links in the Figure 2 risk-chain. When individuals strive to “live healthier”, they intuitively think of mitigating multiple unhealthy behaviors. Interventions aimed at “bundles of behavior” have gained traction because they are more cost-effective than several separate interventions each aimed at one behavior (i.e., only smoking cessation) (NIH 2009). Second, a large number of existing interventions already exist to change poor health behaviors. This eliminates the need to develop new interventions. Third, individuals, the health care field, and policy makers already find health behavior change interventions valuable and reasonable. In some arenas, interventions claiming to change some aspect of personality itself may be greeted with skepticism—or, worse, with shrill accusations of social engineering. However<
interventions targeting specific behaviors may actually have secondary effects on more general C or more wide-ranging personality processes. For instance, an elementary school program aimed at preventing substance use, violence, and sexual activity not only mitigates rates of these behaviors (Beets et al., 2009), but also exerted effects on processes within the C domain such as self-discipline and achievement striving (Flay et al., 2001).

The behavioral approach is also supported by evidence from psychotherapeutic endeavors to broadly impact personality. The research on the treatment of personality disorders is an instructive example. Such treatment is almost always focused on symptomatic behaviors, and not on changing personality disordered traits themselves. The goal of treatment is not personality change, but rather change in symptoms and particular problematic behaviors. Personality traits are utilized only peripherally, as the personality disorders are defined by specific symptoms and behavioral markers, and only secondarily by personality traits. There are those who suggest that the personality disorders can be captured more thoroughly by traits than by symptoms and behaviors (Widiger and Trull 2007), and this has yet to be determined for the next diagnostic manual.

The consensus is emerging that structured, consistent, organized approaches to patients with personality disorders produce significant change in symptoms, measured behaviorally. Various treatment packages posit different mechanisms of change, for these behaviors: e.g., learning of skills (Crowell, Beauchaine et al. 2009), increase in adaptive capacities such as mentalization (Fonagy and Luyten 2009), and change in schematic representations of others (Arntz, Bernstein et al. 2009). These hypothesized mechanisms of change may actually be thought of as personality processes, such as effortful control, affect regulation, etc. Research is also beginning on the endophenotypic level to describe these functions at a latent or biological
level. For example, borderline patients have been found to exhibit particular deficits in the processing of negative affect (Silbersweig, Clarkin et al. 2007).

Another argument for targeting behaviors directly is that personality traits are typically measured by self-report instruments, and there is always the possibility that any changes detected in pre-post intervention studies might be due to the demand characteristics of the study itself. Statistical techniques that might remediate this are seldom used in practice. More broadly, the health science community is likely to be more convinced and excited by changes in health related behaviors that are directly observable.

**Personalizing Existing Prevention and Intervention Programs.**

Although these considerations suggest considerable promise for targeting specific behaviors, existing “one size fits all” approaches to health behavior modification implicitly assume that a single program will be globally effective. Even if people improve on average, considerable heterogeneity in response to behavioral interventions is nearly always present. For this reason, considerable interest has arisen in tailoring or personalizing treatments to individuals (2009). Traditional approaches to determining the cost-effectiveness of interventions also recently been called into question, because they sometimes fail to determine in whom the intervention is cost-effective and in whom it is not, preferring instead to average over all people (Garber and Tunis 2009).

Interest in individual differences in health treatment response has gained great traction over the last decade under the rubric of *personalized medicine* (Hamburg and Collins 2010). Such approaches typically tailor health treatment on the basis of genetic information. Although genetic assessment promises great detail and a sense of objectivity, it is complementary, rather than superior to, personality assessment in personalizing medicine for several reasons. First,
while increasing sophistication in statistical estimation of latent trait scores has improved psychological measurement, genetic risk profiling can be alarmingly error-prone (Ng, Murray et al. 2009). Second, psychological tests are able to predict behavioral criteria with an accuracy similar to which medical tests predict medical criteria (Meyer, Finn et al. 2001). Since health is a complex function of behavior and biology, personalizing health care would ideally involve measuring both. Third, genetic risk profile typically select specific candidate genes that have been shown to predict health outcomes. Innumerable other candidate genes may be relevant, making this means of personalization fairly selective due to limited understanding of the doubtlessly complex role of genetics in health. Fourth, personality phenotype reflects the effect of environmental inputs, and reflects it at a behavioral level. Genes may turn on or off depending on environmental experience, but for this at level of behavior are often unclear. Thus, personality phenotype is likely to provide additional helpful information beyond genetic markers in the quest to personalize medical care.

A major part of personalized medicine involves risk models designed to accurately assess an individual’s risk for various health problems. Genetic information has improved the predictive accuracy of these risk models only marginally (Manolio 2010), perhaps for some of the reasons discussed above. New generation personalized-medicine approaches might profitably incorporate personality phenotype into a patient’s risk profiles. For instance, our group is conducting studies of the predictive accuracy of mortality risk indices developed from the Eysenck Personality Inventory, compared to classical biomedical risk indices such as the Charlson Comorbidity Index (for all-cause mortality) or the Framingham score (for cardiovascular death). The goal is to determine whether the broad biopsychosocial information encoded in responses to personality items can be used to forecast longevity to a comparable or
even more accurate degree than strictly biomedical information. Preliminary findings indicate that 22 of 57 individual items on the EPI predict age and sex-adjusted all-cause mortality over a 20-year follow-up period, a somewhat astonishing result given that the items were not developed for this purpose.

One goal of risk forecasting in personalizing care is to target and tailor prevention and intervention to the patient’s characteristics. Personality information in particular can help guide intervention choices. For instance, chronic disease patients with more maladaptive personality tendencies (including low C) seem more likely to benefit from a “stock” intervention designed to help them manage their diseases better (Franks et al., 2009; Jerant et al., 2010). Administering the intervention to individuals liable to benefit will increase cost-effectiveness, because “good candidates” will yield greater improvement for the resources expended. In an era where cost effectiveness dictates sustainability, intervention researchers must move beyond the expectation of main effects for their treatments, asking instead for whom the program does and doesn’t work.

The goal is not to deny care to people with a poor chance of benefiting from an intervention, but to find an alternative that will help them. For instance, Bagby and colleagues were able to provide recommendations for whether patients should be administered CBT or pharmacotherapy for depression, based on the differential effectiveness of each intervention according to personality profile (Bagby, Quilty et al. 2008). In an example dealing with physical health, Christensen (Christensen 2000) has suggested that the poor adherence to dialysis treatment shown by low-C patients indicates that a more structured treatment is necessary. Oversight phone calls by case managers and a controlled setting such as a dialysis clinic provide the external structure necessary for such patients to comply with regular dialysis treatments. By contrasts, high C patients are responsible and reliable, making them capable of independent
home dialysis. Directing them to this treatment engenders fewer health care system costs then
sending them unnecessarily to a dialysis clinic, and allows them maintain a greater sense of
autonomy. Behavior dyscontrol in children can be more effectively treated by tailoring the
approach to their temperament (McClowry, Snow et al. 2005). Another finding is that hostile
individuals actually benefit more from exercise to prevent future heart attacks (Lavie and Milani
1999).

The same ideas of targeting and tailoring based on personality apply to prevention efforts
such as public health message and information campaigns. A large body of literature suggests
that tailoring prevention programs increases their effectiveness and cost-effectiveness (Kreuter
and Wray 2003) (Noar SM 2007), and that personality is a key element of such tailoring (Dutta
2000; Dutta-Bergman 2003). In research evaluating brief health messages that communicated the
substantial synergistic risk of lung cancer resulting from smoking in homes with above-threshold
levels of radon gas had only modest effects on smoking outcomes (Lichtenstein, Boles et al.
2008) (Lichtenstein, Andrews et al. 2000). The perceived risk of the combination of smoking and
radon predicted a reduction in cigarettes smoked in the home only for those high on
conscientiousness (Hampson, Andrews et al. 2000). In a second study, greater perceived risk
predicted quitting for more conscientiousness women but not men (Hampson, Andrews et al.
2006). Higher levels of conscientiousness may have enabled people to change smoking
behaviors in response to a perceived risk. For those lower in conscientiousness, it may also be
necessary to intervene on conscientiousness competencies for risk communications to lead to
behavior change.

In addition to tailoring existing prevention and intervention programs by personality,
targeting is another way in which personality can inform health interventions (Kaplan 2000).
Because low C is so robustly associated with poor health behaviors and outcomes, this suggests that low C individuals in particular should represent a “target demographic” in the same way that other at-risk demographic groups (men, women, young, old, etc.) are sometimes targeted. While this can be done in smaller setting where personality can be screened (i.e., primary care office health questionnaires, which we discuss below), it is often not feasible at the population level. Low-C is not a recognized demographic segment outside of psychology and thus personality is not measured by the census, for instance. Forms in the bureaucracy of daily life have check boxes for age, gender, race, and ethnicity, but not for low C.

Thus, an alternative strategy is to return to tailoring and develop a universally applicable intervention that is effective for those most at risk. This approach is particularly appropriate for school-based programs where it is more egalitarian and practical to apply the same intervention to all children. We are currently evaluating the efficacy of a school-based smoking prevention program consisting of components that were each shown to change smoking-related outcomes in prior laboratory studies. To be included in the final version of the program, each component had to be effective for either the group as a whole, or for one or more at-risk subgroups. High sensation seeking defined one of these at-risk groups. In a randomized controlled trial, the program significantly reduced children’s intentions and willingness to smoke, and was particularly efficacious for sensation seekers (Andrews et al., under review).

A final consideration in targeting and tailoring behavioral intervention by personality is that relevant personality traits must be, at some point, assessed. The idea of adding hostility screening items to the standard health-history forms used in primary care settings idea was originally proposed over a decade ago (Kubzansky, Kawachi et al. 1999). Brief Big 5 measures (Gosling, Rentfrow et al. 2003; Donnellan, Oswald et al. 2006) also exist as potential screeners.
Individuals flagged by such screens as potentially risky personality profiles might receive a subsequent, more detailed assessment to verify the initial results or identify false positives. This serial testing strategy that has proven to be quite effective in medicine (Woodward 2005). However, traditional Big 5 measures are developed based only on the internal structure of items, not on the relation of items to important outcomes (the so-called criterion keying approach used to construct the initial Minnesota Multiphasic Personality Inventories). Improved balancing of internal structural validity with criterion validity has been recommended recently to increase the applicability of personality measurement for particular areas (Borghans L 2008), and fascinating new techniques in statistical theory are arising to accomplish this (Hastie 2009).

Level of Prevention and Intervention

Interventions can be mounted at different levels of social abstraction. One useful framework for considering the level of intervention is Brofenbrenner’s ecological systems theory (Brofenbrenner and Evans 2000). This framework conceptualizes life context as a concentric ring of circles ranging from the individual him or her-self (the “micro-system”; i.e., psychological and biological systems); to families, friends, and social networks (the “meso-system”), to community level institutions (i.e., schools and workplaces; the “macro-system”); to broader systems involving culture and society (the “exo-system”). We consider personality-informed healthy aging interventions at all of these levels below.

Micro-System: Individual Level

Psychotherapy. Traditionally, psychotherapy has been used to treat maladaptive personality tendencies. Extant treatments specifically targeting personality tend to focus on borderline personality disorder and perhaps a few other examples of DSV-IV Axis II pathology.
Low C is characteristic of the Big 5 profiles of such disorders (Bagby, Costa et al. 2005; Bagby, Sellbom et al. 2008), and the treatments often involve efforts to increase C-relevant process such as self-discipline and impulse control. Non-axis II psychotherapies may have similarly de-facto effects on aspects of personality. Motivational interviewing, for instance, is intended to resolve ambivalence about behavior change, and could be useful for “energizing” individuals showing deficits in C-related processes such as agency and goal-striving (Faris, Cavell et al. 2009).

Individual level intervention can profit from the experience and developments in psychotherapy research for the personality disorders. Kazdin (2006) has articulated a current framework for the steps in treatment development, including conceptualization of the disorder/problem area, articulation of the intervention in sufficient detail to be replicated by others, generation of initial effect sizes, leading to randomized clinical trials, investigation of moderators and mediators of the effects, and successful transfer of the intervention from more university/medical school settings to community settings with more heterogeneous groups of subjects and less selected therapists/interventionists.

Another important lesson from this area is that there is little evidence that the hypothesized mechanisms of change as embedded in the treatment manuals are, in fact, the change agents. The manualized treatments for the severe personality disorders are complex, multifaceted treatments that contain many elements that could potentially be operative in the change process. It is unlikely that any one process is essential to change (Gabbard 2009), and it has been difficult so far to isolate the operative elements in change. A conservative view at the present is that common elements across the treatments, such as an organized, structured approach to the patient with encouragement for attitudinal and behavioral change, is essential. Whether or not these changes persist over time is still an open question. One follow-up study has found a
retention of treatment changes over an eight year period, but this study is an exception (Bateman and Fonagy 2009). The issue of maintenance of change is related to the question about the mechanisms of change, and what endures with the individual following the active intervention period. Lessons from the treatment of personality disorders thus suggest that a) behaviors are optimal targets, b) changes in behavior may or may not reflect changes in personality process, and c) the extent to which behavioral change is maintained over the long-term requires careful consideration. This is a particularly important issue for health behaviors, because individuals may begin smoking again during times of stress, drinking heavily after successful periods of moderation, or gain weight after losing it.

Pharmacotherapy. Some recent studies have noted the effects of pharmacotherapy on personality (Costa, Bagby et al. 2005) (Tang 2009). These studies examined personality change in depressed patients, and effects are most obvious for affectively-loaded personality domains such as Neuroticism and Extraversion. Nevertheless, changes in personality in these studies do appear distinct from changes in the depressive syndrome. In general, further systematic study of pharmacotherapy for pathologically low-C would appear indicated, given evidence for the role of serotonergic systems in self-regulatory processes (Carver, Johnson et al. 2009). Again, emphasis should not be restricted to agents operating on a single neurotransmission system, however. A caveat is that while pharmacologic treatment of maladaptive personality is familiar to psychiatry and psychology, it may appear sinister to other audiences. Thus, research in this area should also focus on the impairment thresholds at which various personality trait configurations may warrant pharmacologic intervention. Examination of this area would appear most feasible in on-going pharmacotherapy trials for Axis I disorders, statistically differentiating change in personality from change in Axis I disorders in the fashion of Tang and colleagues (Tang 2009).
Meso- and Macro-Systems: Intermediate Levels of Social Structures

Meso-Systems. The most intimate social system for many individuals is the family, and parenting and familial functioning have lasting effects on personality development (Caspi, Roberts et al. 2005). Family systems interventions may be an important ingredient in preventing later health damaging behaviors arising from personality across the lifespan. For instance, spouses with higher C may mitigate some of the health risk incurred by individuals with low C (Roberts, Smith et al. 2009). Familial strains in later life such as caring for relatives with chronic diseases impact the health of caregivers with certain personality characteristics (Hooker, Monahan et al. 1992). The family system is therefore a critical level at which interventions may optimize personality driven health outcomes.

In addition to the family, other social groups—either naturally occurring or constructed for some ad-hoc purpose—represent a promising level at which to mount interventions. Such approaches may involve educating patients, leveraging an environment of mutual support among many suffering from the same problem, formal skill development, or some combination of these. For instance, Weight-Watchers, a commercial intervention targeting specific behaviors related to weight gain, provides consumers not just with education and tools to improve their diet and activity level, but with regular meetings at which attendees can receive support for their efforts. Group exercise programs are ubiquitous in commercial fitness settings, and provide a pleasurable social environment for strenuous activity low-C persons consider aversive. Smoking cessation programs are sometimes offered at the group level, as are the Chronic Disease Self-Management (Lorig and et al. 2001) and Mindfulness Based Stress Reduction (Krasner and Quill 2009) Programs. Intervening at the level of small groups is also often more cost-effective than individual approaches (Health 2009). The need to target and tailor such interventions according
to personality increases in complexity in groups, because many personalities are involved. Generally however, interpersonal personality dimensions such as Extraversion and Agreeableness, may dictate how well patients respond to such interventions. A low C person extremely low in Agreeableness, for example, may not only fail to benefit from a group-level intervention, but may sabotage the effectiveness of the intervention for others by generating hostility, tension, and discomfort.

While these examples deal with physically localized groups, general social networks are more diffuse and provide another possible level of intervention (2009). Smoking (Christakis and Fowler 2008) and obesity (Christakis and Fowler 2007) both appear to be transmitted through social networks. The role of personality traits in social network diffusion is not yet well understood, but personality characteristics are known to modulate susceptibility to influence by others (Petty 1998). In social network parlance, some individuals in a network will have a “low transmission threshold”, meaning they are likely to adopt novel behaviors they see in peers. This could for instance, be a function of the Big 5 Openness to Experience dimension. Agreeableness (conformity and compliance) and C (resisting temptation, dutifulness or diligence to ideals in the face of peer pressure) are also likely to influence propagation of unhealthy behaviors through a network.

In theory, high C individuals with high influence in networks could be identified to promote better health behaviors in the hopes of that they will pass such behaviors on. In otherwords, one “seeds” the network at strategic locations designed to maximally disseminate healthy practices. Low-C individuals, or those susceptible to the contagion of unhealthy behavior, could similarly be targeted for preventive programs with a bent toward resisting the unhealthy influences of peers. Using these techniques, the natural properties of network are
leveraged to reach large numbers of people with strategically focused efforts. In order to investigate the role of behavioral transmission in social networks, greater information on personality must be collected from individual members. On-line social networks represent a low-cost, convenience sampling frame in which to test these ideas, and are already being utilized for other aspects of personality research (Back, Stopfer et al. 2010).

**Macrosystems.** The educational system is a somewhat broader context for personality-informed interventions to promote health. Childhood and adolescent personality appears to influence educational attainment (John, Caspi et al. 1994) (Hampson, Goldberg et al. 2007), suggesting a causal role for personality in educational achievement and explaining modest correlations between personality and education in adulthood (Costa and McCrae 1992; Goldberg, Sweeney et al. 1998). However, these correlations almost certainly reflects bi-directional influences between formal education and personality over time (Miller, Kohn et al. 1986; Borghans L 2008). Formal education develops self-discipline, planning, organization, goal-setting, and a number of other C-relevant personality processes. Head start data indicated that early educational enrichment benefits C-relevant personality tendencies as much as actual knowledge (Heckman 2006; Cunha and Heckman 2009). In both the famous Terman cohort and in a population-based Finnish cohort, personality partially mediates the association between early educational achievement and health outcomes (Kern and Friedman 2008) (Pulkki, Kivimaki et al. 2003). This too suggests an effect of education on later personality.

The implication is that formal education, which reaches a large segment of the populace during years critical for personality formation, may serve as a de-facto personality intervention. Several aspects of existing variation within educational systems require study as naturally occurring C-interventions. What happens to the development of C in a school cohort when...
school environments increase in overall achievement focus and decreases in drop-out and
delinquency rates? What effect does summer school have on C-relevant processes? School days
of varying lengths, curricula varying in autonomy level, and literally hundreds of other structural
and process features have been studied in the education literature. However, outcomes are
typically achievement scores, grades, and so forth, and greater heed should be paid to personality
processes. Higher education also requires investigation as a shaper of personality, though
obvious selection effects exist based both on cognitive ability and personality. Educational
systems also differ in the characteristics of their occupants. However, such issues are familiar
and statistically tractable issues in quasi-experiments. The major task, therefore, is to increasing
understanding of what aspects of education have the most powerful impact on personality using
existing data and by building personality batteries into existing infrastructures.

Many school-based programs outside of the general educational curriculum also fall into
the category of macro-system interventions potentially improving the personality and health
interface. These programs address children’s social and emotional development and/or are
designed to prevent problem behavior relevant to conscientiousness and health behavior. A meta
analysis of evaluations of 73 after-school programs indicated that they have positive effects on
children’s feelings and attitudes, behavioral adjustment, and school performance (Durlak, Taylor
et al. 2007). Another meta analysis of social and emotional learning (SEL) programs
demonstrated an 11% increase on achievement tests among children who received SEL
compared to the control groups (Durlak & Weissberg, in press). The American Psychological
Association (APA) has also developed and successfully evaluated a curriculum for third-grade
students called “The Other Three Rs: Reasoning, Resilience, and Responsibility.” Other
programs delivered to children in the educational system focus on cognitive control (Diamond,
Barnett et al. 2007). These programs aim to change core competencies in the C domain, such as self-management, responsible decision making, maintaining attention, and planning ahead.

Another macro-systemic context for interventions is employment. Employment is similar to education in that it is both an effect of personality, and plays a causal role in shaping personality. The finding that C predicts occupational success was so widely replicated in industrial organizational psychology that by 2005, leading I/O psychologists called for a moratorium on the topic (Barrick and Mount 2005). Other traits as well determine selection into various jobs and career success (reviewed in (Borghans L 2008).

However, the nature of jobs and careers also affects personality. Findings suggest that jobs requiring flexibility and creativity increase traits related in intellectual flexibility (the Big 5 Openness), self-directedness, and the ability to choose and successfully pursue goals (a C-related trait) (Kohn and Schooler 1978; Kohn and Schooler 1982; Miller, Slomczynski et al. 1985). Recent research by Sutin has shown that increases in career standing and salary over 10 years diminished Neuroticism (Sutin, Costa et al. 2009), while psychological demands of one’s job predicted 10-year Extraversion increases, and hazardous work conditions predicted decreased Agreeableness (Sutin and Costa 2010). Two other studies have also shown links between career and personality change (Roberts, Caspi et al. 2003; Scollon and Diener 2006).

Given this, job factors such as the availability of employee assistance programs, or changes to structural or process elements of the work milieu, may be de-facto personality interventions. It is important to note that these job programs are instituted or altered usually with the overarching intention of improving the employer’s bottom line, not to improve maladaptive personality. One exception was the JOBS program, an effort intended to prevent depression following JOB loss (Vinokur, Schul et al. 2000). The program succeeded, partly by encouraging
re-employment through improvements in personality processes such as self-efficacy (van Ryn and Vinokur 1992). Regardless of the reason such programs are mounted, greater consideration of their effects on personality appears warranted. Do promotions requiring increasing diligence and responsibility induce changes in C that translate into non-occupational behaviors, such as health habits? Do unemployment and jobs with few demands diminish traits in the C-domain? Do workplace interventions motivated by I/O psychology principles alter people’s cognitive, affective, and behavioral tendencies only at work, or more generally?

A final macro-system necessary to consider is the neighborhood in which a person resides. A large literature suggests neighborhoods affect health (Kawachi and Berkman 2003), and new work on large scale geographic correlates of personality (Rentfrow, Gosling et al. 2008) has paved the way for micro-geographic studies of personality. Some evidence already suggests that neighborhoods influence the development of maladaptive personality tendencies (Jaffee, Caspi et al. 2007; Hart, Atkins et al. 2008) (Leventhal and Brooks-Gunn 2003). Poverty, crime, and local norms for behaviors, as well as physical aspects of neighborhoods, may account for these effects. For instance, the “broken window effect” is a phenomenon in which a single unrepaired broken window is thought to establish a set of norms encouraging social disorder (Keizer, Lindenberg et al. 2008). One demonstration program attempted to intervene to change, among other things, negative psychological effects of high-poverty neighborhoods by moving low-income families out of these areas. Although parental and child distress decreased (Leventhal and Brooks-Gunn 2003), educational outcomes did not appear to be enhanced (Leventhal, Fauth et al. 2005), and relocated children had greater hyperactivity and substance use problems, and harsher parenting, than those remaining in poverty (Fauth, Leventhal et al. 2007). Data thus do not suggest favorable effects on personality development.
Systemic interventions focusing on optimizing the environments of impoverished neighborhoods themselves, rather than systematically relocating residents, may show greater promise for shaping healthy personality tendencies. Establishing neighborhoods conducive to health and optimal personality development is a task at the intersection of several government and private sectors including urban planning, urban economic development, and public safety. Yet the extent to which psychological factors enter into urban planning at the level of local government is unknown. Increased presence of behavioral scientists on such community planning committees may help steer their activities in directions that eventuate in beneficial effects on resident personality.

Society and Culture: The Exosystem.

The exosystem is the most general level of abstraction in contextual theory, focusing on aspects of broad society. Cultural and societal influences on health are well documented in the social epidemiology literature (Berkman and Kawachi 2000). We therefore focus on how individual personality may be influenced by the exosystem, and how social and health policy may function as exo-systemic interventions in light of these links.

Inequality in socioeconomic status (SES) is a fundamental social condition encompassing a variety of environmental and cultural factors (Berkman and Kawachi 2000). SES is often measured by occupational status and education, two factors already discussed with respect to personality. However, personality also appears linked to other SES indicators such as income and earnings (see (Borghans L 2008), for a review), and to aggregate measures of SES constructed from multiple indicators. For instance, in a population sample, we estimated that persons at the 75th percentile of SES were 75% more likely to be in the top quintile of Conscientiousness than persons at the 25th percentile of SES (Chapman, Fiscella et al. 2010).
One explanation for the association may be self-selection by personality into various levels of the socioeconomic gradient (Caspi, Roberts et al. 2005). It is also acknowledged implicitly in literature on neighborhoods and health (Kawachi and Berkman 2003), wherein one attempts to separate “context” (the neighborhood itself) from “composition” (the characteristics of the neighborhood’s inhabitants) effects of neighborhoods. Evidence also exists for the influence of socioeconomic context on personality development during childhood; capacity such as self-control are negatively impacted by development in lower SES strata (Conger and Donnellan 2007). Work by sociologists also suggests that place in societal structure influences the C-relevant trait of self-direction during adulthood (Kohn, Naoi et al. 1990; Kohn and Slomczynski 1990; Kohn 1995). Marxist personality theory (Smith 1985) conjectures that socioeconomic disenfranchisement breeds, among other things, demotivation for the pursuit of one’s life goals due to powerlessness.5

A related exo-systemic influence on personality is that of general cultural values. For instance, the shift in cultural ideals from communism to capitalism that occurred in eastern Europe during the late 1980s and early 1990s suggests that capitalist cultural values induce greater individualism and self-direction (Kohn and Slomczynski 1990; Kohn, Slomczynski et al. 1997; Kohn, Zaborowski et al. 2000; Kohn 2006). In another study of 33 countries, higher C was associated with increasing acceptance and expectation of stratification of power and resources—a seemingly capitalist value (Hofstede and McCrae 2004). Other work also points toward association between socio-cultural contexts and the Big 5 (McCrae and Terracciano 2005).

5 The lens through which personality-SES correlations are viewed may vary subtly depending on one’s discipline: personality psychologists may focus more on the effects personality exerts on socioeconomic outcomes, because they are interested in the general influence of personality on life outcomes. On the other hand, researchers with sociological and developmental interests may focus on the shaping role of SES in personality development and change. Our view—and certainly one to which both camps would assent—is that SES and personality influence one another reciprocally over the life course.
Among purveyors of societal values, the entertainment and advertising industries loom large. While not all popular culture has negative effects on dispositions, movies and television programs sometimes glamorize low-C behaviors. Loss of self-control is portrayed as desirably cathartic and exciting; lack of planning and motivation as happy-go-lucky; evasion of responsibility as free-spirited; impulsivity as spontaneity. While the entertainment media may shape personality in an unhelpful fashion, the advertising industry often exploits those already low in C. This leads to an exacerbation of the consequences of deficient C. Persons with poor judgment are induced to make questionable financial decisions, leading to downward social mobility with attendant effects on health. Those with poor self-control are encouraged to supersize servings, “cut loose” and eat and drink to excess, choose high-caloric foods whose long-term damage is never shown in advertisements. The same individuals are induced to pay unreasonable amounts for exercise gizmos claiming to yield Olympian physiques while minimizing the time spent in physical activity.

Fortunately, the public health damage inflicted by these entities may be addressed by social and health policy. Legislation prioritizing and facilitating government and foundation funding for education, and for programs targeting character development within education, represent general social policy avenues of interventions. Health policy can economically incentivize or disincentivize target behaviors, and/or mount counter-marketing campaigns that seek to popularize healthy behavior (Health) 2009). Health-damaging industries have become adept at avoiding the concrete rules of false advertising, utilizing a variety of subtle marketing techniques for predation of the low C population. Social policy regulating these practices is difficult to enact, but can be achieved in the face of indubitable public health peril. Regulation of tobacco advertising represents an instructive case study in policy intervention.
A debate currently exists in health policy over whether laws and regulations should be based on personal or social responsibility for health (Wikler 2002; Cappelen and Norheim 2005). Proponents of social responsibility attribute the fundamental cause of ill-health to SES disparities outside an individual’s control, and favor policy-level interventions striving to mitigate social inequalities. On the personal responsibility side, ill-health is attributed to volitional individual behavior born of an individual’s psychological and behavioral disposition. Health policies are thus advocated which hold individuals responsible for their own health decisions (Minkler 1999). From a personality perspective, both types of policy are important. SES and social environment undoubtedly influence the development of health-destructive behavior and personality tendencies both. Yet at the same time, personality traits explain individual differences in health that exist within the same SES strata. Thus, many favor health policies informed by some balance of social vs. personal responsibility for health (Minkler 1999).

One example of a policy intervention endeavoring to strike such a balance was the West-Virginia Medicaid experiment of 2006 (Steinbrook 2006; Steinbrook 2006). The initiative provided a base level of Medicaid coverage to all social disadvantaged participants, but attempted to incentivize healthy behavior by providing additional benefits to individuals who met benchmarks for preventive care and improved health behavior. The effect of such programs is under debate (Trapp 2008), and may well vary by personality. For instance, low C persons may refuse to engage in the behavior necessary to gain additional benefits under programs like the West Virginia Medicaid project.

More broadly, taxation of unhealthy behaviors has also been suggested as a viable policy intervention balancing social and individual health responsibility (Cappelen and Norheim 2005). Additional taxes for food items with no nutritional value (i.e., non-diet soda) are another
example being implemented by various states. Many of these initiatives are enacted in cities, rather than states. At the time of this writing, San Francisco, for instance, is considering banning the dispensation of toys in Happy Meals exceeding 600 calories (a de facto tax). New York City is contemplating legislation that would make the purchase of junk food with food stamps more costly. Unlike incentives to engage in voluntary behaviors (preventive care visits, etc.), taxes cannot be avoided by low C individuals.

Such taxation has been ethically defended from a social justice perspective (Cappelen and Norheim 2005). It punishes voluntary behaviors, rather than the involuntary consequences of the behavior. In other words, individuals are held responsible for health damaging behavior (being taxed for eating too much chocolate cake), but not for the outcome (i.e., they are not denied care for health problems related to obesity). Most objections to such taxation come from industry, which has a vested financial interest in unfettered purveyance of unhealthy products. Those who engage in the unhealthy behavior itself also frequently object. A counterargument is that the personal liberty to erode one’s health harms other by burdening health-care systems with voluntarily-acquired preventable diseases.

A more ethically contentious policy intervention involves care-rationing. Under such policies, low C individuals who have engaged in health damaging behavior that has lead to a negative consequence (overeating leading to diabetes, smoking to lung cancer) would be placed lower on waiting lists for medical care for the resulting condition—behind individuals requiring the same care who do not have such a behavioral risk history (Cappelen and Norheim 2006). To some extent, care rationing already occurs and is necessitated by finite resources (Persad, Wertheimer et al. 2009). Taxing health-destructive behaviors would appear more viable as a personality and health policy intervention than care rationing, however. The behavioral
consequence of paying additional money to engage in unhealthy behavior is immediate, and likely to be more effective for low-C individuals. By contrast, diseases arising from these behaviors often take years to emerge and may be perceived as less likely to occur at all by low-C people. The specter of standing second in line for care, behind those who did not voluntarily encourage their own health problems, may thus be a feeble deterrent to low-C individuals.

Lifecourse Timing\textsuperscript{6}

Childhood, Adolescence, and Young Adulthood

Personality traits and processes are still in formation during early childhood, adolescence, and young adulthood \cite{Caspi2005}, making this a sensitive period for personality-informed prevention and intervention. Data from the childhood obesity epidemic indicates that physical inactivity and poor dietary practices are also likely to be important behavioral targets from the earliest years of life \cite{Ogden2010}. Smoking is another important behavioral target, particularly during adolescence, when its initiation appears linked to the onset of other preventable risk behaviors, including alcohol and substance use \cite{Hanna2001}. Antisocial behaviors have a strong personality component and emerge during this time \cite{Krueger2000}. Efforts to induce resilient personality processes (e.g., adaptive coping skills) during early life may also offset the negative effect of social environments on developing poor health behaviors \cite{Institute2006}\textsuperscript{7}.

\textsuperscript{6} We assume that readers understand the lifespan as continuous and that reference to life stages represent only a widely accepted metaphor, rather than literal sharp separations between ages groups. When we mention age ranges corresponding to young, middle, and late life phases, they are for general convenience only.

\textsuperscript{7} Buffering of deleterious environmental forces upon health can take two forms. The first is most familiar as the concept of moderation, in which social environments exert negative effects on health only in people who are dispositionally prone to respond to the environment. The second is a compensatory / cumulative relationship between personality and social environmental risks. In this form of buffering, environmental and personality are additive, meaning that personality traits adds incrementally to or reduce the risk conferred by disadvantageous environments. This is akin to additive main effects after personality- ses correlations are controlled, rather than
It is also during this period that interventions mounted from within the education system, represent important contexts for interventions. Interventions at the level of diffuse social networks would appear optimally timed during adolescence and young adulthood, when variation and size of such networks is greatest (Carstensen, Isaacowitz et al. 1999) and their impact on behavior pronounced. Finally, the family system is critically important level for intervention, because the acquisition of poor health behaviors is often directly traceable to the behavior of parents. Even individual-level interventions, such as child counseling and psychotherapy, or pediatric care, are contingent on parents arranging such care during early phases of this period. Economic perspectives suggest that early investment in children’s cognitive and personality skill formation can yield great social benefit for years to come (Heckman 2006; Cunha and Heckman 2009).

Mid-life

Midlife represents a period of important psychological role transitions relevant to personality (Caspi and Roberts 2001). It is also a sensitive period for the emergence of chronic diseases of aging (Ben-Shlomo and Kuh 2002). Although global change in the C domain is still possible, more feasible targets for intervention during this period may be specific personality processes and personality-driven health behaviors. The principle of heterotypic continuity (Caspi, Roberts et al. 2005) suggests that the manifestations of the same personality tendencies change over the life course. For instance, the health risk of low C during earlier adulthood may be more manifest in risky and impulsive behaviors, but as the prevalence of these behaviors decreases

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with age in the population, low C health risk by midlife may arise more from passively negligent behaviors such as failure to exercise, seek preventive care, and/or adhere to medication. Behaviors themselves are more proximal triggers of actual health problems, as shown in the risk-chains of Figure 2.

The US Preventive Services Task Force Guidelines also recommend testing for a number of chronic diseases that begin to emerge during midlife, such as hypertension, hyperlipidemia, and diabetes (Barton, Miller et al. 2007). A critical distinction to be made is between screening—assessing risk factors such as personality to prevent the emergence of disease—and case finding, or identifying the presence of the disease. Lipid panels in primary care are mainly case-finders for hyperlipidemia which, if present, requires treatment. By contrast, personality risk assessment would be a screening mechanism aimed at preventing the emergence of hyperlipidemia (Sutin, Terracciano et al. 2010). Diseases of later life for which personality is a risk factor, such as dementia, may also be in a pre-clinical phase during early life (Duberstein P in press). Early screening for distal risks such as personality permits enhanced monitoring in such persons. For those at midlife already diagnosed with diabetes, hypertension, cardiovascular disease, and other chronic diseases, personality may influence the management and course of the disease via stress physiology and self-care behaviors (Scheier and Bridges 1995). Both weight gain (Brummett, Babyak et al. 2006) and smoking status (Chapman and Kawachi) may be personality-driven behavioral targets during this period.

Interventions may be easily delivered at the individual level during this phase of life. Most individuals have seen a primary care doctor, for instance, and many see physicians regularly. Increasing numbers of people have also utilized psychotherapy and medication interventions, as well. Social networks tend to become somewhat smaller and more selective
(Carstensen, Isaacowitz et al. 1999), meaning that family and selective friendships represent important levels for potential intervention. Ascension in occupational and career standing also makes this the ideal period for employment-based interventions. Finally, health-policy becomes an important level at which interventions may be actuated, as the timing of disease leads to greater attention to one’s health and healthcare during this period. Interventions are also likely to serve a tertiary prevention purpose as well. For instance, following one heart attack a hostile patient might be referred to a program aimed at reducing hostility (Gidron, Davidson et al. 1999) and/or a cardiac exercise program for hostile patients (Lavie and Milani 1999) to prevent a second heart attack.

**Late Life**

Trait malleability itself tends to be lowest during the last decades of life. Nevertheless, data indicate that personality change does continue naturalistically, so personality itself need not be dismissed out of hand as an intervention target. However, a variety of personality-driven behaviors and processes would appear higher priority targets of intervention because they are directly linked to the exacerbation and course of chronic conditions already manifest. Appropriate service use and medication compliance, both of which have significant personality contributions during this period (Chapman Bp 2009; Jerant A in press), are required to maintain health in the face of age-related physical declines. The aging of the immune system (Franceschi and et al. 2000) may exacerbate personality effects on HPA and SAM axis dysfunction, highlighting the importance of mind-body stress-response processes during the later years (Coe and Laudenslager 2007).

Another important intervention target during the last phase of life is cognition. Considerable evidence exists for the role of personality in cognitive decline and the development
of Alzheimer's (e.g., Wilson, Bennett et al. 2004; Boyle 2010; Duberstein P in press). Cognitive engagement and stress reduction thus both appear to be important targets for intervention during this period (Grossman, Niemann et al. 2004; Hertzog and Lindenberger 2009). Another general area relevant to this period of life is health-related quality of life (HRQOL), which involves subjective well-being and everyday functional capacity (Lawton 2001) and is affected by personality independent of disease (Chapman, Duberstein et al. 2006; Chapman, Duberstein et al. 2007). Potential interventions targets include important HRQOL determinants such as social connection, optimizing role-function, and improving mood regulation (Lawton 2001).

The level at which interventions may be mounted remains flexible during this period. However, individual-level intervention, in the form of the doctor-patient relationship, may be the most common. As spousal loss increases, children move away, and social networks from work are lost with retirement, there is a need to increase consideration of interventions mounted in social and group formats. Because social isolation is often implicated in deteriorating health in older adults, the mere effect of increasing social contact through such interventions may have positive outcomes.

**Summary and Recommendations**

**A Translational Perspective**

While evidence for the role of personality in healthy aging is considerable, a number of questions still remain. Tantamount are questions about which mechanisms link which trait configurations to which outcomes at what times. The question thus arises of whether enough is known to implement personality information in health practice. One school of thought is that without thorough understanding of mechanisms, basic science findings cannot be confidently
integrated into practice. Another position is that the mechanism of action is not important if the program achieves desired results (Lipsey 1990).

We believe that both agendas—finding what works for whom, and finding why it works—are complementary. This notion is the basis of the National Institutes of Health’s recent emphasis on *translational research*, or research bridging basic and applied health sciences (Woolf 2008). A basic science finding might inform an intervention effort, while prevention and intervention findings might inform basic research on mechanisms (Howe, Reiss et al. 2002). A translational view would hold, for instance, that if personality-based risk screeners help forecast important outcomes, there is grounds for incorporating them into practice because they can enhance medical care. At the same time, discovering the biopsychosocial mechanisms explaining their predictive power is an important scientific advance. A value judgment is required to prioritize one goal over the other. From a translational perspective, both agendas can be pursued without subsuming one beneath the other. We conclude by providing recommendations in this spirit.

**Recommendations**

1) **Early Intervention.** Interventions targeting Conscientiousness or other dimensions of the big 5 may be more effective earlier in the life span when plasticity along these general spectra of personality is greatest. Interventions remediating global C have the advantage of curtailing numerous life-course risk pathways beginning with low C. This reduces the time and effort necessary to intervene in later life across multiple pathways of problem behaviors traceable to low C and other forms of personality risk.

2) **Socioeconomic Context.** Numerous factors are likely implicated in the development of low C. These include not only genetics and parenting, but also socioeconomic circumstances and
cultural norms. Efforts to enhance C at any point in the lifespan must attend to the interface of personality with socioeconomic context. Further work is needed of how personality and SES are reciprocally interrelated over the lifespan, and how their interface affects disease risk and course at different points. Careful study is therefore needed of whether social programs such as job training and continuing education, which aim to enhance the socioeconomic position, also impact aspects of C or other personality dimensions during adulthood.

3) Focus on Specific, Rather than Global Aspects of Personality During Adulthood. Although the Big 5 are never totally immutable, change in global dimensions is smaller and may take longer at later points in the lifespan. Because health-related prevention and intervention typically requires somewhat faster and more substantial changes in habits specific personality processes may prove more amenable targets than global dimensions. Candidates include both traditional social cognitive processes such as self-regulation and self-efficacy, and as well as skills such as risk evaluation and decision making.

4) Continued Research on Biological Aspects of Personality. Sociogenomic theory, personality neuroscience, and psychoneuroimmunology are building exciting new understanding of the biological bases of personality. Incidental observations from pharmacotherapy trials for other outcomes warrants further study of the role psychotropics may play in alleviating the general life risk and burden of maladaptive personality configurations. More basic science work in the genomic, brain imaging, and neuroimmune areas of personality can help refine such efforts.

5) Programs at Multiple Systemic Levels. Given its population impact, risk-prone personality configurations should receive the social and health policy attention of other public health problems. From a policy perspective, low C can be framed as “personal irresponsibility”, which is a more understandable concept to the lay public and individuals from other disciplines. Social
policy facilitating funding of early interventions represents one way to impact C in developing generations. Health policy encouraging personal responsibility for health will also serve to target some of the behavioral mechanisms through which low-C operates. From a practical standpoint, effecting policy-level interventions will require persuasion and communication in the idiom of public policy, which may differ from that behavioral science.

6) Personalized Medicine: Prevention and Personality in Risk Modeling. Current personalized medicine risk-assessment focuses on genetic information and neglects the additional information on gene-environment interaction and behavior encoded by personality phenotype. Such information signals propensity toward disease development prior to the appearance of signs and symptoms, and is thus critical for preventing disease emergence. Work is needed to incorporate relevant personality information into risk models. This involves two tasks: determining what personality information to include in such models, and determining how such information can be feasibly and expediently collected via screening and testing in medical settings. Both are priorities in the translation of basic personality science findings into health practice.

7) Personalized Medicine: Intervention and Personality in Targeting and Tailoring. A second important part of the personalized medicine movement is targeting and tailoring prevention and intervention strategies according to the individual information collected during risk assessment. Some research on differential effectiveness of health behavior interventions by personality exists, but more is needed. Also, health behaviors often represent proximal causes of disease. Personality may also affect responsiveness to traditional biomedical interventions via behaviors such as treatment adherence, or biological routes such as immune function. Treatment research must become more attuned to individual differences in treatment response so that interventions
can be allocated more cost-effectively to those who benefit and alternative approaches can be
designed for those who do not benefit.

Conclusion

Personality plays an important role in public health. Prevention and intervention efforts
aimed at global dimension of the Big 5 such as Conscientiousness may be possible, but other
options may be preferable depending on an individual’s point life stage of health trajectory
position. In some cases, altering specific personality processes such as self-discipline may be
sufficient to reduce life-course health risk. In many cases, traditional prevention programs and
behavioral interventions can be improved by targeting and tailoring them according to
personality. Translational work is needed integrating personality measurement into public health
and medical risk assessment practice. Greater attention is needed on how personality informed
prevention and intervention efforts operate in socioeconomic contexts. Finally, careful analysis
of social and health policy for personality, healthy and aging is needed, along with the ability to
communicate findings to policy makers. In the final analysis, personality plays an important role
in healthy aging that will receive increasing notice with the advance of personalized medicine.
Advances in the research will help translate personality science into evidence-based health
practices that can make a difference in successful population aging.
Table 1: Personality and Health Life-Span Intervention Cube Examples

<table>
<thead>
<tr>
<th>Systems Level</th>
<th>Big 5 Domain</th>
<th>Personality Process</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Life-Young Adulthood</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Intervention Target</strong></td>
<td></td>
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<tr>
<td><strong>Individual</strong></td>
<td>Parental socialization toward self-control and pro-social disposition</td>
<td>Ritalin to reduce self-regulatory difficulties</td>
<td>Token economy to enhance physical activity and healthy food choices</td>
</tr>
<tr>
<td><strong>Social System</strong></td>
<td>Family therapy preparing home environment for healthy personality development</td>
<td>Classroom: APA 3 R’s to enhance self-discipline and social skills</td>
<td>Exercise programs in schools</td>
</tr>
<tr>
<td><strong>Societal</strong></td>
<td>Youth-culture media figures modeling health-adaptive personal dispositions</td>
<td>Early educational intervention (i.e., Head Start) conveying training in goal setting and achievement</td>
<td>Age prohibitions against smoking and drinking</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Personality Process</th>
<th>Behavior</th>
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</thead>
<tbody>
<tr>
<td><strong>Midlife</strong></td>
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<tr>
<td><strong>Intervention Target</strong></td>
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<tr>
<td><strong>Individual</strong></td>
<td>Psychotropics affecting various self-regulatory capacities</td>
<td>Long term, depth psychotherapy to remediate maladaptive character propensities</td>
<td>Self-help literature improving health behaviors</td>
</tr>
<tr>
<td><strong>Social System</strong></td>
<td>Sweeping change in social / professional role demanding shift in basic disposition</td>
<td>Group psychotherapy to enhance interpersonal processes</td>
<td>Workout buddies, exercise classes to facilitate physical activity</td>
</tr>
<tr>
<td><strong>Societal</strong></td>
<td>Social upheaval: counterculture movement, economic depression altering fundamental worldview</td>
<td>Mass marketing glamorizing personal responsibility, beneficence</td>
<td>Taxation of unhealthy behavior to disincentive unhealthy dietary choices</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Systems Level</th>
<th>Big 5 Domain</th>
<th>Personality Process</th>
<th>Behavior</th>
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</thead>
<tbody>
<tr>
<td><strong>Older Adulthood</strong></td>
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<tr>
<td><strong>Intervention Target</strong></td>
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<tr>
<td><strong>Individual</strong></td>
<td>Pharmacotherapy improving serotonergic function</td>
<td>Reminiscence therapy improving emotion regulation</td>
<td>Assistive devices (pill counters, memory aids) facilitating health behaviors</td>
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<tr>
<td><strong>Social System</strong></td>
<td>Naturally occurring retirement communities (NORCS) promoting interpersonal traits</td>
<td>Bereavement support groups, activity clubs shaping emotion regulation and social cognition</td>
<td>Social service assistance programs (senior group exercise) enhance self-care skills</td>
</tr>
<tr>
<td><strong>Societal</strong></td>
<td>Increased funding for aging research, allowing older demographic to stave off declining health impact on basic tendencies</td>
<td>Prohibition of age discrimination in hiring decisions, allowing occupation to shape processes</td>
<td>Laws mandating handicap accessibility permitting more independent behavior</td>
</tr>
</tbody>
</table>

*Notes*: Examples of possible intervention and prevention initiatives from a personality-informed approach to healthy aging. Levels of social systemic generality and life course division are approximate and not intended to represent actual discrete categories. Personality operationalized according to integrated frameworks bridging trait, process, motive, and other perspectives. Big 5 dimensions are global classes of specific tendencies (Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness). Personality processes refer to more narrow aspects of personality, include specific traits (in a personality structure sense), social cognitive processes, and physiological processes. Behaviors refer to relatively specific health behaviors with demonstrated personality contributions. Division is for convenience purposes only and with an understanding of the importance of other possible classes of personality study such as motivation or personal narratives.
Table 2: Example Behaviors Associated With Conscientiousness, Indirect Health Relevance

<table>
<thead>
<tr>
<th>Jackson et al., 2010</th>
<th>Chapman and Goldberg, preliminary results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back out on appointments (-)</td>
<td>Played sick to avoid doing something unpleasant (-)</td>
</tr>
<tr>
<td>Ignore employer’s suggestions (-)</td>
<td>Misplaced something important (glasses, car keys, etc.) (-)</td>
</tr>
<tr>
<td>Work or study long hours (+)</td>
<td>Enrolled in a class (at a community center, university, or college) (+)</td>
</tr>
<tr>
<td>Persist at tasks after meeting setbacks or failures (+)</td>
<td>Swore around other people (-)</td>
</tr>
<tr>
<td>Lose something important in the clutter of my living quarters (-)</td>
<td>Broke a promise (-)</td>
</tr>
<tr>
<td>Have trouble deciding what to do with my day (-)</td>
<td>Slept past noon (-)</td>
</tr>
<tr>
<td>Watch TV or go on the internet instead of taking care of responsibilities (-)</td>
<td>Lounged around my house without any clothes on (-)</td>
</tr>
<tr>
<td>Allow trash to overflow from a container (-)</td>
<td>Arrived at an event more than an hour late (-)</td>
</tr>
<tr>
<td>Belch in public (-)</td>
<td>Let work pile up until just before a deadline (-)</td>
</tr>
<tr>
<td>Go shopping with a list and only buy things on the list (+)</td>
<td>Chewed on a pen or pencil (-)</td>
</tr>
<tr>
<td>Use slang terms or cursing when speaking to my boss (-)</td>
<td>Drank five or more cups of coffee a day (+)</td>
</tr>
<tr>
<td>Borrow something and lose it, break it, or never return it (-)</td>
<td>Obtained stock market prices (+)</td>
</tr>
<tr>
<td>Double check my work (+)</td>
<td>Had an overdue fine for a movie rental or library book (-)</td>
</tr>
</tbody>
</table>

Notes: + indicates that the behavior is positively associated with Conscientiousness, - that it is inversely associated with Conscientiousness. Jackson et al. developed a theory-driven taxonomy of Conscientious behaviors. Chapman and Goldberg are conducting behavioral expression analysis of 400 candidate act frequencies using a gene expression analysis paradigm.
Figure 1: Web of Complexity (Feedback Loops Not Shown)

Hierarchically Organized Traits

Conscientiousness

- C1
- C2
- C3
- C4
- C5

Cognitive / Affective Processes

- Decision Making
  - Risk preferences
  - Delay - Discounting
- Social Cognition
  - Self-monitoring
  - Self-efficacy
  - Self-regulation
  - Goal Setting
- Social / Emotional Process
  - Affect regulation
  - Social motivation
  - Role engagement
  - Social reliability

Intermediate Social / Behavioral Outcomes

- Daily Health Behavior
  - Activity
  - Diet
  - Tobacco
  - Alcohol
  - Risk-taking
- Health Service Use
  - Preventive Care
  - Timely treatment
  - Adherence
- Social Activity
  - Loneliness
  - Conflict
  - Role Under/ Overextension

Biological Outcomes

- Overweight / Obesity
- Endocrine / Immune Dysregulation
- Illness Burden Accumulation
  - Hypertension
  - Diabetes
  - CVD
  - Dementia
  - Cancer
  - Arthritis
  - COPD
  - Others

Neural Substrates of Effortful Control

- Prefrontal Activity
- Serotonergic systems

Chronic Stress Response

- HPA Axis Overactivity
- SNS Overactivity

Genetics & Environment

Intermediate Biological Processes
Figure 2

Systemic Level

Exo: Societal - Cultural

Meso: Social System

Micro: Individual

Lifespan Period

Early

Mid

Late

Big 5 Dimension

Personality Process

Behavior

Intervention Target


NIA / OBSSR Conscientiousness & Healthy Aging Interventions Group


