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Understanding Conscientiousness Across the Lifecourse: An Economic Perspective*

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The role of Conscientiousness in healthy aging is a topic of increasing interest in public health relevance. It is at the interface of personality psychology and lifecourse health development studies. The papers in this special issue of *Developmental Psychology* constitute a useful summary of recent developments in the field and analyze the Conscientiousness–aging relationship from different perspectives. In this commentary, we discuss some of these papers, drawing on a coherent economic framework developed in our work that helps to systematize, qualify, and interpret the existing evidence and that provides guidance on areas that would be fruitful subjects for future research.

Our research has two main ingredients: (a) models for measuring psychological (and other) capabilities and (b) models describing their evolution over the life cycle. We describe these in turn.

Psychological capabilities are skills that evolve over the life cycle, not fixed “traits” that are set at conception or birth. This is consistent with a large body of evidence summarized in Borghans et al. (2008) and Almlund et al. (2011) and some of the papers in this issue that show that psychological capabilities change over the lifetime, although there is substantial persistence in them.

All psychological measures, including measures of Conscientiousness, are based on performance on tasks, broadly defined

Tasks include performance on tests or other assessments. They also include measured conduct towards others as well as oneself—self-control, temperance, and excess.

Psychologists often distinguish their measures from behaviors, not recognizing that their

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measures are just particular types of behaviors. In our view, both measures and behaviors are manifestations of vectors of individual capabilities θ_t at age t in specific situations that may elicit different behaviors. Capabilities include cognition θ_t^C , personality characteristics θ_t^P , and health and mental health θ_t^H . Outcomes for $Y_{j,t}, j = 1, \dots, J, t = 1, \dots, T$ depend on the capabilities to different degrees for different tasks (j) at different stages of the life cycle t . The dimensionality of θ_t may increase as people mature and exhibit more complex personalities. Outcomes also depend on effort $e_{j,t}$, applied at stage t to task j . The effort in turn may depend on both the private and social rewards $R_{j,t}$ to performing task j .

All measurements are performance measures for the tasks:

$$Y_{j,t} = \phi_{j,t}(\theta_t, e_{j,t}) \quad \begin{matrix} j = 1, \dots, J, \\ t = 1, \dots, T, \end{matrix} \quad (1)$$

where T is the last stage of life and where effort depends on rewards for performance in task j at stage t , $R_{j,t}$. Thus

$$e_{j,t} = \varphi_{j,t}(R_{j,t}). \quad (2)$$

Substituting (2) into (1), we obtain performance on task j at age t :

$$Y_{j,t} = \phi_{j,t} \left(\underbrace{\theta_t}_{\text{capabilities}}, \underbrace{\varphi_{j,t}(R_{j,t})}_{\substack{\text{rewards} \\ \text{effort}}} \right). \quad (3)$$

This equation captures the essence of the “person–situation” debate. Capabilities (“traits” at age t) affect performance, but so do incentives, which in turn depend on rewards in a situation. No single task is privileged for defining or measuring capabilities, although scholars proceed as though there were such tasks but differ in the specification of which tasks capture which measures. Even scores on IQ tests are affected by incentives and by other traits (see the evidence cited in Borghans et al., 2008). Different capabilities are differentially productive in different tasks. Equation (3) instructs us that analysts of the effects of Conscientiousness (and other psychological measures) need to standardize all measures of capabilities by (a) the incentives to perform on the task used to measure capabilities and (b) the other capabilities of the person. Borghans et al. (2008) show that less Conscientious people respond more to rewards for performance on IQ and achievement tests. The more Conscientious are already working full tilt.

To our knowledge, current studies in psychology ignore this basic point and uncritically equate performance measure $Y_{j,t}$ with capabilities, usually assuming that one measure—say, j —captures “trait” or “capability” $\theta_{j,t}$ at age t . It would be fruitful in comparisons of measures across tasks to perform this standardization. Failure to do so leads to a bewildering array of measures for the same capability and differences across studies. An empirical measure of the importance of effort and capabilities in shaping performance would be informative on the relative importance of the “situation” and the “person” in determining outcomes. See the discussion in Almlund et al. (2011) and in Epstein (1979).

The literature also shows that the capabilities that shape performance on tasks change over the life cycle in a way that depends on experience and investment. Capabilities θ_t are not solely genetically determined. They are also produced, starting early in the life of the child. Their evolution over time can be represented by the following equation for the dynamics of capability formation (Heckman, 2007):

$$\theta_{t+1} = f_t(\theta_t, I_t, \theta_t^F). \quad (4)$$

This equation captures the notion that the development of child and adult capabilities in subsequent periods (θ_{t+1}) depends on the stock of capabilities already present (θ_t) and on family traits and environments (θ_t^F) and investments (I_t), starting with the initial endowments determined at conception (θ_0), which are a function of maternal investments in pregnancy. It also captures the idea that capabilities at one age enhance capabilities at later ages. Figure 1 provides a graphical representation of the framework. It makes clear that cumulative processes unfold over the life cycle and that both environments and capabilities are determinants of investments.¹

Among the papers in this special issue, one attempt to conceptualize a life cycle model that encompasses several main determinants of health is Friedman et al. (2012). The authors of this paper include, among the elements of their “full causal model,” “traits” (really “capabilities” or “skills”) that evolve over time, healthy behaviors, social relationships, health status and biological determinants, in an array of uni- and bidirectional influences. However, they do not consider cognition or distinguish between choices (education, marriage, smoking) and health stocks affected by those choices.² Our framework, instead, clearly distinguishes among the choices the agents make—first the parents (by choosing how much to invest in their children), and then the children themselves (once able to make their own choices)—and the stocks of capabilities, which are affected both by those choices and by other stocks (through self- and cross-productivity).³ This distinction is particularly important: the fact that agents make choices needs to be taken into account. However, this is not usually done in this literature, and it is not clear how problems of endogeneity or reverse causality are dealt with and or how causality is established. In the following sections we show how our framework is useful to model both the expression and the evolution of capabilities and to establish causality and interpret the effects of interventions.

The Expression of Capabilities: A Measurement Framework

The first aspect that the framework captures in a coherent way relates to issues of measurements. The capabilities are modeled econometrically as latent variables with numerous error-ridden proxies for each component. A commonly used linear specification

¹During childhood, this implies that parents make investment choices both as a function of their own traits and of the capabilities of the child, as well as in reaction to shocks unobserved by the analyst (for example, more educated parents might invest more in their children, or parents can decide to spend more time engaging in learning activities with smarter children, or may spend more money in medical treatments if the child is hit by a health shock).

²In particular, their “biological base” includes both smoking and drinking in pregnancy (prenatal choices made by the mother, I_t in our framework), and the formation of neural synapses (a health capability, θ_t in our framework).

³For self- and cross-productivity, we mean that a higher stock of capabilities at time t fosters higher stocks at time $t + 1$, either of the same type (in the case of self-productivity) or of the other types included in the θ_t vector (in the case of cross-productivity).

writes for measurement vector Y : $Y_t = \mu_t + \alpha Q_t + v_t$, where Y_t is a vector of measurements at age t , Q_t is a vector of factors (capturing θ , I_t and θ_t^P), v_t is measurement error, and μ_t can depend on observed characteristics that we keep implicit here. General models for measurement error with nonlinear relationships have been developed (Cunha, Heckman, and Schennach, 2010). Accounting for measurement error has been shown to be empirically important (Cunha and Heckman, 2008; Cunha, Heckman and Schennach, 2010; and Conti, Heckman and Urzua, 2011). In multiple data sets the fraction of variance of the measurements due to measurement error varies with the measuring instrument used, and in general it is non-negligible. Nonetheless, many of the papers in the special issue use the unadjusted (for incentives and situations) measurements as error-free proxies of the underlying “traits.” This might be especially problematic, given that in more than one instance, reports are provided by different observers (e.g., parents and teachers) and are also elicited using different methods, ranging from self-reports to more objective, laboratory-based measures. These different instruments might all measure the same trait with different margins of error, and they might also be affected by different determinants.⁴ In addition to these measurement issues, there is a lingering question about the number and the structure itself of the “traits” that underscores many of the contributions in the special issue. First, a common theme spanning the various papers is the lack of a general agreement about the hierarchical organization of the component traits of Conscientiousness, despite a similarity in the definitions used in the literature for Conscientiousness itself. This is the case not only for adult Conscientiousness, but also when researchers try to identify similar traits in children. For example, Eisenberg et al. (2012) adopt a broad definition, given that, among the works cited in their extensive review on the childhood origins of Conscientiousness, there are papers like the ones by van Lieshout and Haselager (1994) and by Mervielde, Buyst, and de Fruyt (1995) that obtain childhood Conscientiousness factors that load on intellectual capacity and curiosity/exploring (the former) and on intelligence and creativity (the latter). Similarly defined traits are “operationalized” using different measurements across different studies.⁵ There is no control for the “other” capabilities that might affect the measurement of any particular capability. In the end, it is not surprising that when children enter school, there are aspects of their personality that reflect their tendency to focus attention and control impulses, to be diligent and careful, and to be motivated and attentive in class, which are predictive of long-term outcomes. It is, however, somewhat surprising that, in their search for the early origins of Conscientiousness, Eisenberg et al. (2012) ignore the literature in psychiatry and mental health. This is especially striking since, for the first time, this year mental health problems have displaced physical conditions as the leading causes of disabilities in U.S. children (Slomski, 2012). Other papers in the volume, such as Roberts et al. (2012), give definitions both on the positive and on the negative sides of the spectrum when reviewing the different facets of Conscientiousness.

Another issue raised by Roberts et al. (2012) as a critical goal for future research is the need to develop new psychometric work, more advanced than the classic multitrait–multimethod

⁴As a side note, one might also wonder how implicit/behavioral and explicit measures of Conscientiousness can be uncorrelated and yet measure the same construct (Roberts et al., 2012).

⁵While the body of literature reviewed in Eisenberg et al. (2012) is vast, in no instance are the items or measurements used to identify the various constructs compared, or the methods used to aggregate them into factors and analyze them mentioned.

approach, to judge whether a construct belongs to a domain or not. This need arises because Conscientiousness itself as measured in adults is correlated with several other traits, such as delay of gratification (Mischel, Shoda, and Rodriguez, 1989), ego control (Block and Block, 1980), and effortful control (Kochanska, Murray, and Harlan, 2000) in developmental psychology; self-control (Baumeister et al., 2007) and self-regulation (Carver and Scheier, 1998) in social psychology; impulsiveness (Eysenck, 1958) and constraint (Watson and Clark, 1993) in clinical psychology; and grit (Duckworth et al., 2007) in positive psychology—to the point where the reader is left wondering what is the benefit of having so many correlated traits defined with different names and measured with different instruments, and what any particular measure means, absent control for other “traits.”⁶ Finally, the experimental measures of Conscientiousness (e.g., the Marshmallow Test) appear to proxy for constructs similar to what economists define as time preferences, as noted in Almlund et al. (2011). However, the few papers in the economics literature that have investigated the relationship between preference parameters and Conscientiousness have found low and insignificant correlations among them (Becker et al., 2012).⁷

In sum, there is clearly a need to develop and routinely apply robust methods for assessing the dimensionality of the broad array of facets that have been associated with the domain of Conscientiousness and the measurements proxying the various dimensions, without relying on constructs pre-specified on a theoretical basis or arbitrarily chosen threshold rules for the factor loadings and the inter-trait correlations.

Conti et al. (2013) make a step forward in this direction. They develop a novel Bayesian Exploratory Factor-Analytic (EFA) procedure that neither pre-specifies the numbers of latent factors underlying a set of measurements nor relies on predetermined allocation of measurements to factors. Instead, the Bayesian EFA they propose simultaneously allows determination of the number of factors underlying the set of observed measurements and allocation of the measurements to the factors. Additionally, they confirm that the different tests and procedures routinely used in psychometrics to infer the number of latent factors give quite different answers, even when applied to the same set of data.

In the end, despite the wealth of research reviewed, the reader is left with doubts. If personality cannot yet be measured in a reliable way—especially to track changes over time—then all the conclusions reached in the various studies have to be reconsidered with great care.

⁶In this regard, the analysis by Drake et al. (2012) suggests that, although correlated, these traits could have different determinants. The authors find that secure child–parent attachment among preschoolers is only predictive of social self-control, not of task persistence or effortful control, three traits which are all correlated with Conscientiousness. The authors argue that this occurs because, according to Bowlby’s (1969) theory, children use parents as a secure base to explore the environment; hence, it makes sense that parent–child attachment is predictive of an aspect of personality that measures behavioral and emotional regulation in social contexts.

⁷Interestingly, both Rustichini et al. (2012) and Becker et al. (2012) have found that personality and preferences both contribute independently in explaining the variance of the outcomes. On the other hand, these studies have reported a sizeable and significant correlation between cognitive ability and time preferences, and—among the Big Five—between Agreeableness and time preferences (but not between Conscientiousness and time preferences).

The Evolution of Capabilities: A Dynamic Framework

Second, our framework produces a coherent developmental perspective for the childhood precursors of Conscientiousness. Rather than conceptualizing self-regulation in childhood and Conscientiousness in adulthood as two different traits (as implied in Eisenberg et al., 2012), within a developmental perspective they are more coherently modeled as one trait that evolves over time, although new aspects of self-control may emerge with the stage of the life cycle as people mature. (The dimension of θ_i may increase.) This point is suggested in Roberts et al. (2012), who note, “We believe there is a key piece of evidence from development research that tips the evidence in the direction of the latent trait model” and conclude that “well-informed longitudinal studies tracing the development of Conscientiousness and its formative antecedents from childhood to adulthood would appear imperative.” Operationalized by estimating a dynamic latent (multi)factor model, the framework also allows for the capabilities to be proxied by different measurements at different ages, both in terms of type and number (as noted in Friedman et al., 2012, this is necessary to measure change across development); for these different measurements to be affected by different determinants and to also have different error components (even allowing for nonclassical measurement error); and for the number of capabilities to change over time⁸ and to be affected by different inputs. Indeed, as noted in Drake et al. (2012), different traits can emerge at different developmental phases, can causally influence traits emerging at a later time, and can have different developmental determinants. The need for more complex longitudinal models is advocated by Friedman et al. (2012), who note that none of the existing approaches “can explain what happens when personality matures or changes” and that there is a need to account for “intervening processes” that act between early life events and health effects decades later. Additionally, our dynamic framework not only allows for personality to affect health, but also incorporates feedback loops from health to personality. This is quite an important aspect, since most studies do not account for the possibility that health and personality exhibit dynamic complementarities over the life cycle. Such a framework is formally modeled in Heckman and Mosso (2013).

In conclusion, the framework underlying Figure 1 provides a deeper understanding of the mechanisms through which early life conditions are translated into late life health outcomes, as well as the role played by traits developed at different stages of the life cycle, which are necessary to develop more informed interventions.

The Causal Status of Conscientiousness

Third, important issues concerning causality are neglected in the papers. A common feature of all the papers reviewed is that most of the evidence presented is correlational. It seems that personality psychologists have not yet attempted to establish the causal status of Conscientiousness. As such, it is hard to say whether Conscientiousness matters *per se*, or whether it is merely proxying for unobserved factors that are also correlated with the outcomes of interest. Yet for policy purposes, it is fundamental to know the mechanisms of causation in order to explore the relevance of different interventions. This concern seems of particular relevance, especially because many studies do not control for other (non-

⁸This is what Caspi, Roberts, and Shiner (2005) refer to as “factorial changes” in personality.

personality) traits of the individual; for example, cognition or health, which—as the framework makes clear—can generate cross-effects with personality. One study that constitutes a significant departure from the rest of the literature, since it both adopts a longitudinal design and also controls for differences in intelligence, is Moffitt et al. (2011). Hence, it is encouraging that the contribution by Friedman et al. (2012) stresses the need to move beyond the vast body of cross-sectional correlational evidence in search of the causal mechanisms linking Conscientiousness and health. The authors recognize that both Conscientiousness and health could be caused by genetic factors and/or early life stressful experiences, and they conclude by explicitly stating that “some of the links between Conscientiousness and health are *noncausal*.” In this light, it is somewhat surprising that Roberts et al. (2012) advocate for much more research on understanding “what Conscientiousness is and where it comes from” solely on the basis of the “impressive predictive capability of the trait,” and that Chapman et al. (2012) indicate personality as an optimal target for health promotion interventions on the basis that it represents the “*causal* root of numerous problem behaviors and their health consequences.” Unless a causal basis for the effect of Conscientiousness is established, it is premature to advocate policies that promote it. This perspective is in stark contrast with the more scientific approach put forward in Friedman et al. (2012), who call for carefully designed randomized intervention trials to check the malleability of personality and its causal role—if any—in promoting behavior change.

Recent work in economics identifies the causal effects of personality traits on a variety of outcomes, starting with the contribution of Heckman, Stixrud, and Urzua (2006) under conditions specified there. Building on their work, Conti and Heckman (2010) and Conti, Heckman, and Urzua (2010) investigate the developmental origins of the education–health gradient by estimating a model in which early life capabilities affect the educational choices individuals make, and in which both these capabilities and education affect a variety of adult outcomes. They conceptualize child capabilities as being three-dimensional (cognition, self-regulation, and physical health)⁹ and proxy each dimension with a variety of indicators (cognitive test scores, personality scales, and anthropometric indicators, respectively), using rich data from the British Cohort Study (the 1970 cohort). They decompose the disparities in health by education into a selection component due to early life factors (more educated individuals, for example, might smoke less because they have greater self-regulation, which is correlated with both the educational choice and the health behavior) and a causal component, the “treatment effect” of education (for example, more educated individuals smoke less *because* of their higher education). A by-product of this exercise is the estimation of the causal effects of early life capabilities on education and adult outcomes. They obtain several important results. First, they show that early life factors (both child capabilities and family environments) explain a sizeable proportion of the gradient and explain a bigger proportion of the education gradient in health than in healthy behaviors. Second, they show that, while child cognition is the main determinant of educational choices and labor market outcomes, it plays very little role in determining health and healthy behaviors, especially for males. However, its effect is vastly overstated if personality traits

⁹This assumption is relaxed in Conti et al. (2013).

are not properly accounted for.¹⁰ Third, they show that both non-cognitive dimensions (self-regulation and early physical health) are important determinants of adult outcomes, of equal strength for the non-labor market outcomes. Among other recent work in economics, for its relevance to the subject at hand, is the work of Savelyev (2013), who investigates the effects of childhood Conscientiousness and post-compulsory education on longevity using a sample of high-ability individuals from the Terman data. Unlike previous work in psychology, he carries out detailed Exploratory and Confirmatory Factor Analysis (EFA and CFA), uses both parents' and teachers' ratings and explicitly accounts for measurement error, and allows for residual unobserved heterogeneity using latent classes (Heckman and Singer, 1984). He finds that Conscientiousness strongly affects both education and longevity, and that Conscientiousness and education are substitutes in the production of longevity. This latter result is in line with the findings of Conti and Heckman (2010) and Conti, Heckman, and Urzua (2010), who also find evidence of substitutability between self-regulation and education in the production of healthy behaviors.

Interventions to Promote Conscientiousness

Another important aspect to be discussed, which is mentioned to different degrees in many of the papers in the special issue, is the malleability of Conscientiousness. The most convincing evidence that personality can change is certainly provided by brain lesion studies (Damasio, 2005). Additionally, a few other recent studies—not mentioned in the otherwise exhaustive review by Chapman et al. (2012)—show that it is possible to change preferences and personality through experiments that change brain chemistry.¹¹ However, even if these studies provide convincing evidence that personality can be changed, the interventions studied are certainly not a viable option for large-scale interventions. Our framework suggests different avenues through which private (e.g., parenting) and public (e.g., child care) investments can causally affect personality traits.

First, differently from growth curve models, our framework allows for investments and interventions to shift developmental trajectories. Importantly, as already mentioned, it also accounts for the endogeneity of parental investments; i.e., for the fact that parents *choose* how much to invest on the basis of child traits, parental attributes, and shocks unobserved by the analyst. Cunha and Heckman (2008) and Cunha, Heckman, and Schennach (2010)¹² estimate technologies of skill formation to understand how the skills of children evolve in response to the stocks of skills children have already accumulated, the investments made by their parents, and the stocks of skills accumulated by their parents. Although they do not directly consider Conscientiousness, the measure of child traits they use (the Problem Behavior Index from the CNLSY¹³) shares many facets with what Eisenberg et al. (2012) define as the childhood antecedents of it. Among their main findings: Personality fosters the development of cognition, but the reverse is not true; it is equally easy to compensate for

¹⁰Conti and Hansman (2012), using data from the National Child Development Study (the 1958 cohort), also show that child personality contributes to the education–health gradient to an extent nearly as large as that of cognition.

¹¹For example, Figner et al. (2010) show that magnetic disruption of the lateral prefrontal cortex can increase experimentally elicited discount rates.

¹²Cunha, Heckman, and Schennach (2010) exploit “exclusion restrictions” (i.e., variables that affect parental investments but do not directly affect the development of capabilities), such as parental resources, to identify the effects of parental investments.

¹³The Children of the National Longitudinal Survey of Youth.

deficits in personality in both childhood and adolescence (while this is not the case for cognition); and personality explains 12% of the variation in educational attainment (vis-à-vis the 16% explained by cognition).

Although they do not carry out a fully fledged dynamic analysis and do not explicitly account for the endogeneity of parental investments, the contribution of Drake, Belsky, and Fearon (2012) is one of the few papers to study the developmental precursor of Conscientiousness, in particular the role of attachment. They estimate latent growth curve models of the effect of attachment (measured at 15 and 36 months) on social self-control and task persistence (measured in grades 1–5), using rich data from the NICHD-SECCYD.¹⁴ They show that children who are securely attached score higher on effortful control as measured by a continuous performance test with a computerized task at 54 months and on social self-control (as rated by the teacher) at grade 1 (but not beyond) than do insecurely attached children, while no effect is found for task persistence. Additionally, they show that social self-control has a significant role as mediator between attachment at both 15 and 36 months and school engagement in grade 5. Although nicely done, their analysis could be fruitfully recast within our framework. First, additional dynamics would be accounted for, so that attachment at 15 months would be an input in the production of attachment at 36 months; in turn, this would be an input, together with other forms of parental investments, in the production of social self-control, task persistence, effortful control, and school engagement in grade 1—which would all be inputs (and outputs) until grade 5, so that this extended model would also account for feedback effects. Despite these limitations, the paper by Drake, Belsky, and Fearon (2012) is an important contribution that investigates the role played by parent–child attachment in the development of self-regulation—which has been relatively understudied so far. On the one hand, most of the available human evidence comes from observational data (Kochanska, 2001); on the other hand, the importance of early attachment for the development of self-regulation is well supported by experimental evidence on nonhuman primates. Rhesus monkeys that have not established a secure attachment relationship with a primary caregiver have been shown to develop both behavioral (Suomi, 1999) and mental health problems (Conti et al., 2012).¹⁵

Second, our framework facilitates investigations of how public investments (early child care, education, job training programs) change traits, starting in early childhood. Indeed, one of the best examples of the power of interventions in changing personality is provided by the Perry Preschool Program. This intervention, which enriched the lives of low-income black children with initial IQs below 85 at ages 3 and 4, did not have a lasting effect on cognition, but it did improve several life outcomes through changes in personality—in particular, through a reduction in externalizing behavior (Heckman et al., 2013), which is related to Conscientiousness, as noted in Eisenberg et al. (2012).¹⁶ Campbell et al. (2013) provide evidence that Conscientiousness is the main mediator of the effect of the treatment for the ABC program on a reduction of smoking prevalence in the treatment group, as compared to

¹⁴The NICHD Study of Early Child Care and Youth Development.

¹⁵Interestingly, while reversibility has been shown for social disorders (Suomi, Harlow, and Novak, 1974), mental health problems seem to display more persistent effects (Conti et al., 2012).

¹⁶The children were taught valuable skills through “plan-do-review” activities, in which they first planned a task, then executed it, and then reviewed it with teachers in front of their peers.

the control group, at both ages 27 and 40. Similar changes in personality, which led to improvements in adult earnings, have also been found in Project STAR (Chetty et al., 2011) and the Montessori preschool curriculum (Lillard and Else-Quest, 2006). Also, specific interventions have shown that training children for attention using computerized tasks can have beneficial effects (see, e.g., Rueda et al., 2005). Additionally, education itself can change personality, although its effect varies depending on the trait considered and the qualification attained (Heckman, Stixrud, and Urzua, 2006; Heckman, Humphries, and Veramendi, 2013).¹⁷ Heckman and Kautz (2014) summarize a large body of evidence. Finally, although limited (and not clear-cut in the case of cancer), the evidence on the effectiveness of hostility-reducing interventions in lowering blood pressure (Gidron et al., 1999) and of chronic negative affect-reducing psychotherapy on increasing survival of patients after a heart attack (Denollet and Brutsaert, 2001) seems promising. As a complement to early childhood interventions, an interesting area to pursue in the future would be to study the persistence over time of the changes observed in adults in the above-mentioned psychotherapy trials, whose follow-up periods have been months, not years—with rare exceptions (Bateman and Fonagy, 2009). Overall, our developmental framework allows recasting the role of interventions to promote healthy aging in a life cycle perspective, rather than focusing on those aimed at adults. At the same time, it is flexible enough to allow for later interventions to take place.

Third, Chapman et al. (2012) identify two ways in which personality can inform interventions to promote healthy aging: first, by devising interventions promoting personality change;¹⁸ second, by tailoring interventions according to personality characteristics. Given the distinction made between capabilities and investments/environments (and the careful modeling of the choices individuals make), our framework also allows tackling this second aspect, by going beyond mean effects to look at distributions and treatment effect heterogeneity.¹⁹ Conti and Heckman (2010) provide a general framework to operationalize and interpret the abundant evidence in child development on differential susceptibility; for example, on the fact that parenting has differential effects depending on the child's genetic endowment (see, e.g., Kochanska et al., 2011). Van IJzendoorn and Bakermans-Kranenburg (2012) also advocate the need to go beyond correlational designs and to rely on randomized controlled trials to study how interventions have differential effects as a function of genetic endowments. Along these lines, our framework allows analysts to study heterogeneity in the effects of interventions according to both genetic and personality characteristics, as advocated in Chapman et al. (2012) and formalized in Conti and Heckman (2010), in order to target interventions to those individuals who are more likely to gain from them.²⁰ Understanding the different mechanisms and the complex pathways that lead to different health outcomes is critical for developing effective interventions, as noted in Friedman et al. (2012).

¹⁷Almlund et al. (2011) provide additional evidence that some adolescent and adult interventions can induce changes in Conscientiousness.

¹⁸With reference to this aspect, and in addition to what mentioned above, it seems that more work also needs to be done in building bridges between intervention and personality research, given that the former is often designed in terms of reduction of low Conscientiousness as a risk factor, while the latter mostly studies Conscientiousness as a continuous measure.

¹⁹As Eisenberg et al. (2012) put it, "[...] an overreliance on methods useful for detecting main effects limits the understanding of how the reviewed processes operate for children living in different environments or for children who have different assets or risks."

Finally, for the purpose of policy analysis, it is also important to know at which stages of the life cycle interventions are most cost-effective. As noted in Chapman et al. (2012), the cost-effectiveness of the various interventions needs to be taken into account: some may be cheaper, but obtain more focused results, while others (such as ECIs) might be more expensive, but obtain more global and long-lasting changes in health behavior. In particular, rigorous cost-effectiveness analyses should be carried out in relation to personalized interventions, both individual healthcare interventions and public health programs tailored to a specific target population. It is clear that the costs involved, both in the ideation and in the execution, are not negligible; however, it is not equally clear that there will be a corresponding increase in the benefits.

Conclusions

Although a substantial body of research has already been carried out on the relationship between Conscientiousness and healthy aging, in many respects the field is still in its infancy. The first topic that needs substantial work is the definition itself of Conscientiousness. On the one hand, for the survey-based measures, researchers are not in agreement about the different facets of the trait. On the other hand, the measures derived from observational and experimental methods are not all that well correlated. Fundamental measurement issues are not addressed, and measures are not standardized. Psychologists often uncritically equate measures with “traits.” The second aspect that needs thorough investigation is that related to the *causal* role of Conscientiousness in affecting health. While its predictive power has now been established, in order to justify designing policy interventions to increase Conscientiousness, causal knowledge is required. Third, once the causal role of Conscientiousness has been established, an investigation of the mechanisms through which it affects health would allow the design of better interventions. As a complement to the last two aspects, a better understanding of the developmental origins of Conscientiousness would allow to design interventions across the lifecourse, *preventing*, rather than curing, disease. All of these represent exciting avenues for future research.

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²⁰Conti and Heckman (2010) show that, for example, the effect of education on reducing smoking is stronger for individuals with higher cognition and lower self-regulation. Using a similar model, Conti et al. (2012) study the effects of maternal capabilities (cognition, personality, and health) and investments (education and smoking in pregnancy) on newborn health (the probability of being born SGA, Small-for-Gestational-Age), and show significant treatment effect heterogeneity, in particular that women with a poorer physical constitution are more likely to suffer the harm from smoking.

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Figure 1.
A Life Cycle Framework for the Development of Capabilities