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A life course approach to the development of mental skills

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Abstract

A wide variety of factors across the life course jointly influence cognitive and emotional development. Indeed, research from a variety of disciplines strongly suggests that cognition and mental health are intertwined across the life course, by their common antecedents and underlying physiology in development, and in their interplay across adult and later life. We suggest that cognitive and socio-emotional function fuse to form skills for life supporting self-regulation, competence and quality of life that persist into later life, through linked reciprocal processes of genetic influence, nurturing, schooling, work, and lifestyle.

Keywords

cognitive; emotional; life course; skills; self-regulation; mastery; wisdom

A. Introduction

Research from a variety of disciplines shows that cognition and mental health are intertwined across the life course, by their common antecedents and underlying physiology in development, and their interplay across adult and later life. We suggest that cognitive and socio-emotional function gradually fuse to form skills for life, with implications for mental and physical health in ageing, as implied by Rutter a quarter of a century ago:

“... what is needed for optimal cognitive development is a combination of active learning experiences that promote cognitive competence together with a social context in which the style of interaction and relationships promotes self-confidence and an active interest in seeking to learn independently of instruction.” (Rutter, 1985, p. 699).

This echoes earlier views still; the sociologists Bowles and Gintis (1976) were among the first to highlight the importance of ‘non-cognitive’ skills (e.g. conscientiousness, tenacity) in educational and occupational achievement; this has gained currency in other disciplines, particularly economics (e.g. Heckman & Rubinstein, 2001). As we will attempt to show, this fusion of cognitive and emotional processes has long-term resonance for the development of human agency. This article is not specifically oriented to the life course origins of cognitive decline and psychiatric illness (Whalley, Dick & McNeill, 2006; Rutter, Kim-Cohen & Maughan, 2006). Rather, we are concerned with a life course approach to the development of competence and quality of life, which we regard as returns to life skills.

With regard to terminology, life course epidemiology, which investigates the independent effects or interactive effects of intrauterine, childhood, adolescent and adult risk and protective factors on adult health and disease (Kuh, Ben Shlomo, Lynch, Hallqvist & Power, 2003), borrows concepts from lifespan psychology and life course sociology traditions. The former refers to individual development (ontogenesis) of biologically-based capabilities, in this context those of higher mental function; whereas the latter addresses the embedding of individual lives into social structures over the lifetime (Mayer, 2003). We should note however that the issue of social change is beyond our present reach. The historian Gillian Sutherland (2010) vividly illustrates the complexities of social and policy-led changes since World War 2 in a single structure (education) in a single country (the UK) and its differing regions, in a manner suggesting that the assimilation of cohort effects into the present article would be a formidable task.

B. Early influences on cognitive and emotional development

1. Genetic influence

As O'Donovan and Owen (2009) note, "with its role in human adaptability and survival, it would be remarkable if traits that result from variation in brain function were not influenced in part by genes". In fact evidence suggests that the brain is at its most environmentally plastic in very young childhood, with heritability of general cognitive ability at approximately 30% at this stage, rising over the life course to as much as 80% in older adults (Deary, Johnson & Houlihan, 2009). This increase may partly result from a gradual matching to environment, i.e. a reciprocal causation between cognitive ability and environment leading to gene-environment correlation (Dickens & Flynn, 2001; Rodgers & Wänström, 2007); and also from increasing genetic influence on neural processes with age (Lenroot et al., 2009). Later still in the life course, the operation of neural defense and repair mechanisms, themselves under genetic control, may become important as the brain accumulates insults (Deary et al., 2009). In comparison, the heritability of major depressive disorder is estimated to be approximately 50%, with around 55% of the genetic risk shared with the dimensional trait of neuroticism (Levinson, 2006). Like cognition, there is some evidence that the heritability of emotional problems increases with age, explained in part by an increase in gene-environment correlation through negative life events (Rice, Harold & Thapar, 2003).

In additions to any effects of the DNA sequence, genetic influence on mental development also occurs through epigenetic alteration of gene expression during interaction with the environment. In animal studies, offspring of high-nurturing mothers (in terms of licking or grooming) tend to have relatively low levels of anxiety (Gottlieb, Wahlsten & Lickliter, 2006; Meany & Szyf (2005). They also show an attenuated hypothalamic-pituitary-adrenal (HPA) axis response to stress, and higher levels of glucocorticoid receptor gene expression in the hippocampus (with parallel implications for cognition), a difference in methylation that persists across the life course. This epigenetic alteration almost certainly occurs in humans, and information is accumulating about the way this affects risk of neurocognitive disorders (Urduingio, Sanchez & Esteller, 2009). For example, parental age shows an inverted-U relationship with cognitive development (Malaspina et al., 2005), where the effect of older fatherhood in particular is thought to reflect de novo mutations or abnormal methylation of paternally imprinted genes. Parental age is also positively associated with risk of psychiatric disorder (Durkin et al., 2008). In both cases these effects are of public health concern in view of steadily increasing mean parental age in middle and high income countries (Durkin et al., 2008).

Looking ahead to old age, epigenetic alteration has been implied or implicated in the development of Alzheimer's disease (AD) (Deary et al., 2002; Wang, Oelze & Schumacher,

2008; Chouliaras et al., 2010), although it is currently unclear when in the life course such epigenetic drift begins.

2. Influence of the uterine environment

Neural development begins soon after conception, and by the time of birth head circumference, an index of brain volume, is far closer to its final size than the rest of the body. A traditional focus in life course epidemiology, most commonly linked to the work of David Barker, is the effect of fetal growth on mature health. Birth weight is positively and independently associated with cognitive development in the general population (Shenkin, Starr & Deary, 2004), almost certainly because endocrine systems target areas of the brain that underlie mental function while simultaneously driving skeletal growth (Berger, 2001). However, this does not appear to have long-term consequences for cognitive aging (Richards, Hardy, Kuh & Wadsworth, 2001), although there is evidence of an inverse association between birth weight and risk of late life depression, independently of childhood and adult social circumstances (Thompson, Syddall, Rodin, Osmond & Barker, 2001).

The extent to which fetal growth mediates the effect of maternal exposures during pregnancy on offspring cognitive and emotional development is unclear. However, a range of such exposures are themselves linked to mental development, including aspects of the maternal hormonal milieu, such as the positive and negative influence, respectively, of insulin-like growth factors (Gunnell, Miller, Rogers & Holly, 2005) and elevated cortisol (LeWinn et al., 2009). The latter is associated with maternal stress, itself a predictor of offspring emotional and cognitive problems (Talge, Neal & Glover, 2007). Maternal morbid conditions such as gestational diabetes and hypertensive disorders are negatively associated with offspring cognitive function, although this may be partly because they are risk factors for preterm birth (Chatzi et al., 2009). However, greater attention has been given to agents thought to be teratogenic, particularly tobacco and alcohol. These are negatively associated with cognitive and behavioral development, although confounding by maternal IQ (Batty, Der & Deary, 2006) and other inherited factors (Thapar & Rutter, 2009) are serious challenges in this research, and many prenatal exposures also persist into the postnatal environment, so that their precise timing is not always easy to identify. Such caveats almost certainly apply to maternal nutrition, in spite of the PERLIP Working Group and the Early Nutrition Programming Project conclusion that (Koletzko, Cetin & Brenna, 2007) intake of fish or other sources of long-chain omega-3 fatty acids is positively associated with offspring cognitive development.

We should note, however, that availability of micronutrients critical to mental development is deficient in many geographical regions, as documented by the International Child Development Steering Group (Walker et al., 2007). In particular, iron deficiency anaemia, which can lead to behavioural disturbance (Golub, Hogrefe, Germann, Capitanio & Lozof, 2006), is one of the most prevalent forms of malnutrition in the world; and iodine deficiency is the most common preventable cause of learning disability (Walker et al., 2007).

3. Early childhood development

While the most rapid neural development occurs during fetal growth, dramatic development of this nature also occurs during first five years of postnatal life. At this time environmental factors, including nutrients, play a critical role in the 'blooming and pruning' of the cytoarchitecture of the brain (Levitt, 2003). This leads us into postnatal life itself.

Maturation—Skeletal growth continues to be positively associated with cognitive development, independently of birth weight (e.g. Richards, Hardy, Kuh & Wadsworth, 2002). Neural development during infancy, as marked for example by growing head

circumference (Gale, O'Callaghan, Bredow & Martyn, 2006) and motor milestone attainment (Murray, Jones, Kuh & Richards, 2007), are associated with cognitive development; milestone attainment is also associated with emotional and behavioral problems at the population level (Liu, Sun, Neiderhiser, Uchiyama & Okawa, 2001), although more evidence of this kind is required. The emerging physical health of the child also becomes an important influence on mental development (e.g. Pless, Cripps, Davies & Wadsworth, 1989); in this way cognition may represent an "archaeological type record" of a range of early insults (Whalley & Deary, 2001). Nutrition, of course, plays an essential role in mental development at this stage. Breast feeding benefits cognitive development (Anderson, Johnstone & Remley, 1999), with inconsistent evidence of parallel effects on emotional development (Allen, Lewinsohn & Seely, 1998; Robinson et al., 2008; Waylen, Ford, Goodman, Samara & Wolke, 2009). The dominant explanation is that benefit results from essential long chain fatty acids, although it should be emphasized that the association is strongly confounded by maternal IQ (Richards et al., 1998; Der, Batty & Deary, 2006) and in any case does not appear to track very strongly over the life course (Richards, Hardy & Wadsworth, 2002). There are also non-nutritional reasons why breast feeding may be associated with mental health, such as reciprocity and closeness (Dignam, 1995).

Socialization—The world of most infants and children centers on the family, above all on the caregiver. The classic writings of Harlow, Bowlby, Ainsworth and others emphasize the fundamental importance of mother-infant attachment in early life, and the long-term impact on psychopathology of insecure attachment or loss of the caregiver. The theoretical approach of Bowlby recapitulates the role of genetics, since, in collaboration with ethologists such as Hinde, he emphasized the evolutionary imperative of attachment formation for survival. The security of this attachment requires intense reciprocal regulation and organization (Cairns & Cairns, 2006). A well-studied manifestation of this is the use of games such as peek-a-boo and hide-and-seek, which help to provide a 'scaffold' for language structure and function (Ratner & Bruner, 1978) while playing a role in the development of emotional self-regulation (Stifter & Moyer, 1991). In fact this reciprocity characterizes human development across the life course (Bronfenbrenner & Morris, 2006), a topic to which we shall return. It is in this context that we should note that separation from a caregiver through parental divorce is one of the most common stressors faced by children in Western cultures (Maughan & McCarthy, 1997), and is associated with lower academic achievement and poorer emotional adjustment (Amato and Keith, 1991; Amato, 1994). This is a complex stressor, usually involving parental distress, financial difficulties, possible relocation, and the introduction of new family members (Maughan & McCarthy, 1997; Fors, Lennartsson & Lundberg, 2009).

Linked and reciprocal interactions between caregiver and child require some discussion of socialization, defined as the manner in which individuals selectively acquire skills, knowledge, values, motives, behaviors and roles (Bush & Simmons, 1992). Socialization processes occur within multiple domains over the life course, including school, peers, neighbourhood, and workplace, but are of course shaped by the family, as well as the caregiver's families of origin, the immediate social environment, and their social status positions based on gender, class, and race or ethnicity. For example, racial and ethnic socialization involves an intergenerational transfer of attitudes, beliefs, and experiences that are likely to include themes important for exposure to unfair treatment, such as promotion of mistrust (i.e., encouraging social distance from and wariness of the dominant group) and preparation for racial bias (Hughes et al., 2006).

An important aspect of socialization is parenting style. The influential model of parenting proposed by Baumrind (e.g. 1991) distinguishes three styles: authoritative (high expectation of compliance with rules; open dialogue; and a child-centered approach characterized by

warmth and involvement); authoritarian (high use of coercive discipline; low use of open dialogue; with a high control-low trust parent-centered approach); and permissive (low expectations; lack of control; and inconsistent approaches to discipline). Evidence suggests that the authoritative style is most associated with the development of competence and adjustment, where autonomy-granting is particularly important (McLeod, Wood & Weisz, 2007). Conversely, authoritarian and permissive parenting hinders the development of competence and self-regulation. This again raises the issue of interaction and reciprocity, first suggested in this context by Sameroff (1975), and more recently by the circular model of Kuczynski (2003). The 'transactional loop' between parent and child can take the form of a 'vicious circle', for example between a strained parent and an aggressive child (Patterson, Reid & Dishion, 1998), as well as a positive recursive process. Of course there are non-linear effects on cognitive development of very poor or extreme exposures, as suggested for example by Turkheimer and Gottesman (1991) and by Rutter (1985), and there is little question that the most extreme manifestations of negative parenting, severe neglect and physical and sexual abuse, are major risk factors for severe long-term psychiatric disorder (Anda et al., 2006; McLaughlin et al., 2010).

Family and neighborhood environment—The socioeconomic environment of the family has an important distal influence on cognitive and socio-emotional development. Chronic poverty is associated with lower cognitive performance and more behavioral problems in children, and later poverty tends to be more detrimental than early poverty (National Institute of Child Health and Human Development, 2005). Indeed chronic economic hardship over the life course is associated with depression and self-reported cognitive difficulties in late middle age and early old age (Lynch, Kaplan & Sharme, 1997). Earlier in the life course effects may be partly mediated by negative parenting, since poverty also causes maternal depression, although in fact these independently impair cognitive development and emotional wellbeing of children (Kiernan & Huerta, 2008). Other mechanisms through which material poverty can impair mental development include elevated exposure to acute and chronic stressors (McLoyd, 1998). It is long known that overcrowding can lead to autonomic and neuroendocrine dysregulation, and contemporary work tends to confirm the negative effect of this on cognitive and emotional development (Evans, 2006). In fact a long-term evaluation of early childhood care and education programs in the USA found that, while Head Start participation was associated with higher reading and math skills through the school years (in girls), the home environment had a larger impact (Joo, 2010).

There are additional distal effects of the neighborhood on school achievement and mental health (Aneshensel & Sucof, 1996), independently of individual and family-level characteristics (Ross, 2000), although negative mental health effects tend to be expressed more as externalizing behaviors than as poor emotional adjustment (Leventhal & Brooks-Gunn, 2000). Potential mechanisms include quality of services (e.g. education, health, transport, recreation, retail); control of noxious or hazardous exposures (e.g. noise, pollution, street traffic, crime); and more subtle factors such as community responsibility for individuals (Leventhal & Brooks-Gunn, 2000; Evans, 2006). Combined deprivation in all these respects may explain the striking decline in IQ between ages six to 11 years urban children in Detroit, USA, after controlling for key factors such as maternal IQ and education; whereas those of suburban children in the same metropolitan area remained relatively unchanged (Breslau et al., 2001). Importantly, these two study areas are strongly segregated by race; analysis suggests that severely disadvantaged neighborhoods can reduce later verbal ability in African-American children to a degree equivalent to missing a year or more of schooling (Sampson, Sharkey & Raudenbush, 2008). This is almost certain to have a long-term impact on cognitive aging, and there is also little question of the deleterious

impact of material and physical environments on adult mental health (March et al., 2008; Kim, 2008), with some evidence of accumulation in this respect (Wheaton & Clarke, 2003).

C. Self-regulation in development and the emergence of skills for life

1. The concept of self-regulation

In considering the above early influences on the twin outcomes of cognitive and emotional development, some factors appear to shape one of these outcomes more than the other, yet most operate as common-cause factors. Through these common causes begins the intertwining of cognitive and emotional processes that persists into old age, with important implications for competence and quality of life. It is now necessary to look more closely at this process of entwinement itself. A reference point is the concept of self-regulation, defined as “self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals” (Zimmerman, 2000, p. 14). This reflects the neuropsychological construct of executive function, based on specific skills underlying goal-oriented behavior such as self-initiation and inhibition, and mental structuring and set-switching, which is conventionally thought of as cognition. Yet it also implies interpersonal feeling and functions, such as belonging, social engagement and respect for others, that arise from socio-emotional development and underpin psychological wellbeing (Duckworth, Akerman, MacGregor, Salter, & Vorhaus, 2009). Integrating these two strands, Schunk and Ertmer (2000) suggest that self-regulated learning involves:

“setting goals for learning, attending to and concentrating on instruction, using effective strategies to organize, code and rehearse information to be remembered, establishing a productive work environment, using resources effectively, monitoring performance, managing time effectively, seeking assistance when needed, holding positive beliefs about one’s capabilities, the value of learning, the factors influencing learning and the anticipated outcomes of actions, and experiencing pride and satisfactions with one’s efforts” (Schunk & Ertmer, 2000, p. 631).

This echoes the quote by Rutter (1985) at the beginning of this article, and captures the emerging theme of agency. This emergence could be seen as the development of human capital, with non-cognitive behaviors as important productive assets as cognitive skills (Farkas, 2003). This view does not of course take into account difficulties or even failure in establishing self-regulation and the long-term consequences of this. Clearly lack of inhibition in terms of poor impulse control is a feature of slower socio-emotional development. This may be seen in childhood conduct problems; these have a widespread and serious adverse impact on life chances, from skill formation to economic attainment and social functioning (Richards & Abbott, 2009), with negative implications for mental aging. How do these processes unfold over the life course? One clue is in the life course continuity in cognitive and emotional functions themselves.

2. Continuity and cross-linkage in cognition and mental health

Cognitive ability in childhood (Deary, Whalley, Lemmon, Crawford, & Starr, 2000; Richards & Sacker, 2003) and early adulthood (Plassman et al., 1995; Snowdon et al., 1996) correlates highly with cognitive ability in midlife and old age. To some extent this is a matter of tracking, since this correlation is observed even when the influence of education and father’s and own occupation are controlled (Richards & Sacker, 2003). However, as we shall see there is little question that education and occupation themselves contribute to this continuity through recursive processes.

Emotional problems in adolescence also show continuity into adulthood (Clark, Rodgers, Caldwell, Power, & Stansfeld, 2008). Rutter et al. (2006) estimate that depressed adolescents have 2-7 times the odds of being depressed in adulthood, with 40-70% showing major depressive disorder during this phase of the life course. Indeed, in the British 1946 birth cohort 71% of those with emotional problems in adulthood also showed evidence of these problems in adolescence; conversely, only 14% of those who showed these problems in adolescence reported no emotional problems in adulthood (Colman, Ploubidis, Wadsworth, Jones & Croudace, 2007). Prospective evidence also suggests lifetime continuity in psychological wellbeing (Richards & Huppert, in press). Rutter et al. (2006) review possible mechanisms that drive or mediate negative mental health continuity. These include increasing gene-environment correlation with age (as previously highlighted, and applying equally to cognition); and the effect of cognitive attributional biases that increase vulnerability to depression (Abramson et al., 2002) and mediate the association between depressive symptoms and subjective memory problems in older people (Crane, Bogner, Brown & Gallo, 2007). We should also refer to life course continuity in personality, which increases with age (Caspi & Roberts, 2001), and is thought to be maintained by a combination of genetic influence, environmental stability, and person-environment interactions (Willis & Blaskewicz Boron, 2008). Of particular relevance to this context is neuroticism, which arguably represents long-term predisposition to emotional stress (Wilson et al., 2005).

Finally, in addition to their own continuities cognitive and emotional processes also show longitudinal cross-linkage. Lower cognitive ability in childhood or early adulthood is associated with increased risk of emotional problems in midlife (Richards et al., 2001; Zammit et al., 2004; Hatch et al., 2007; Koenen et al., 2009), which in turn are associated with cognitive impairment in later life (e.g. Steffens et al., 2006). Neuroticism also shows long-term linkage to later cognitive function (Willis & Blaskewicz Boron, 2008); these authors raise the possible mediating role of health behaviors, although this association may also reflect a long-standing correlation between the stable aspects of these traits since childhood (Gale, Deary, Kuh, Huppert & Richards, 2010). What broader processes might support this linkage? We briefly referred to the role of education and occupation in the context of cognitive continuity (Richards & Sacker, 2003), and have referred throughout to reciprocity. Drawing together these strands, at least three reciprocal life domains are relevant: education, work, and leisure, themselves interdependent through 'linked lives' (Elder, 1994).

3. The role of education

Education is the first major socializing institution outside the family, albeit with more narrowly defined goals in this respect (Hatch & March, 2010). Cognition is an important determinant of educational achievement (Deary, Strand, Smith & Fernandes, 2006), yet education itself can augment cognitive skills independently of prior cognitive ability (Snow & Yallow, 1982; Hernstein & Murray, 1994; Richards & Sacker, 2003; Hatch, Feinstein, Link, Wadsworth, & Richards, 2007). Human capital theory again provides a model for this, focusing on the way in which schooling teaches specific knowledge, teaches practical skills for the workplace, refines other cognitive skills, socializes the individual for success, and shapes confidence, motivation and other aspects of self-regulation discussed above (Kohn & Slomczynski, 1993). As with parenting, this should not be seen purely in terms of input; as well as having a clear focus on academic goals, effective classroom management, and adequate but discriminating use of classroom teaching and motivational techniques, schools that successfully promote academic achievement tend to encourage student participation in, and responsibility for, the running of school life (Rutter, 1985). These aspects of the classroom may also an important long-term determinant of racial disparities in cognitive

function. In a large sample of older community-dwelling people African Americans scored lower than Whites on a range of verbal and nonverbal tests, even though these groups were matched for years of education; yet these differences were largely explained by reading level, which these authors suggest reflects quality rather than quantity of schooling (Manly, Jacobs, Touradji, Small & Stern, 2002). In this context there are large historical racial inequalities in the provision of schooling itself in the USA (Glymour & Manly, 2008), in the type of schooling within which an individual is enrolled, and in educational attainment (Kao & Thompson, 2003). The long-term effect of these inequalities on skills for - and quality of - life is therefore a matter of particular concern.

Beyond these processes that are internal to the institution, status attainment is influenced by how concordant or discordant the expectations of educators, families, and peers become, particularly during the school to work transition. Education also provides a readily identifiable credential that selects the individual into the workforce and stratifies adult socioeconomic status (Collins, 1979), with significant consequences for cognitive aging. This credential also signals to employers (Rosenbaum et al., 1990) that the individual possesses the very qualities of self-regulation described by Schunk & Ertmer (2000) above. There are almost certainly racial disparities in the signaling power of a particular credential too; based on 2008 USA Census Bureau statistics, mean income returns to a bachelor's degree for African American and Hispanic males were nearly 30% lower than those for Whites (Williams, Mohammed, Leavell & Collins, 2010).

4. Work and leisure

With regard to work itself, the longitudinal study of Kohn & Schooler (1983) showed that, echoing education, while cognitive ability is a determinant of intellectually demanding work, work complexity is also beneficial to cognitive function. This was replicated elsewhere by Hauser & Roan (2007), with the important additional control for adolescent cognitive ability. Of particular importance from the life course perspective, the latter effect appears to be greater for older compared to younger workers, possibly because of the reduction in routine, and the growing reliance on occupational self-direction with age and experience (Schooler, Mulatu & Oates, 1999). These authors also raise the possibility, to our knowledge not yet resolved, of an additional recursive process whereby higher cognitive ability leads to longer time spent in the labor force, further increasing its benefit to subsequent cognitive function. Parallel phenomena are observed for leisure activities, whether complex and intellectually challenging (e.g. number of books and magazines read and their intellectual level; Schooler & Mulatu, 2001) or physical exercise (Richards, Hardy & Wadsworth, 2003; Richards, Stephens & Mishra, 2010). Consistent with this, a bidirectional association between sedentary lifestyle and depression is observed in adolescents and older people (Barbour & Blumenthal, 2005; Ortega, Ruiz, Castillo & Sjös, 2008; Roshanaei-Moghaddam, Katon & Russo, 2009). What are the broader implications of this kind of reciprocity? We have referred to the emergence of self-organization; we now turn to a related concept with developmental origins yet strong implications for mental aging: mastery.

5. Mastery and wisdom

The construct of mastery was developed by Pearlin (e.g. Pearlin & Schooler, 1978). This refers to the ability to manage life circumstances, and to control those circumstances that significantly impact the individual, and thus reflects the dynamics of self-regulated learning. It arises partly from status achievement, which in turn confers a greater sense of control and self-direction; and partly out of successful coping with stressors across the life course, although of course these two strands are themselves inter-connected. Mastery can develop relatively early in the life course, for example through effective management of problems

within interpersonal roles such as relationship formation and child-rearing (Pearlin & Schooler, 1978). On the other hand mastery declines with age, and can be impaired by exposure to difficult conditions in salient areas of life that are resistant to personal control, for example job loss through bankruptcy of an employer, or the demands on caregiving from a family member with severe limiting illness (Pearlin, Nguyen, Schieman & Milkie, 2007). Importantly, even where the construct of mastery appears to have universal underlying meaning, the criteria by which particular relevant skills are valued can vary widely, and should be considered in reference to the occupation of social statuses and changing social context. For example, the skills that are necessary for a low-income person to survive are very different to those deployed by a high-income individual to signal status (Farkas, 2003). Success or otherwise in mastering challenge also has long-term implications; in a large community-dwelling sample of older people an association between past circumstances (educational and SES attainment, and various stressors) and current mastery was found to be mediated by the belief of the individual to have directed and managed the trajectories that connect their past to their present (Pearlin et al., 2007).

In considering mastery the emphasis seems to be on skill, competence and control; however, the reciprocal interaction of these processes with emotion may lead to the development of wisdom as defined by Kramer (1990), expressed in problem solving, ability to advise others, engage in management of social institutions, life decision-making, and spiritual reflection. As also defined by Baltes (e.g. Baltes & Staudinger, 1993), wisdom involves rich factual and procedural knowledge, but also three broader aspects of maturity: lifespan contextualizing; value relativism and tolerance; and the recognition and management of uncertainty, including the limits of one's own knowledge. In terms of implicit theory, wisdom is generally assumed to be a characteristic of older age, although this is not always supported by empirical evidence (Staudinger, 1999; Webster, 2003). As Sternberg & Lubart (2001) note, "People become wiser at a given age with respect to the problems that confront them at that point in their lives" (p. 504).

Baltes & Staudinger (1993) suggest a research framework for the life course antecedents of wisdom, integrating individual characteristics such as cognition and mental health, experiential factors such as coping with life problems (similar to the way in which mastery may evolve from the need to overcome adversity as well as succeed during advantage, as acknowledged above), and socioeconomic factors such as education and occupation. Wisdom is explicitly seen as a "fine-tuned coordination of cognition, motivation and emotion", which, again like mastery, integrates past, present and future. We might regard this process as akin to that of contemporary notions of wellbeing, although in the eudemonic sense of self-realization and purposeful engagement rather than the hedonic sense of happiness and life satisfaction (see Ryan & Deci, 2001). At their best these processes may evolve into generativity, a sense of optimism as skills for life are passed from one generation to the next. Yet wisdom can have negative aspects, for example when it generates a burden of responsibility, apprehension, and over-concern for the common good (Coleman & O'Hanlon, 2004) It can also become impaired by the same kinds of stressful events over which individuals have little control that hinder mastery (Meacham, 1990).

D. Conclusions

The central message of this article is that cognitive and socio-emotional function are intertwined across the life course, and, we suggest, fuse to form skills for life supporting self-regulation, competence and quality of life that persist into later life. In attempting to understand the entwining of cognition and emotion over the life course, and the consequent emergence of competence, we have followed a thread connecting reciprocal phenomena that run from genes to environmentally altered gene expression to genetic matching to

environment; through proximal and distal effects of environments themselves: caregiver, family, neighborhood, school, workplace, and the choices and effects of adult lifestyle. However, it is equally important to acknowledge that the formation of skills for life within this framework is not a universal, homogenous process; many components of this chain represent points at which skill formation can become impaired, with negative implications for mental aging. This raises the question of intervention. We began our story in early life, where developmental processes are at their most malleable. Thus Heckman, who himself recognized that cognitive, linguistic, social and emotional skills are interdependent, estimated that financial returns to investment in disadvantaged children are greatest when this investment occurs in early life (Heckman, 2006). Our concern is with the returns of competence and quality of life to cognitive and emotional skills, which we argue may require a more encompassing view across the life course in regard to optimizing the development of these skills. This is reflected in life course models of abnormal mental development and aging (e.g. Richards & Deary, 2005; Whalley et al., 2006; Rutter et al., 2006), but applies with equal force to normative processes, and the transactional emergence of human agency.

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