Life Course Approach to the Development of Hostility and Anger: Family Origins in Childhood and Unemployment in Adulthood

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Contents

Abstract

Previous studies have suggested that hostility and anger are associated with serotonergic function, that they are relatively stable personality characteristics, and that their development is affected by early family factors. Hostile and angry individuals have also been suggested to be at risk for social problems. However, there is a limited number of studies that have examined these issues from a life course perspective, which is the aim of the present thesis.

The participants for the current study were from the ongoing, nationally representative, longitudinal, population-based Cardiovascular Risk in Young Finns Study (YFS), which began in 1980. The present thesis had two aims: 1) to investigate how serotonin receptor 1B, family factors, and early antecedents of hostility and anger are related to the life course development and stability of hostility and anger, and 2) how hostility over the life course is related to unemployment in adulthood.

The results indicate that low parental socioeconomic status, a hostile child-rearing style and aggressive behavior in childhood predicted high levels of hostility and anger in adulthood, but the association between aggressive behavior and hostility was moderated by the serotonin receptor 1B. Both hostility and anger seemed to be moderately stable characteristics over the life course. Hostility and unemployment were found to have a bidirectional relationship, but hostility was a stronger predictor of unemployment than vice versa.

The current study provides new information on unemployment as an outcome of hostility and emphasizes the role of early antecedents and family factors in the development of hostility and anger over the life course. Based on these findings, the prevention of hostility and anger should be targeted at the early stages of life. This could greatly lower the costs of high levels of hostility and anger to the individual as well as to society.

Tiivistelmä

Vihamielisyys ja ärtyneisyys ovat kohtalaisen pysyviä persoonallisuuden piirteitä ja aiempien tutkimusten perusteella varhaisen perheympäristön sekä serotoniinijärjestelmän on havaittu vaikuttavan niiden kehityskulkuun. Sekä vihamielisyys että ärtyneisyys on yhdistetty lukuisiin terveydellisiin riskitekijöihin sekä sosiaalisiin ongelmiin. Tässä väitöskirjassa keskitytään tarkastelemaan näitä asioita elämänkaariperspektiivistä.

Tutkimuksen osallistujat valittiin vuonna 1980 alkaneesta ja edelleen käynnissä olevasta väestöpohjaisesta Lasten ja nuorten sepelvaltimotaudin riskitekijät (LASERI) -tutkimuksesta. Väitöskirjalla oli kaksi päätavoitetta: 1) selvittää, kuinka varhainen perheympäristö, serotoniinireseptori 1B ja vihamielisyyden sekä ärtyneisyyden varhaiset edeltäjät ovat yhteydessä vihamielisyyden ja ärtyneisyyden kehitykseen nuoruudesta aikuisuuteen, ja 2) selvittää, kuinka vihamielisyys on yhteydessä työttömyyteen.

Tulokset osoittavat, että vanhempien alhainen sosioekonominen asema ja kielteinen kasvatustyyli sekä tutkittavien lapsuuden aikainen aggressiivinen käyttäytyminen ennustivat aikuisuuden vihamielisyyttä ja ärtyneisyyttä. Serotoniinireseptori 1B kuitenkin muokkasi lapsuuden aikaisen aggressiivisen käyttäytymisen ja aikuisuuden vihamielisyyden välistä suhdetta. Sekä vihamielisyyden että ärtyneisyyden havaittiin olevan kohtalaisen pysyviä ominaisuuksia nuoruudesta aikuisuuteen. Vihamielisyyden ja työttömyyden välillä havaittiin kaksisuuntainen yhteys, tosin vihamielisyys ennusti vahvemmin työttömäksi joutumista kuin työttömyys vihamielisyyden lisääntymistä.

Tutkimus tuo uutta tietoa vihamielisyydestä työttömyyden ennustajana ja siitä, kuinka varhainen perheympäristö sekä vihamielisyyden ja ärtyneisyyden lapsuuden aikaiset edeltäjät ovat yhteydessä vihamielisyyden ja ärtyneisyyden kehityspolkuihin elämänkaaren aikana. Tutkimuksen löydösten perusteella aikuisuuden vihamielisyyden ja ärtyneisyyden ennaltaehkäisyyn olisi hyvä panostaa jo lapsuuden aikana, mikä voisi vähentää niistä yhteiskunnalle ja yksilölle koituvia kustannuksia.

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List of original publications

This thesis is based on the following publications:

I Hakulinen, C., Jokela, M., Hintsanen, M., Merjonen, P., Pulkki-Råback, L., Seppälä, I., Lyytikäinen, L.P., Raitakari, O.T., Kähönen, M., Viikari, J., Lehtimäki, T., Keltikangas-Järvinen, L. (2012). Serotonin receptor 1B genotype and hostility, anger and aggressive behavior through the lifespan: the Young Finns study. *Journal of Behavioral Medicine*. Advance online publication. DOI: 10.1007/s10865-012-9452-y

II Hakulinen, C., Jokela, M., Hintsanen, M., Pulkki-Råback, L., Hintsa, T., Merjonen, P., Josefsson, K., Kähönen, M., Raitakari, O.T., Keltikangas-Järvinen, L. (2013). Childhood family factors predict developmental trajectories of hostility and anger. A prospective study from childhood into middle adulthood. *Psychological Medicine*, 43, 2417–2426. DOI: 10.1017/S0033291713000056

III Hakulinen, C., Jokela, M., Keltikangas-Järvinen, L., Merjonen, P., Raitakari, O.T., Hintsanen, M. (2013). Longitudinal measurement invariance and stability of anger and hostility. *Journal of Behavioral Medicine*. Advance online publication. DOI: 10.1007/s10865-013-9501-1 2013

IV Hakulinen, C., Jokela, M., Hintsanen, M., Pulkki-Råback, L., Elovainio, M., Hintsa, T., Hutri-Kähönen, N., Viikari, J., Raitakari, O.T., Keltikangas-Järvinen, L. (2013). Hostility and unemployment: a two-way relationship? *Journal of Vocational Behavior*, 83, 153–160. DOI: 10.1016/j.jvb.2013.04.003

Abbreviations

BIC   Bayesian Information Criteria

CAD   Coronary Artery Disease

CFA   Confirmatory Factor Analysis

CFI   Comparative Fit Index

GWAS   Genome-Wide Association Study

FFM   Five-Factor Model

FIML   Full Information Maximum Likelihood

HTR1B   Serotonin Receptor 1B

MI   Modification Index

RMSEA Root Mean Square Error of Approximation

SD   Standard Deviation

SNP   Single Nucleotide Polymorphism

SES   Socioeconomic Status

YFS   Young Finns Study

1. Introduction

Hostility and anger are personality characteristics that, due to their extensive health consequences, are seen as central psychosocial concepts in behavioral medicine. Hostility and anger play a role in the pathogenesis of coronary artery disease (CAD) (Albus, 2010; Chida & Steptoe, 2009; Smith, 1992) and CAD prognosis (Albus, 2010; Chida & Steptoe, 2009), and they have also been shown to predict coronary heart disease events (Barefoot et al., 1983; Gallacher et al., 1999). In addition, hostility and anger have also been associated with mental health problems such as depression (Nabi et al., 2010) and interpersonal problems such as intimate partner violence (Norlander & Eckhardt, 2005). Hostility and anger have been associated with all-cause mortality (Barefoot et al., 1983; Koskenvuo et al., 1988; Miller et al., 1996; Tindle et al., 2009), which could be partly explained by the found associations between hostility and health behavior (e.g., Pulkki, Kivimäki et al., 2003; Scherwitz et al., 1992; Siegler et al., 1992), and between depression and mortality (e.g., Cuijpers et al., 2013; Wulsin et al., 1999).

Hostility and anger are mainly used when referred to adult behavior, whereas childhood aggression has been suggested to be an antecedent of adult hostility and anger (Caspi, 2000; Caspi et al., 2003; Kokko et al., 2009). In addition, the serotonergic system has been suggested to be one of the components controlling aggressive behavior (Craig & Halton, 2009; Williams, 1994). Early childhood environment has been previously connected to adulthood hostility and anger (e.g., Matthews et al., 1996; Räikkönen et al., 2000), and hostility and anger have been shown to be moderately stable characteristics over time (e.g., Siegler et al., 2003). With these findings in mind, the current thesis examines the antecedents and longitudinal development of hostility and anger, and their relations to social outcomes.

1.1 Hostility, anger and aggression

Traditionally, hostility has been viewed as a multidimensional construct containing three different facets: hostility, anger, and aggression. From these facets, hostility refers to cognition, anger to affect, and aggression to behavior. Early self-report measures that

were used to measure hostility, such as the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957) and the Cook-Medley Hostility Scale (Cook & Medley, 1954), were assumed to measure these different facets. However, it has been later demonstrated that hostility is not actually as multidimensional as it has been theoretically assumed. For example, it has been shown that the Cook-Medley Hostility Scale measures mainly a component that can be called cynicism and distrust (Costa et al., 1986; Greenglass & Julkunen, 1989). Thus, hostility as a term seems to primarily refer to a general cynical attitude and interpersonal mistrust.

Anger is typically defined as an emotional state or trait that contains feelings ranging from mild irritation to rage. As in the case of hostility, it has been suggested that anger is a multidimensional concept containing different components such as trait and state (Spielberger et al., 1983), or facets such as angry emotions, aggressive behavior and cynicism (Martin et al., 2000). In addition, anger has also been seen as one of the temperament traits in the EAS temperament theory (Buss, 1991).

Aggression is defined as behavior that intends to harm others physically or mentally. Usually different forms of aggression, like physical, verbal and indirect, are differentiated from each other. Aggression has also been divided to proactive and reactive aggression depending on the function of aggression (e.g., Dodge & Coie, 1987; Hartup, 1974). Proactive aggression has been described as instrumental or "cold-blooded" aggression, whereas reactive aggression is described as emotional, anger-meditated or "hot" aggression.

Whereas measures of hostility and anger have been typically found to correlate moderately (Barefoot & Lipkus, 1994), these constructs are conceptually quite different from each other (Smith, 1994). In addition, the relation between them is not very well understood, and in studies they have been operationalized in multiple ways (Miller et al., 1996). Thus, numerous researchers have suggested that they should be treated separately from each other. However, this has not always been an easy suggestion to follow. For example, anger and hostility are typically grouped together in review articles (e.g., Chida & Steptoe, 2009). Researchers have previously noted that hostility and anger are examples of closely related concepts that can be difficult to differentiate (Merjonen, 2011; Russell & Fehr, 1994).

In the present thesis, hostility, anger and aggression will be examined as separate constructs. Here the term hostility will contain two separate components of hostility, namely cynicism and paranoia. Cynicism will refer to cynical hostility, whereas paranoia will refer to feelings of emotional isolation and anguish. In the first study, these components will be analyzed together, while in the second and third study the focus will be on cynicism. In the fourth study, cynicism and paranoia will be analyzed separately. Because cynical hostility has been previously identified as the central dimension of hostility (Costa et al., 1986; Greenglass & Julkunen, 1989), and there is also some evidence suggesting that it might also be the most relevant to health outcomes (e.g., Almada et al., 1991; Tindle et al., 2009), the focus of the present thesis is on cynicism, that is, cynical hostility, and anger. Of all the different forms of aggression, the present thesis will focus on childhood physical aggression.

1.2 Development of hostility and anger

1.2.1 Genetic background of hostility and anger

Hostility and anger have been shown to be at least moderately heritable (Hur, 2006; Miles & Carey, 1997; Rebollo & Boomsma, 2006), but currently particular genes for hostility or anger have not been found. A recent genome-wide association study using the Young Finns Study (YFS) data found a few possible associations, but they did not replicate across measurement times (Merjonen, Keltikangas-Järvinen et al., 2011). However, there is some evidence that aggression related behaviors, such as hostility and anger, are regulated by the serotonergic system (Williams, 1994). Some specific polymorphisms of genes regulating serotonin functioning have been found to be associated with hostility (e.g., Lesch & Merschdorf, 2000), anger (e.g., Conner et al., 2010) and aggressive behavior (see: Craig & Halton, 2009).

From the serotonergic system, particularly the serotonin receptor 1B gene (HTR1B) has been identified as one of the candidate genes for aggressive phenotype in model animals and humans. It has been shown that mice lacking the serotonin 1B receptors show increased aggression and impulsivity (Saudou et al., 1994). Most of the studies in humans have examined the G861C (rs6296) single nucleotide polymorphism (SNP) of

the HTR1B. Associations have been found with psychiatric problems such as antisocial alcoholism (Lappalainen et al., 1998), and suicide attempts (New et al., 2001), but not with pervasive aggressive behavior in children (Davidge et al., 2004) or with impulsive aggression (New et al., 2001). In addition, a recent study failed to detect associations between HTR1B SNP rs6296 and either anger or hostility in young adults (Conner et al., 2010). Whereas the 861C allele has been associated with lower binding potential of the serotonin 1B receptors in the brain (Huang et al., 1999), the G861C polymorphism does not appear to be functional itself. However, the polymorphism is in linkage disequilibrium with many other functional polymorphisms in the HTR1B gene (Sanders et al., 2002).

In sum, it is not clear whether there is an association between HTR1B gene and aggression-related phenotypes. It is also possible that rs6296 might be associated with only some of the aggression-related phenotypes or only during a certain development period. According to the probabilistic epigenesis theory, multiple interacting factors such as genetic activity and behavior contribute to the development on an individual during life course (Gottlieb, 2007). There is also some evidence indicating that specific genes could moderate the association between childhood and adulthood characteristics (e.g., Keltikangas-Järvinen et al., 2008). However, there are no previous studies that would have examined whether specific genes could moderate the association between childhood aggression and adulthood hostility and anger.

1.2.2 Childhood aggression as antecedent of adulthood hostility and anger

Physical aggression is quite common in childhood. On average, physical aggression decreases with age as children learn to inhibit their impulses (Cairns et al., 1989; Cote et al., 2006; Tremblay, 2000), but for some individuals aggression becomes a more stable behavioral pattern (Cote et al., 2006; Nagin & Tremblay, 1999). However, the attenuation of childhood physical aggression with age does not mean that aggressive behavior disappears altogether. Rather, childhood physical aggression may be the precursor of other forms of non-physical or milder aggression, like social (Archer, 2005) or verbal aggression (Tremblay, 2000). In addition, childhood physical

aggression has been connected to adult anger (Kokko et al., 2009) and hostility as well (Caspi, 2000; Caspi et al., 2003).

All this suggests that childhood physical aggression could be an example of a heterotypic continuity in which the underlying psychological construct manifests itself differently in different age periods (Loeber & Hay, 1997). Hostility and anger have also been connected to similar health outcomes as physical aggression, which has led to the suggestion that they could form a unitary constellation of hostile behavior (Smith et al., 2004; Smith, 1992). In earlier research, hostile behavior was seen as the core of coronary-prone behavior that has been identified already in early childhood (Matthews & Haynes, 1986). Aggression, impatience, competitiveness, and leadership are typically seen as key characteristics of this behavior in childhood (Matthews & Angulo, 1980). However, measurements of childhood coronary-prone behavior do not typically include hostility or anger (Thoresen & Pattillo, 1988), which have been seen as more typical in adults and adolescents. Taken together, manifestation of the hostile behavior constellation and its components may vary over the life course from childhood to adulthood.

1.2.3 Family origins of hostility and anger

Early family environment have been shown to play a crucial role in the development of the offspring. Research has particularly focused on two different aspects of early family environment: parental socioeconomic status (SES) and parental child-rearing behavior. Many prospective longitudinal cohort studies have shown that childhood socioeconomic status is a robust predictor of offsprings' later health and well-being (e.g, Birnie et al., 2011; Cohen et al., 2010; Power et al., 2013) In general, parental SES is related to access to social and material resources (Bradley & Corwyn, 2002), and thus it reflects the quality of the early child-rearing.

Repetti et al. (2002) proposed a 'risky families' model that described risky families as aggressive and conflictive, and characterized by negative and unsupportive relationships between family members. Repetti et al. (2002) concluded that growing up in a risky family can have a negative influence on children's emotion control and development of emotion expression, social competence, and physical and mental health.

Parental socioeconomic status (SES) has also been shown to affect family functioning and low SES has been related to most of the risky family characteristics such as harsh disciplinary style (Chen et al., 2002; Repetti et al., 2002). For example, in a study of 3,225 adult participants, low childhood SES was associated with harsh parenting, which in turn was associated with high hostility (Lehman et al., 2005).

The risky families model also predicts that these deficits would contribute to the development of hostility and anger, which manifest later during the life course. Previous studies have found support for the notion of a risky family, and growing up in families characterized as cold, strict and lacking warmth in parenting has been associated with the development of hostility and anger. In retrospective studies, hostile individuals have recalled that their parents were less approving, and had more strict control and expectations (Houston & Vavak, 1991). In prospective studies, negative relations between parents and children have been shown to predict children's later hostility (Matthews et al., 1996). Three previous longitudinal studies that have used the same YFS dataset as the current study have shown that both parental behavior and family environment are associated with the levels of hostility in adolescence and early adulthood (Keltikangas-Järvinen & Heinonen, 2003; Merjonen, Pulkki-Råback et al., 2011; Räikkönen et al., 2000). In the first of those studies, children's temperament and mother's child-rearing style predicted hostility over nine-years, independently of each other (Räikkönen et al., 2000). In the second study with a 15-year follow-up, it was shown that parental Type A behavior, parents' life dissatisfaction and socioeconomic status (SES) predicted adulthood levels of hostility for both genders (Keltikangas-Järvinen & Heinonen, 2003). In the third study, mothers' care-giving attitudes, which reflect the emotional significance of the child to mother, predicted offspring hostility 21 years later (Merjonen, Pulkki-Råback et al., 2011).

Thus, associations between risky family characteristics and later hostility have been demonstrated, but currently it is not known whether these associations persist as stable differences over the life course, whether they dilute or amplify with age, or whether they are typical of a specific developmental phase. Most studies have concentrated on the consequences of parenting processes in adolescence or early adulthood. In addition, many studies have measured childhood environment retrospectively, which may give biased information because retrospective self-reports may reflect the effects of an

individual's hostility as much as the effects of the early environment. Neither have previous studies examined the possible age-related accumulation of the risky family environment, that is the risky family environment and age interaction, and whether this could contribute to the development of hostility and anger over time.

1.2.4 Stability and change

There is a limited number of longitudinal studies investigating life-course rank-order and the mean-level stability of hostility and anger. Rank-order stability refers to stability of relative ranking of an individual within a population. Mean-level stability, in turn, refers to continuity of an average level. In a sample of 3,399 civil servants from the Whitehall II cohort study, cynical hostility was found to have moderate stability over 10 years (Nabi et al., 2010). In addition, there are a number of studies with short follow-up that have found high rank-order stability for hostility (e.g., Haukkala et al., 2001; Julkunen et al., 1994; Woodall & Matthews, 1993) and some studies showing that rank-order stability of hostility decreases over time (e.g., Adams, 1994). In a sample of 2,200 college students, hostility was found to show moderate rank-order stability, but the mean levels of hostility declined over 23 years of follow-up (Siegler et al., 2003). In addition, a mean level decrease in anger through age was found in a recent cross-sectional study (Zimprich & Mascherek, 2011).

Consistent with these findings, average expressions of anger and negative emotions have been shown to decrease over time (Galambos et al., 2006; Galambos & Krahn, 2008; McAdams & Olson, 2010). Furthermore, there are numerous studies that have conceptualized hostility in terms of the Five-Factor Model (FFM) of personality (Digman, 1990), which suggests that hostility is conceptually similar to low agreeableness, high neuroticism and low extraversion (Tremblay & Ewart, 2005; Watson & Clark, 1992). The rank-order stabilities of these traits have been found to be relatively high (Roberts & DelVecchio, 2000). However, it seems that mean levels of neuroticism decrease, and mean levels of both extraversion and agreeableness increase when individuals age (Roberts & DelVecchio, 2000; Roberts et al., 2006). However, these changes are not however found in all studies (e.g., Srivastava et al., 2003). In sum, previous findings suggest that hostility and anger have at least moderate rank-order

stability and that the mean levels of hostility and anger decrease with age. However, there are no population based studies that would have examined these issues using both hostility and anger measures.

1.2.5 Longitudinal measurement invariance

While studies in behavioral medicine have concentrated on examining the outcomes of hostility and anger, there are only a few studies that have investigated the psychometric properties of methods that are used to assess these constructs. Typically, hostility and anger are measured using self-report questionnaires (see: Eckhardt et al., 2004), but interview and observations methods have also been used. Most large epidemiological studies rely on self-report questionnaires due to their practicality and low cost.

Usually differences in self-report questionnaire scores are interpreted as true differences in conceptual characteristics, and it is assumed that the latent variable behind the measures remains the same, which means that there is no qualitative change across time or groups. In many cases this might be true, but it has been argued that this assumption should be tested before it is accepted (Borsboom, 2006). Measurement consistency (or measurement invariance) can be analyzed to test whether particular items of an instrument measure the same underlying latent variable across time points or age groups (Horn & McArdle, 1992; Meredith, 1993). The importance of addressing the issue of measurement invariance is well established (e.g., Schmitt & Kuljanin, 2008; Vandenberg & Lance, 2000), and a lack of measurement invariance can lead to misleading conclusions (Borsboom, 2006).

Previous studies examining the measurement invariance of hostility and anger have been cross-sectional (Zimprich & Mascherek, 2011; Zimprich & Mascherek, 2012); thus, longitudinal measurement invariance of hostility and anger remains to be empirically demonstrated. There are some studies that have examined the longitudinal measurement invariance of the FFM. The measurement invariance of Five-Factor personality traits is typically found over a short period of time (e.g., Marsh et al., 2010). However, in a recent study 11 out 70 personality items in women were found not to be measurement invariant over 25 years (Smits et al., 2011); thus, it is possible that single items that assess personality factors are not measurement invariant over a long period of

time. In sum, it is possible that conclusions drawn from longitudinal studies might not be valid if there is qualitative change in the latent variables examined.

1.3 Hostility and social outcomes

Hostility and anger have been connected to various social problems such as substance abuse (Pulkki, Kivimäki et al., 2003; Siegler et al., 2003) and deviant behavior in the workplace (Judge et al., 2006). It has also been proposed that hostility and anger are key factors that guide adolescents into criminal behavior (Agnew, 1992). According to the psychosocial vulnerability model, hostility and anger are associated with various interpersonal problems and poor coping skills in stressful situations (Smith & Frohm, 1985; Smith, 1994). Most of the studies have found support for this notion. For example, hostile individuals have been found to interpret other people's intentions pessimistically (Guyll & Madon, 2003; Larkin et al., 2002), which can lead to social conflicts in personal relationships. A high level of hostility has also been shown to be associated with low social support (Benotsch et al., 1997; Heponiemi et al., 2006; Smith et al., 1988), and individuals with high hostility do not benefit from social networks or resources as much as individuals with low hostility do (Seeman & Syme, 1987; Vahtera et al., 2000; Watkins et al., 1992). Taken together, these findings suggest that hostility and anger can affect how an individual succeeds in life.

1.3.1 The link between hostility and unemployment

Numerous studies indicate that unemployment can lead to poor health and mental health problems (McKee-Ryan et al., 2005; Paul & Moser, 2009; Wanberg, 2012). For example, in a recent meta-analysis, it was concluded that the unemployed have worse mental health than the employed individuals by the difference of a half standard deviation (SD) in cross-sectional studies (Paul & Moser, 2009). A similar difference was also found in longitudinal studies, but the effect size was somewhat smaller (Paul & Moser, 2009). Unemployment has also been linked with suicide (Chen et al., 2010; Classen & Dunn, 2012) and mortality (Eliason & Storrie, 2009; Roelfs et al., 2011; Sullivan & Von Wachter, 2009), especially in those who lose their job early in their

career (Roelfs et al., 2011). However, this relationship seems to be mediated by societal and economic factors (McLeod et al., 2012); thus, it has not been found consistently (e.g., Martikainen et al., 2007).

Many people become unemployed for reasons that are beyond their control, including economic depression or lay-offs due to organizational changes. However, there are at least two possible pathways linking hostility to unemployment. First of all, individual differences in personality characteristics may be related to selection into unemployment. Childhood aggressive behavior has been shown to, directly and also indirectly, predict long-term unemployment in adulthood (Kokko & Pulkkinen, 2000; Kokko et al., 2000). In addition, the temperament trait high negative emotionality, which contains anger as one of its subcomponents, has been shown to predict unemployment and the duration of unemployment in adulthood (Hintsanen et al., 2009). High hostility has also been associated with poor career achievement (Siegler et al., 2003) and temporary employment among individuals from low socioeconomic background (Virtanen et al., 2005). Altogether, it seems that personality characteristics might contribute to the probability of ending up unemployed.

Second, according to the health selection model, the decline of health can lead to subsequent unemployment (Bartley, 1988; Bartley, 1994). This association has been supported by most of the studies examining it (e.g., Böckerman & Ilmakunnas, 2009; Leino-Arjas et al., 1999; Virtanen et al., 2013). As it has been previously stated, hostility has been found to predict poor health outcomes in numerous studies (Chida & Steptoe, 2009; Miller et al., 1996; T. W. Smith, 1992). High hostility has also been shown to lead to an increase in the number of sickness absences (Vahtera et al., 1997) that in turn are likely to be associated with higher unemployment risk (e.g., Virtanen et al., 2006). High hostility in combination with unemployment has also been found to be associated with poor health (Kivimäki et al., 2003). These findings, together with the psycho-social vulnerability and the health selection model, support the possibility that hostility could contribute to the probability of becoming unemployed. In addition, ending up unemployed could increase hostility levels. Taken together, findings to date suggest that there may be a bidirectional relationship between hostility and unemployment, but there are no prior studies that have examined this.

2. Aims of the study

There is a limited number of studies that have investigated the development of hostility and anger from a life course perspective. The serotonergic system has been hypothesized to play a role in regulating aggressive-related behaviors, but currently the evidence is inconclusive. In the present thesis, development, stability, and social outcomes, i.e., unemployment, of hostility and anger are examined using a prospective longitudinal YFS with a 27-year follow-up. The six specific research questions are as follows:

1) Is the HTR1B rs6296 genotype associated with childhood aggression or adult hostility and anger and does the HTR1B rs6296 genotype modify the degree of continuity between childhood aggression and adulthood hostility and anger? (Study I)

2) Is childhood aggression associated with adult measures of hostility and with adult measures of anger? (Study I)

3) Do hostile child-rearing style and low parental SES predict cynicism and anger trajectories from early to middle adulthood, and do these factors show age-related accumulation effect? (Study II)

4) How stable are cynicism and anger from early to middle adulthood? (Study III)

5) Can cynicism and anger be reliably measured with the self-report instruments used in the current study? (Study III)

6) Is there a bidirectional relationship between adulthood hostility dimensions and unemployment? (Study IV)

3. Methods

3.1 Design of the study

The original sample of the YFS included 3,596 randomly selected Finnish children and adolescents from six birth cohorts (aged 3, 6, 9, 12, 15 and 18 at the baseline in 1980) (Raitakari et al., 2008; Åkerblom et al., 1991). Random selection was done by dividing Finland into five areas according to the locations of university cities with a medical school (Helsinki, Kuopio, Oulu, Tampere, and Turku). Based on personal social security number, urban and rural boys and girls were randomly selected from each of the five areas. After the baseline in 1980, the sample has been resurveyed in eight subsequent waves: 1983, 1986, 1989, 1992, 1997, 2001, 2007, and 2010/2012. Written informed consent was obtained from participants who were at least nine years old and from the parents of younger participants. The study was approved by the ethics committees of each of the five participating universities (medical schools of Helsinki, Kuopio, Oulu, Tampere and Turku).

Study I included a subsample of 1,464 participants from the three youngest age groups (aged 3, 6 and 9 at baseline) who had parent-reported aggressive behavior data available. Due to dropout and missing data, only 811 to 967 of those participants had complete data with gene information available on adulthood hostility and anger measures.

Study II contained data from participants who provided data at the baseline (1980), and at any of the follow-up examinations between 1992 and 2007. Due to attrition and missing data, between 2,734 and 3,458 participants had data available from the baseline and the first follow-up. From follow-ups in 1992, 1997, 2001 and 2007, adulthood cynicism measures were available for 2,316, 2,096, 2,081, 2,041, participants, and adulthood anger measures were available for 2,310, 2,093, 2,090, 2,042, participants, respectively. These participants had at least one hostile maternal child-rearing scale or parental SES measure available from baseline. Altogether, the total number of participants varied between 2,041 and 2,316, and the total number of person-observations used in multilevel models varied between 6,980 and 8,315.

For Study III, 3,074 participants who participated in at least one of the four consecutive waves from 1992 to 2007 and had answered both anger and cynicism questionnaires were selected.

Study IV used follow-up examinations from years 1983, 1992, 2001, and 2007. Data were available from 2,097 participants of whom 2,074 reported the unemployment status between 1992 and 2001, and 1,991 participants reported the duration of unemployment between 1992 and 2001. In addition, unemployment status in 2001 was reported by 1,562 participants and unemployment status at 2007 by 1,624 participants. Finally, 1,517 participants reported their unemployment status history (yes/no) and 1,465 participants reported the total number of unemployment months in 2007.

3.2 Measures

3.2.1 Childhood aggression (Study I)

Childhood aggressive behavior was reported by the parents of the participants (mostly mothers) in 1980 and 1983 when the participants were 3- to 12-years old. The first assessment included three items ("Other children frequently accuse him/her of fighting"; "'Accidentally' hits, trips or shoves other children"; "Aggressive behavior frequently makes disciplinary action necessary") assessed with a dichotomous scale (yes/no). The second assessment included four items ("Other children frequently accuse him/her of fighting"; "'Accidentally' hits, trips or shoves other children"; "Aggressive behavior frequently makes disciplinary action necessary"; "Child easily gets into fights") assessed with a 5-point scale (1="Totally disagree", 5="Totally agree").

To obtain a more stable measurement of childhood aggressive behavior that would be less affected by measurement error, the two measurements in 1980 and 1983 were combined into one aggressive behavior scale. Given that dichotomizing continuous scales reduces information (MacCallum et al., 2002) , values 1 and 3 were assigned to the dichotomous responses of "no" and "yes", respectively, in order to be able to combine them with the continuous scale. This was done based on the distribution of answers: 89.5% of participants answered "no" to all three dichotomous aggression questions and also 89.5 % of participants had the mean score value between values 1

and 2 in the 4-item aggression questionnaire. The mean score of all items was calculated and used in the analysis. The new scale combining 1980 and 1983 measures had sufficient reliability (Cronbach's alpha=.73) and the mean scores of childhood aggressive behavior varied between 1 and 3.2.

3.2.2 Genotyping (Study I)

The genome-wide SNP analyses (GWAS) for Young Finns Study participants were performed in 2009 by using the 670K Illumina platform (Sanger Institute, UK, see details (Smith et al., 2010). Variation in over 670,000 known SNPs was measured from 2,442 study subjects. Imputation up to 2.5 million SNPs has been performed using information on Hapmap 2 by using MACH (the genomic built 26) (http://www.sph.umich.edu/csg/abecasis/mach/). SNP rs6296 was imputed and the imputation quality was good (rsq=0.9649). SNP rs6296 is located in chromosome 6, position 78228979.

3.2.3 Hostility (Studies I-IV)

Hostility was measured in 1992, 1997, 2001 and 2007 using two inventories that measured different facets of hostility. The first of these facets, cynicism, that is cynical hostility, was measured using a cynicism scale derived from the Minnesota Multiphasic Personality Inventory (MMPI) (Comrey, 1957; Comrey, 1958). The scale consists of seven items: Item 1, "It takes a lot of argument to convince most people of the truth"; Item 2, "I think most people would lie to get ahead''; Item 3, ''Most people are honest chiefly through fear of being caught''; Item 4, ''It is safer to trust nobody''; Item 5, ''Most people will use somewhat unfair means to gain profit or an advantage rather than to lose it''; Item 6, ''I think nearly anyone would tell a lie to keep out of trouble''; and Item 7 ''Most people inwardly dislike putting themselves out to help other people''), which were answered on a 5-point Likert scale. The Cronbach alphas were 0.75, 0.78, 0.80 and 0.83 for the four measurement times respectively. Item 5 was asked slightly differently (changes shown in boldface): (". . . means **to gain profit** rather . . .") in the first year. The second of these facets, paranoia, also called distrustful attitudes, was

measured using the paranoid ideation subscale of the Symptom Checklist-90R (Derogatis, 1977). This scale consists of six items: Item 1, "I have ideas and thoughts that others disagree"; Item 2, "Others do not give you proper credit for you achievments"; Item 3, "I feel that people will take advantage of you if you let them"; Item 4, "I feel that people will talk about you behing your back"; Item 5, "I feel that others are blame from most of my troubles"; and Item 6 "I feel that most people cannot be trusted". These items were rated on a 5-point Likert scale (Cronbach alphas .71, .75, .74, and .78). In Study I, cynicism and paranoia scales were combined to form a global measure of hostility.

3.2.4 Anger (Studies I-III)

Anger was measured using the Irritability scale of the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957). The scale consists of seven items (Item 1, ''I lose my temper easily, but get over it quickly''; Item 2, ''I am irritated a great deal more than people are aware of''; Item 3, ''It makes my blood boil to have somebody make fun of me''; Item 4, ''Sometimes people bother me just by being around''; Item 5, ''I often feel like a powder keg ready to explode''; Item 6, ''I sometimes carry a chip on my shoulder''; and Item 7, ''Lately, I have been kind of grouchy''), which were answered on a 5-point Likert Scale. The Cronbach alphas were 0.79, 0.76, 0.77 and 0.78 for the four measurement times respectively. However, some items were put slightly differently at the first time point, 1992 (changes shown in boldface): Item 1, ". . . easily but **also** get . . ."; Item 2, ". . . irritated a **lot** more . . ."; and Item 4, ". . . bother me **only** by . . ."; Item 3 was asked in the reverse order: "If somebody makes fun of me, it makes my blood boil". The questions were modified after the first point in order to achieve measures that would be comparable to another population-based study.

3.2.5 Hostile maternal child-rearing style (Study II)

The maternal child-rearing style scale was developed based on the Operation Family study (Makkonen et al., 1981). The scale contains three different child-rearing components: low emotional significance, low tolerance, and strict disciplinary style. All

these dimensions were self-rated with a 5-point scale by the mothers twice in 1980 and 1983, except for low tolerance in 1980 when the scale was Yes/No. Low emotional significance contains four items (e.g., "The child is significant to me", 1=very significant to 5=not significant), low tolerance contains three items (e.g., "In difficult situations, the child is a burden", 1=totally disagree to 5=totally agree), and strict disciplinary style contains two items (e.g., "Disciplinary actions are regularly needed", 1980: 0=no 1=yes; 1983: 1=totally disagree to 5=totally agree).

3.2.6 Parental socioeconomic status (Study II)

Parental SES was assessed in 1980 and 1983. Following a method used by Pulkki et al. (2003), SES was measured by two indices: (a) the mother's and father's years of education and (b) the annual income of the household (measured on an eight- point scale). The mean of parents' years of education was calculated and then standardized. Income was standardized as well, and then added to the standardized years of education. Composite SES variables were formed for 1980 and 1983 and the correlation between them was 0.89.

3.2.7 Unemployment (Study IV)

Unemployment data was self-reported in 2001 and 2007. In 2001, participants were first asked how many months they had been unemployed during the previous 12 months. All participants who answered zero months were classified as not being unemployed, whereas all others were classified as unemployed during the previous 12 months (short-term unemployment). In addition, participants were asked whether they had been unemployed or laid-off during the years 1992–2001, and how many months they had been unemployed during that time (unemployment duration). In 2007, participants were asked whether or not they were currently unemployed (unemployment status). In addition, participants were asked to indicate whether they had ever been unemployed and how many months they had been unemployed (life course unemployment duration).

3.2.8 Education (Study IV)

Participants' educational level was assessed in 2001 (low=comprehensive school; intermediate=secondary education; high=academic, graduated from a polytechnic or studying at or graduated from a university). Parental education was assessed in 1983 when participants were from 6- to 21-years old, defined according to the educational level of the parent with the higher level of education (low=comprehensive school; intermediate=secondary education; high=academic degree). If a participant had only one parent, or if education of only one parent was known, parental education was defined based on that.

3.3 Assessing measurement invariance and stability

Measurement invariance is traditionally tested in personality psychology using a series of confirmatory factor analyses (CFA) (Brown, 2006). Four types of measurement invariance are typically differentiated in the following order: configural invariance, metric (weak) invariance, scalar (strong) invariance, and residual (strict) invariance. Configural invariance is a baseline model in which factor loadings, residual variances and intercepts are allowed to vary. Metric invariance is established by constraining factor loadings to be equal and allowing residual variances and intercepts to vary. Metric invariance is established when constraints are fixed and the model fit does not change. Scalar measurement invariance is established by constraining factor loadings and item intercepts to be equal and allowing residuals variances to vary. Residual invariance is established by constraining factor loadings, intercepts and residual variance to be equal across groups. If complete measurement invariance cannot be established, it is also possible to establish partial invariance by releasing some factor loadings, intercepts or residual variances of specific items (Byrne et al., 1989). For the investigation to be meaningful, at least partial metric invariance must be established (Horn & McArdle, 1992).

However, it has recently been shown that the traditional CFA strategy can lead to incorrect conclusions by increasing the probability of a type I error resulting from using a series of consecutive CFAs and using a referent item in the CFAs that shows

differential item functioning (Stark et al., 2006). Therefore, Stark and his colleagues (2006) proposed a strategy which they found as effective as the traditional CFA strategy. Stark et al.'s suggestion was to analyze first a fully constrained model in which a mean and variance of the first group are set. Based on evaluation of significant modification indices, the model parameters are then set free. This approach combines item response theory, in which the baseline model is typically fully constrained and metric/scalar models are simultaneously analyzed, with the traditional measurement invariance CFA approach (Stark et al., 2006). However, it is important to remember that any modifications made to the models should also make theoretical sense (Schreiber et al., 2006).

When measurement invariance has been established, it is then possible to evaluate the stability of latent traits. Rank-order stability, i.e., continuity in position, is examined to evaluate how far an individual remains in the same position through development as compared to others. Absolute and mean level differences are investigated to evaluate how much a trait changes with age on average (Caspi & Roberts, 1999). Continuity of divergence, i.e., changes in population variance, can also be evaluated to examine whether interindividual differences remain constant during development (Allemand et al., 2007).

3.4 Statistical analyses

3.4.1 Study I

Prior research has shown that gender can moderate the central nervous system's serotonin functioning (Brummett et al., 2008; Williams et al., 2003); therefore, it was first investigated whether gender x rs6296 x childhood aggressive behavior interaction would be significant. Linear regression analysis was used to analyze: a) the main effects of the HTR1B rs6296 on childhood aggressive behavior and adulthood hostility and anger, and b) the interactions of HTR1B rs6296 and childhood aggressive behavior on adulthood hostility and anger. HTR1B rs6296 was coded with two dummy variables and individuals carrying the CC genotype were used as the reference group. Adulthood measures of hostility and anger mean scores combining the years 2001 and 2007 were

used. In all analyses gender and age were used as covariates. Childhood aggressive behavior and adulthood hostility and anger scales were standardized for regression analysis. HTR1B rs6296 was in Hardy-Weinberg equilibrium ($\chi^2(2) = 1.54$, p = 0.21) and not associated with gender ($\chi^2(2) = .92$, p = .63).

3.4.3 Study II

Longitudinal multilevel modelling (Rabe-Hesketh & Skrondal, 2008; Singer & Willett, 2003) was used to test whether parental SES and components of a hostile childhood-rearing style predicted cynicism and anger trajectories over 15 years. Repeated measurements of adulthood cynicism and anger were arranged in a multilevel format in which measurements were nested within participants, so that the same participants contributed more than one observation in the dataset. A growth curve model, i.e., a random-coefficient model with a random slope, was used to analyze possible changes in cynicism and anger trajectories.

Models for each of the four family factors (three hostile child-rearing style components and parental SES) were built to examine their possible effect on the baseline level. Then the same model (separately for all family factors) was analyzed adding an interaction with age term in order to test the possible effect on the slope. After that, new models were introduced where all the hostile child-rearing style components and a significant hostile child-rearing style component x age interactions were grouped together. Then SES and significant SES x age interaction were added to the second model to analyze whether child-rearing style components were independently associated with anger and cynicism.

Analyses were separately carried out for the baseline (1980) and the first follow-up (1983). Age was centered at 30 for easier interpretations of the results. Because different birth cohorts were followed over the same period of time, analyses were also adjusted for the possible birth cohort effects. In addition, all models were adjusted for age and gender. Cohort and gender were coded as dummy variables.

3.4.2 Study III

Confirmatory factor analysis was used to examine whether a one-factor solution for both cynicism and anger scale would fit the data for all the measurement years separately. The longitudinal measurement invariance was then examined with all cohorts grouped together in order to reduce the complexity of the longitudinal models. A simplex model was constructed from the final longitudinal measurement invariance model, the latent variable being regressed on the latent variable at the preceding time point (T1->T2, T2->T3 and T3->T4). This was done to analyze the total continuity coefficient (that assesses rank order stability). In addition, multiple indicator latent growth modeling was used to examine individual trajectories of anger and cynicism (Muthén & Muthén, 1998-2010, p. 121). Confidence intervals were used to estimate differences between women and men. Figure 1 shows the longitudinal invariance model (Figure 1: Level-1) and the multiple indicator latent growth model (Figure 1: Level-1 & Level-2). Separate models were constructed for anger and cynicism. All analyses were fitted using Mplus, Version 7 (Muthén & Muthén, 1998-2010).

Longitudinal measurement invariance was examined with CFAs. First, a residual invariance model (Model 1) was established by constraining factor loadings, intercepts and residual variance to be equal across time points. Based on modification indices, intercepts that were not measurement invariant were freed to establish partial strict measurement invariance. Because the same individual items were measured at four consecutive time points, their residual variances were allowed to correlate in all the models.

Change in cynicism and anger was examined using a multiple indicator latent growth model that is an extension of the latent growth model. The relevant latent variables are represented by multiple indicators, i.e., individual items. The multiple indicator latent growth model was built by adding intercept, i.e., initial level, and slope, i.e., rate of change, factors to the final longitudinal measurement invariance models (Figure 1; Level-2). Factor loadings of the slope were set to 0, 0.5, 0.9 and 1.5 to represent measurement years. To estimate the mean of the intercept, the factor loading of the strong invariant item, i.e., Item 1 on the anger scale and Item 7 on the cynicism scale, was set to 1 and the intercept to 0. This procedure did not affect model fit.

Model fit estimation was based on the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA) index, as well as Bayesian information criteria (BIC). Modification indices (MI) were used to evaluate which parameters should be removed to improve the model fit. There are no specific guidelines to determine how low values of fit indices must be to represent model misfit. However, it has been shown that only RMSEA is not affected by model complexity and that RMSEA values below .05 indicate good model fit (Cheung & Rensvold, 2002). Others suggested that CFI values of .95 or higher are indicative of acceptable fit (e.g., Hair et al., 2006). BIC was used to compare two different models: the lower the BIC, the better the balance between model fit and parsimony.
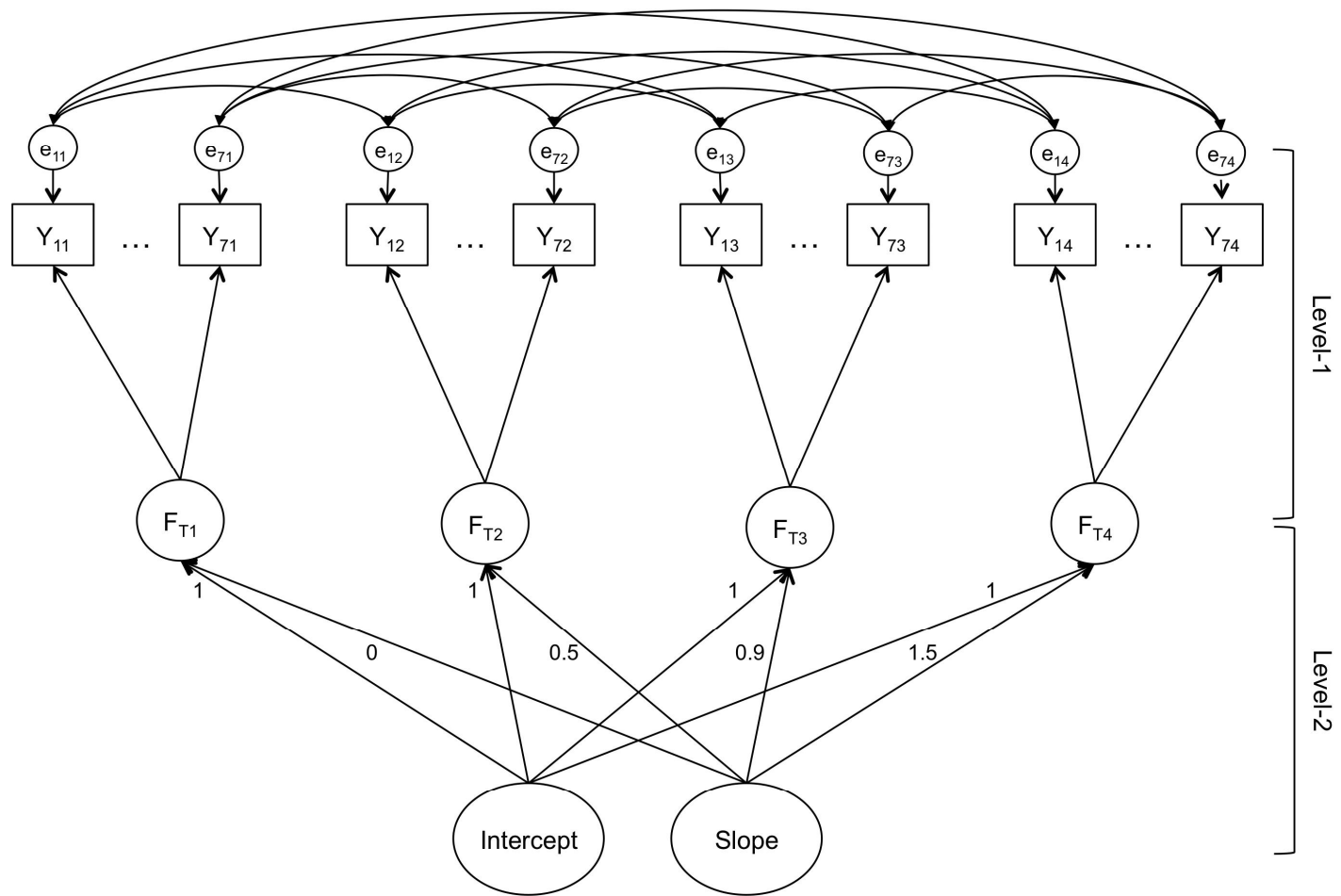
Figure 1. Diagram for the 2-Level multiple indicator latent growth model.

3.4.4 Study IV

Binary logistic regression analysis was used to analyze whether hostility dimensions assessed in 1992 and 2001 were associated with: (1) short-term unemployment in 2001; (2) unemployment between 1992 and 2001; (3) unemployment in 2007, and (4) ever being unemployed. Negative binomial regression analysis, i.e., Poisson regression with mean overdispersion, was used to analyze whether hostility dimensions were associated with: (1) the total number of unemployment months in those participants who had been unemployed in 2001; (2) the total number of months of unemployment in those participants that had been unemployed between 1992 and 2001, and (3) the total number of months of unemployment in those participants that had ever been unemployed. Multiple linear regression analysis was used to analyze whether short-term unemployment months in 2001 were associated with hostility dimensions in 2001 and whether short-term unemployment status in 2001 was associated with hostility dimensions in 2007. These analyses were adjusted for hostility dimensions in either 1992 or 2001. All analyses were adjusted for age and gender, and participants' and parents' education.

3.4.5 Attrition analysis and handling of the missing data

It is well known that selective attrition may bias the results of longitudinal analysis. Previous studies using the YFS data have shown that men and participants with poor health and low socioeconomic status are most likely to drop out of YFS (Hintsanen et al., 2005; Raitakari et al., 2008). It has also been suggested that adequate missing data methods should be used in longitudinal studies and that missing data practices should be reported (Schlomer et al., 2010). Because of this, a number of different approaches were used to handle missing data and attrition.

In Study I, missing data analysis was restricted to analysis of attrition, which showed that when compared with the original population, a greater proportion of the current study participants were women (53.7% of those included in the analyses versus 50.0% of those lost to follow up; $\chi^2(1) = 3.93$, $p = 0.05$), but the participants did not differ

from the original population in childhood aggressive behavior scores $(F(1,2514) = 0.10,$ $P=0.75)$.

In Study II, a pattern mixture approach that has been developed for multilevel models (Hedeker & Gibbons, 1997) was used to adjust the models for attrition patterns. This makes it possible to analyze whether different attrition patterns affect the found results. Two dummy variables for absence were created. The first of these variables indicated missing data in childhood (0=no missing data in 1983: 1=missing data in 1983) and the second one indicated missing data in adulthood (0=no missing data in 1992, 1997, 2001 or 2007; 1=missing data at any point from 1992-2007). Additional analyses were performed where these variables were included separately as covariates.

In Study III Full Information Maximum Likelihood (FIML) estimation was used to deal with missing data. FIML is a modern method of missing data handling that makes it possible to make use of all available data, even when there are individuals with some missing responses. FIML was used because it is a default method of handling missing data in the Mplus software, which was used in Study III.

In Study IV, longitudinal multiple imputation was used to replace missing values for hostility measures in 1992, 2001 and 2007 (Royston, 2004; Spratt et al., 2010). Gender, age and parental education were used as potential predictor variables in the imputation model. Imputation was done by chained equations procedure in Stata 12.1 to obtain 20 imputed datasets (White et al., 2011). Multiple imputation was used because it is currently recommend as one of the modern missing data handling methods in epidemiology (Spratt et al., 2010), and because it is incorporated in the Stata 12.1 statistical software.

4 Results

4.1 HTR1B, childhood aggression, and adulthood hostility and anger (Study I)

Correlations between childhood aggressive behavior and adulthood hostility and anger were low, $r = .14$ and $r = .10$ respectively, but significant ($p < .001$). Older participants had lower childhood aggressive behavior ($r = -.16$, $p < .001$) and hostility ($r = -.08$, $p < .05$) levels than younger participants. Compared to women, men were more aggressive in childhood ($r = .17$, $p < .001$) and had higher hostility scores in adulthood ($r = .11$, $p < .01$), whereas women scored higher on anger ($r = -.20$, $p < .001$) than men in adulthood.

A significant main effect between rs6296 and childhood aggressive behavior was found: individuals having the C/C genotype (6% of the participants) had higher scores of aggressive behavior in childhood than those carrying C/G ($ß=-.34$, $p = 0.008$) or G/G ($ß=-.36$, $p = 0.004$) genotypes (34% and 60% of the participants, respectively). Associations between rs6296 and adulthood hostility or anger were not significant (p-values>.61). An interaction effect between childhood aggressive behavior and rs6296 was found in predicting adulthood hostility but not anger. The association between childhood aggressive behavior and adult hostility was weaker in the C/G and G/G genotype carriers (interaction effects: C/G genotype: $ß=-.23$, $p = 0.066$; G/G genotype $ß=-.28$, $p = 0.020$) than in the C/C genotype group. This interaction is demonstrated in Figure 2. Interaction effects for adulthood anger were not significant (C/G genotype: $ß=.10$, $p = .44$; C/C genotype: $ß=.04$, $p = .70$).

There was no gender difference in the association between childhood aggressive behavior and adult hostility ($ß=-.08$, $p = 0.29$) whereas a significant childhood aggressive behavior x gender interaction in predicting adulthood anger ($ß=-.15$, $p = 0.032$) indicated that childhood aggressive behavior predicted anger more strongly in women ($ß=.22$, $p < 0.01$) than in men ($ß=.06$, $p = .17$). However, the three-way interaction effect between gender x rs6296 x childhood aggressive behavior was non-significant ($p=.81$).
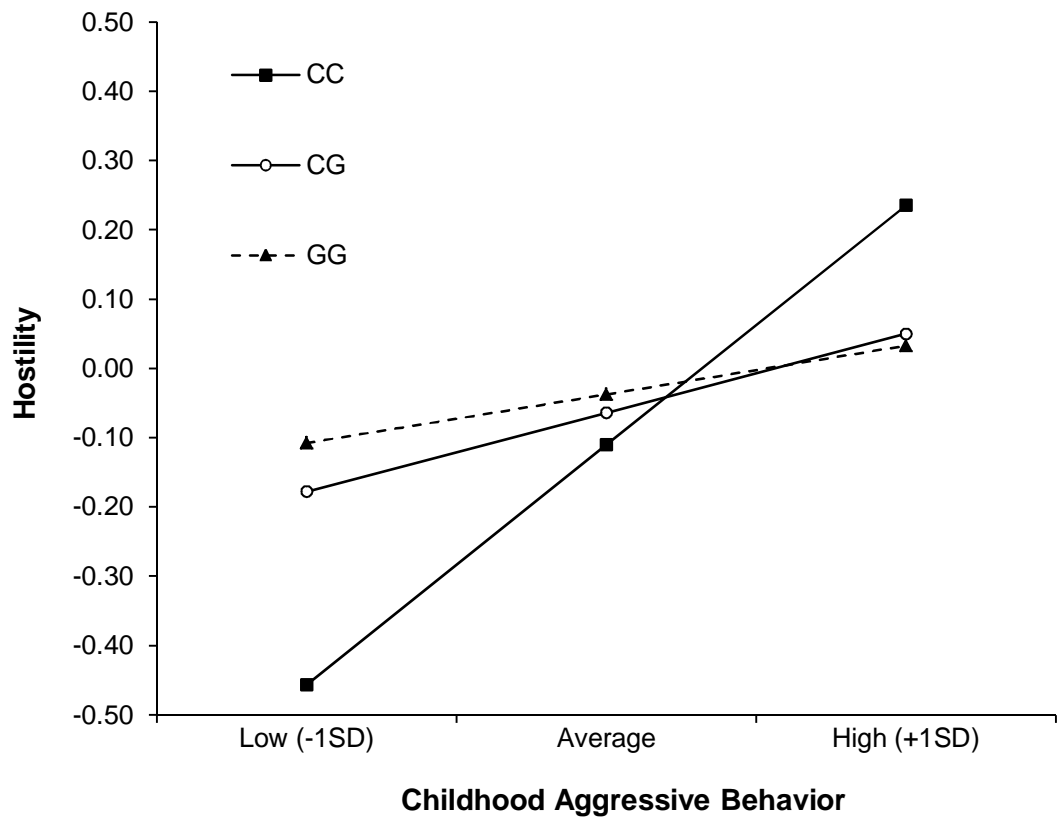
Figure 2. Predicted values of adulthood hostility by rs6296 and childhood aggressive behavior

4.2 Childhood family factors and cynicism and anger trajectories (Study II)

Table 1 presents the results from the separate main effect models for the 1980 family factors. Hostile child-rearing styles and parental SES predicted cynicism and anger trajectories. Low significance, low tolerance, strict disciplinary style and low parental SES predicted trajectories characterized by higher cynicism and anger. However, low tolerance in 1980 was not found to predict a cynicism trajectory. These results were replicated for 1983 for hostile child-rearing styles and parental SES. Unlike in 1980, in 1983 low tolerance was associated with cynicism (ß=.063, p < 0.001).

Table 1. Hostile child-rearing style components and parental SES predicting mean levels of cynicism and anger

	Cynicism	Anger
	β	β
Low tolerance	0.021	0.091***
Low significance	0.093**	0.127***
Strict discipline	0.260***	0.251***
Parental SES	-0.058***	-0.026***

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Values are regression coefficients.

Table 2 (Model 1) presents the results from the separate models with interaction effects for year 1980 family factors. There were also interaction effects between age and family factors assessed in 1980 when predicting adulthood cynicism: low significance, strict disciplinary style and low parental SES became stronger predictors of cynicism with age (Table 2: Model 1). One of these interaction effects, parental SES x age, was replicated for 1983 measurements (ß=-0.001, p < 0.05). No age-dependent associations were observed for anger (Table 2: Model 1).

To analyze the potential effect of SES on family factors, new models were constructed by entering hostile child-rearing components in the first step and parental SES in the second step, with cynicism and anger as outcome variables in separate models. From the year 1980 measurements, low significance, strict disciplinary style

and strict disciplinary style x age interaction predicted the development of cynicism (Table 2, Model 2). Adjusting for parental SES and parental SES x age interaction had a small effect on disciplinary style (a 14% decrease on the regression coefficient), but not on the other regression coefficients (Model 3). Parental SES and parental SES x age interaction were both significant. From the 1983 measurements, strict disciplinary style (ß=0.055, p < 0.01) and low significance (ß=0.057, p < 0.01) predicted the development of cynicism; ß=0.055, p < 0.01). The found association of low significance in 1980 predicting cynicism was not replicated in 1983 (ß=0.022, p > 0.05). As previously, adjusting for parental SES and parental SES x age interaction also had a small effect on strict disciplinary style (a 14% decrease on the regression coefficient), but not on the other regression coefficients (Model 3). Both parental SES and parental SES x age interaction were significant. For anger, low significance, low tolerance, and strict disciplinary style predicted the development of anger (Table 2, Model 2). Adjusting for parental SES had a small effect on strict disciplinary style (a 12% decrease on the regression coefficient), but it did not substantially affect the other regression coefficients (Model 3). From the 1983 measurements, low tolerance (ß=0.084, p < 0.001) and strict disciplinary style (ß=0.073, p < 0.001) predicted the development of anger, and adjustment for parental SES had very little, if any, effect on these two associations. The strengthening associations between strict disciplinary style and cynicism, and parental SES and cynicism, are illustrated in Figure 3 and Figure 4, respectively.

Finally, the effect of selective attrition on cynicism and anger trajectories was examined. While some of the dummy covariates of attrition were significant, neither of these covariates substantially changed the associations of interest (data not shown).

Table 2. Hostile child-rearing style components and parental SES and their interactions with age predicting age-dependent trajectories of cynicism and anger

Cynicism	Model 1 β	Model 2 β	Model 3 β
Low tolerance	0.024	-0.023	-0.011
Low tolerance x age	0.001	–	–
Low significance	0.101***	0.096***	0.097***
Low significance x age	0.005*	0.004	0.004
Strict discipline	0.322***	0.291***	0.251***
Strict discipline x age	0.018***	0.016**	0.015**
Parental SES	-0.061***	–	-0.061***
Parental SES x age	-0.001*	–	-0.002*
Age	–	-0.029***	-0.028***
Gender	–	0.166***	0.171***
Cohort (1962 as reference)	–	–	–
Cohort 1965	–	-0.045	-0.035
Cohort 1968	–	-0.039	-0.032
Cohort 1971	–	-0.114	-0.078
Cohort 1974	–	-0.174***	-0.140**
Cohort 1977	–	-0.058	-0.022
Constant	–	2.622***	2.581***
Anger	**Model 1 β**	**Model 2 β**	**Model 3 β**
Low tolerance	0.091***	0.067**	0.075***
Low tolerance x age	0.000	–	–
Low significance	0.127***	0.098**	0.102***
Low significance x age	-0.001	–	–
Strict discipline	0.263***	0.165**	0.126*
Strict discipline x age	0.007	–	–
Parental SES	-0.026**	–	-0.027***
Parental SES x age	0.000	–	–
Age	–	-0.009***	-0.009***
Gender	–	-0.247***	-0.241***
Cohort (1962 as reference)	–	–	–
Cohort 1965	–	-0.056	-0.043
Cohort 1968	–	-0.041	-0.031
Cohort 1971	–	-0.105*	-0.076
Cohort 1974	–	-0.111*	-0.082
Cohort 1977	–	0.006	0.035
Constant	–	2.384***	2.338***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

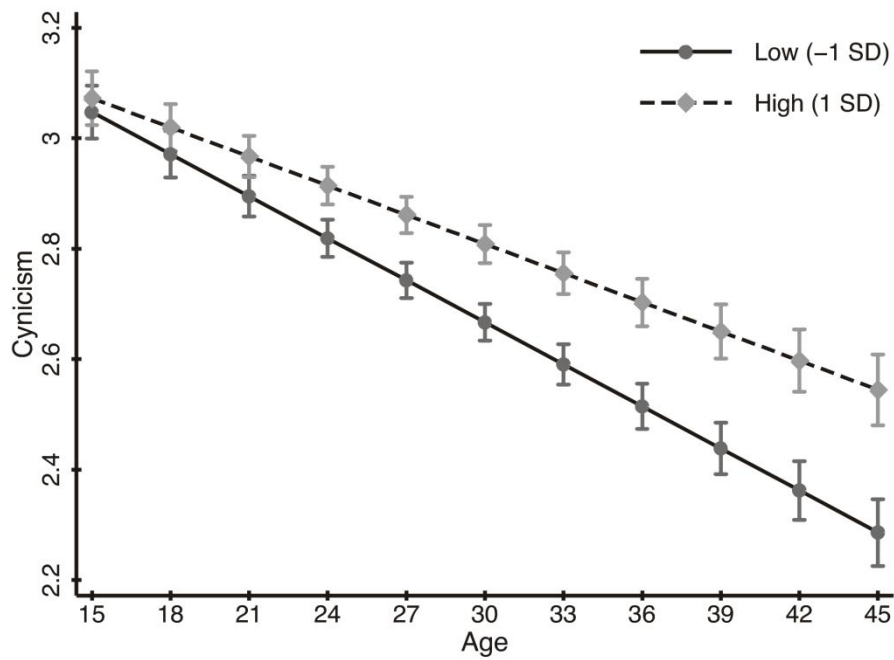**Figure 3.** Predicted cynicism trajectories by strict disciplinary style. Values are means, with 95% confidence intervals represented by vertical bars (low=1 SD below the mean; high=1 SD above the mean)
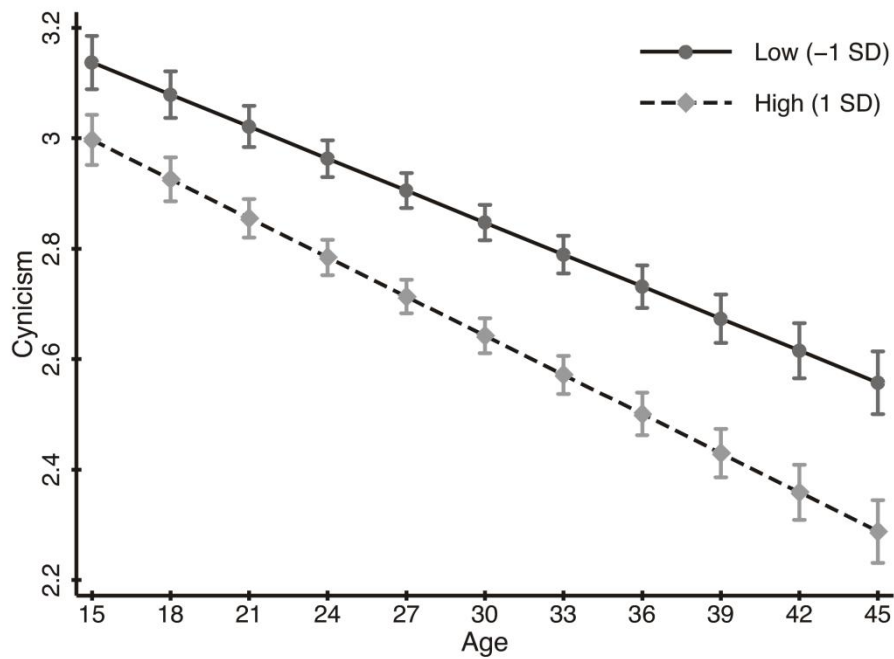

Figure 4. Predicted cynicism trajectories by parental SES. Values are means, with 95% confidence intervals represented by vertical bars (low=1 SD below the mean; high=1 SD above the mean)

4.3 Measurement invariance, stability, and change of cynicism and anger (Study III)

One-factor CFA models for both anger and cynicism fit the data well at each assessment point. Fit indexes indicated a reasonable model fit (CFI > .95, RMSEA < .08) for most of the models and acceptable model fit for 2001 anger (Women: CFI = .944, RMSEA = .075; Men: CFI = .946, RMSEA = .079). Further, except for Item 1 on the cynicism scale, in which loadings varied between .26 and .39 in women, and between .21 and .38 in men, standardized factor loadings were well above .40. There was some variability in standardized factor loadings, but no clear trends across measurement times.

For women, the strict invariance model of anger fits the data well (RMSEA=.042, CFI=.912, BIC=97792), but since the intercepts of Items 2 and 3 had very large MI values for the first time point (1992), the intercepts of these items were set free to establish a partial strict invariance model. This model had better fit (RMSEA=.036, CFI=.935, BIC=97543) than the previous model. Similarly in men, the strict invariance model of anger fits the data well (RMSEA=.039, CFI=.908, BIC=69026), but since the intercepts of the same two items (2 and 3) had very large MI values for the first time point (1992), they were set free. The partial strict invariance model thus established fits with the data better (RMSEA=.034, CFI=.928, BIC=68868) than the previous strict invariance model.

The longitudinal strict invariance model of cynicism was found to fit the data in women (RMSEA=.040, CFI=.922, BIC=91232). However, since the intercept of Item 5 at the first time point had a very large MI value, the Item 5 restriction of equal intercept at the first time point was dropped. The partial strict invariance model established had better fit (RMSEA=.037, CFI=.935, BIC=91080) than the previous one, but there were still large MI values for the intercept of Item 1 at time points 2 (1997) and 4 (2007). Therefore, the Item 1 restriction of equal intercept at the second (1997) and fourth time (2007) points was dropped. The established partial strict invariance model fitted the data better (RMSEA=.032, CFI=.950, BIC=90908) than the previous partial strict invariance model.

For men, the strict invariance model of cynicism fitted the data (RMSEA=.039, CFI=.910, BIC=67195), but since the intercept of Item 5 had a very large MI value for

the first time point (1992), it was set free. The partial strict invariance model established fitted the data better (RMSEA=.036, CFI=.926, BIC=67063) than the strict invariance model. However, there were still two large MI values present for the intercept of Item 1 at time points 2 (1997) and 4 (2007). They were set free and a second partial strict invariance model was established that was found to fit the data better (RMSEA=.031, CFI=.945, BIC=66909) than the previous partial strict invariance model.

Because the items at the first time point (1992) were slightly different from the corresponding items at the following points (1997, 2001 and 2007), additional analyses were performed in which the first point was not used and measurement invariance was evaluated over three time points (T2 -> T3 -> T4). The strict measurement invariance model of anger was found to fit the data well in women (RMSEA=.041, CFI=.939) and in men (RMSEA=.038, CFI=.939). For cynicism, the strict invariance showed a good fit in both women (RMSEA=.044, CFI=.937, BIC=67010) and men (RMSEA=.044, CFI=.925, BIC=47341). However, since for both genders there were two large MI values present for the intercept of Item 1 at time points 2 (1997) and 4 (2007), they were set free and partial strict invariance models were separately established for both genders. In women (RMSEA=.037, CFI=.955, BIC=66850) as well as men (RMSEA=.037, CFI=.948, BIC=47198), the partial strict invariance model yielded a better fit than the previous model.

Rank-order stability and a total continuity coefficient are shown in Table 3.The total continuity coefficient was calculated by multiplying all three time point coefficients. For anger, the total continuity coefficient over 15 years was 0.34 in women and 0.36 in men. The corresponding values for cynicism were 0.37 in women and 0.36 in men.

Results for latent growth curves are shown in Table 4. Linear trajectories for anger showed a good fit in both women (RMSEA=.037, CFI=.928) and men (RMSEA=.035, CFI=.926). Linear trajectories for cynicism also showed a good fit in women (RMSEA=.035, CFI=.940) and men (RMSEA=.032, CFI=.940). Correlations between slope and intercept were negative and significant, except for women in cynicism, but very small (r >.-04).

Non-overlapping point estimates indicated that the mean, i.e., initial, level of anger was higher in women than in men (3.11 vs. 2.69). There were no differences between the initial variance levels. The mean level of slope was also higher in women than men

(-0.12 vs. -0.05), which indicates that women had a higher rate of change, in that their anger levels fell more steeply than men's did. All means and variances of intercept and slope were statistically significant, indicating that there are significant intra- and inter-individual differences in levels of anger and cynicism.

Men had a higher mean level of cynicism than women (2.92 vs. 2.79), but there were no differences between the levels of intercept variance. The mean level of slope did not differ between men and women either, but men had a higher variance of slope (0.11 vs. 0.04) than women. These results indicate that trajectories for cynicism declined at the same rate of change, but that the variance increased more among men than women.

Table 3. Rank order stability of anger and cynicism

Rank-order stability	T1->T2	T2->T3	T3->T4	Total continuity
Women, anger	0.63	0.78	0.70	0.34
Men, anger	0.62	0.71	0.81	0.36
Women, cynicism	0.63	0.77	0.77	0.37
Men, cynicism	0.59	0.75	0.81	0.36

Table 4. Latent growth curves of anger and cynicism

	Intercept				Slope			
	Mean	CI 95%	Variance	CI 95%	Mean	CI 95%	Variance	CI 95%
Anger								
Women	3.11	(3.06; 3.17)	0.18	(0.14; 0.22)	-0.12	(-0.14; -0.09)	0.02	(0.00; 0.04)
Men	2.69	(2.64; 2.75)	0.22	(0.17; 0.27)	-0.05	(-0.08; -0.02)	0.07	(0.03; 0.10)
Cynicism								
Women	2.79	(2.74; 2.83)	0.19	(0.16; 0.23)	-0.17	(-0.20; -0.15)	0.04	(0.02; 0.06)
Men	2.92	(2.87; 2.97)	0.22	(0.17; 0.26)	-0.14	(-0.17; -0.10)	0.11	(0.08; 0.15)

Note. All values were significant at the level of $p < .001$, except for anger in women where the variance of the slope was significant at the level of $p < .05$, and anger in men where the mean of the slope was significant at the level of $p < .01$.

4.4 Unemployment and hostility (Study IV)

Associations between hostility dimensions and unemployment status are presented in Table 5. In cross-sectional analyses, higher cynicism and higher paranoia were associated with higher likelihood of short-term unemployment in 2001. The association between cynicism and short-term unemployment did not remain significant after additional adjustment for parental education level and participants' own education level. Both high cynicism and high paranoia were cross-sectionally associated with a higher likelihood of being currently unemployed in 2007.

In longitudinal analyses, cynicism measured in 1992 did not predict short-term unemployment in 2001. Paranoia measured in 1992 predicted a higher likelihood of short-term unemployment in 2001. However, this association did not remain significant after additional adjustment for parental education level and participants' own education level. High cynicism and high paranoia measured in 2001 predicted a higher likelihood of being currently unemployed in 2007. High paranoia measured in 1992 predicted a higher likelihood of being unemployed in 2007, but after additional adjustment for parental education level and participants' own education level this association did not remain significant.

High cynicism and high paranoia were associated with a higher likelihood of having a history of unemployment during the time period from 1992 to 2001. The associations between high cynicism and a history of unemployment from 1992 to 2001 did not remain significant after additional adjustments for parental education level and participants' education level were made. In all analyses, high paranoia and high cynicism were associated with having a history of unemployment at some point during the life course. These associations were not attenuated by additional adjustments.

Table 6 presents the associations between cynicism and paranoia and unemployment months. High cynicism and high paranoia were associated with a higher number of unemployment months during the previous 12 months in 2001 in cross-sectional analyses. However, neither paranoia nor cynicism measured in 1992 predicted the number of unemployment months (during the previous 12 months) measured in 2001. High cynicism and high paranoia predicted the number of unemployment months from 1992 to 2001, and also the total number of unemployment months (measured in 2007)

during the life-course. These associations were not attenuated by additional adjustment for participants' own level of education and parental education.

The number of unemployment months in 2001 was associated with both higher cynicism ($\beta = 0.02$, $p < 0.001$) and higher paranoia ($\beta = 0.02$, $p < 0.01$) in cross-sectional analyses when cynicism or paranoia in 1992 was controlled. After additional adjustment for parental education and participants' level of education, these associations remained significant ($p < 0.05$). Being unemployed in 2001 did not predict levels of cynicism ($\beta = 0.07$, $p = 0.16$) or paranoia ($\beta = 0.08$, $p = 0.07$) in 2007 when cynicism or paranoia in 2001 was controlled. When earlier, i.e., 1992, measure of cynicism or paranoia was used as a control variable, being unemployed in 2001 predicted higher cynicism ($\beta = 0.10$, $p < 0.05$) and higher paranoia ($\beta = 0.10$, $p < 0.05$) in 2007. However, these two associations did not remain significant after additional adjustments for participants' own education level and parental education level.

Table 5. Cynicism and paranoia predicting odds of being unemployed

	Unemployment status in 2001				Ever unemployed between 1992 and 2001			
	Model 1		Model 2		Model 1		Model 2	
	OR	CI 95%	OR	CI 95%	OR	CI 95%	OR	CI 95%
Cross-sectional								
Cynicism 2001	1.25*	(1.03-1.52)	1.17	(0.96-1.42)	1.22**	(1.07-1.39)	1.15	(1.00-1.31)
Paranoia 2001	1.32**	(1.07-1.63)	1.25*	(1.01-1.54)	1.29***	(1.11-1.50)	1.24**	(1.06-1.44)
Longitudinal								
Cynicism 1992	1.16	(0.94-1.43)	1.08	(0.87-1.34)	1.18*	(1.02-1.36)	1.12	(0.97-1.29)
Paranoia 1992	1.28*	(1.04-1.59)	1.23	(0.99-1.52)	1.22**	(1.05-1.42)	1.19*	(1.02-1.38)
	Unemployment status in 2007				Ever being unemployed			
	Model 1		Model 2		Model 1		Model 2	
	OR	CI 95%	OR	CI 95%	OR	CI 95%	OR	CI 95%
Cross-sectional								
Cynicism 2007	2.15***	(1.43-3.24)	2.04***	(1.35-3.07)	1.35***	(1.14-1.59)	1.31**	(1.11-1.55)
Paranoia 2007	2.10***	(1.41-3.15)	1.99***	(1.33-2.98)	1.48***	(1.24-1.77)	1.44***	(1.21-1.73)
Longitudinal								
Cynicism 2001	2.18***	(1.42-3.34)	2.06**	(1.34-3.18)	1.39***	(1.17-1.64)	1.35***	(1.14-1.60)
Cynicism 1992	1.52	(0.98-2.34)	1.42	(0.91-2.21)	1.41***	(1.18-1.68)	1.37***	(1.14-1.64)
Paranoia 2001	2.02**	(1.33-3.07)	1.91**	(1.25-2.91)	1.55***	(1.29-1.86)	1.51***	(1.26-1.82)
Paranoia 1992	1.57*	(1.04-2.38)	1.49	(0.98-2.27)	1.45***	(1.20-1.75)	1.41***	(1.17-1.71)

* p < 0.05, ** p < 0.01, *** p < 0.001.

Model 1 - adjusted for age and gender

Model 2 - adjusted for age, gender, education, and parental education

Table 6. Poisson regression with overdispersion for cynicism and paranoia predicting unemployment months among those who had been unemployed at least one month

| | Unemployment months during past 12 months in 2001 | | | |
| | Model 1 | | Model 2 | |
	IRR	CI 95%	IRR	CI 95%
Cynicism 2001	1.42**	(1.10-1.82)	1.35*	(1.05-1.72)
Cynicism 1992	1.15	(0.87-1.51)	1.05	(0.80-1.38)
Paranoia 2001	1.42*	(1.08-1.86)	1.37*	(1.05-1.78)
Paranoia 1992	1.28	(0.99-1.66)	1.22	(0.94-1.58)
	Unemployment months between 1992 and 2001			
	Model 1		Model 2	
	IRR	CI 95%	IRR	CI 95%
Cynicism 2001	1.45***	(1.21-1.74)	1.33**	(1.11-1.60)
Cynicism 1992	1.39***	(1.15-1.69)	1.27*	(1.06-1.53)
Paranoia 2001	1.45***	(1.18-1.76)	1.34**	(1.10-1.63)
Paranoia 1992	1.41**	(1.17-1.71)	1.32**	(1.09-1.59)
	Unemployment months up to 2007			
	Model 1		Model 2	
	IRR	CI 95%	IRR	CI 95%
Cynicism 2007	1.52***	(1.20-1.93)	1.44**	(1.14-1.82)
Cynicism 2001	1.73***	(1.35-2.22)	1.65***	(1.28-2.11)
Cynicism 1992	1.51**	(1.15-1.97)	1.43**	(1.10-1.86)
Paranoia 2007	1.59***	(1.23-2.06)	1.52**	(1.17-1.96)
Paranoia 2001	1.80***	(1.38-2.36)	1.75***	(1.33-2.29)
Paranoia 1992	1.71***	(1.28-2.29)	1.64***	(1.24-2.18)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Model 1 - adjusted for age and gender

Model 2 - adjusted for age, gender, education, and parental education

5. Discussion

The present thesis examined the development of hostility and anger from a life course perspective. Current findings emphasize the effect of childhood family factors, childhood aggression, and the serotonergic system on developmental pathways of hostility and anger, which were found to be moderately stable. In addition, hostility during the life course was found to be associated with unemployment, that in turn, was found to influence hostility in the short term.

5.1 Influence of HTR1B on continuity of childhood aggression to adulthood hostility and anger

Childhood aggression was found to predict adulthood anger and hostility over 27 years. This provides further support for the continuity of childhood aggression as adult anger and hostility (Caspi et al., 2002; Caspi et al., 2003; Kokko et al., 2009). Rs6296 was found to be associated with childhood aggression. Individuals carrying the CC genotype had a higher level of childhood aggression than individuals carrying the CG or GG genotype. Previous studies have not found childhood aggression to be associated with the C allele of the rs6296 gene (e.g., Davidge et al., 2004).

HTR1B rs6296 was not found to be related to hostility, but it was found to modify the association between childhood aggression and adulthood hostility. Individuals who were highly aggressive in childhood and had the CC genotype of rs6296 had a higher level of adult hostility than individuals who carried the CG or GG genotypes. Present findings suggest that individuals with the genetic risk (CC genotype) are more likely to follow a psychologically unhealthy developmental pathway if they are aggressive as children. In contrast, it seems that individuals who are not aggressive as children, but who have the CC genotype, are less likely to be hostile in adulthood.

Most previous gene-interaction studies have concentrated on examining the interactions between genes and specific environmental factors (e.g., Jokela et al., 2007), whereas here the focus was the interaction between the characteristics of the individual and genes. There are some previous findings where specific genes have moderated the association between childhood and adulthood characteristics (e.g., Keltikangas-Järvinen

et al., 2008). The current finding supports the probabilistic epigenesis theory that presents individual development as a product of multiple interacting factors (e.g., genetic activity and behavior) that may have bidirectional influences (Gottlieb, 2007). Most of the studies that investigate the probabilistic epigenesis theory come from behavioral ecology and focus on environmental influences in non-human animals. There is, however, some evidence of bidirectional influences between genetic activity, life events, and personality in humans that support the theory's application in this domain (Kandler et al., 2012). The current results add to these findings and provide further evidence how genes could influence individual developmental pathways.

There are some possible explanations why rs6296 can affect the continuum of childhood aggression to adulthood hostility. Rs6296 has been shown to be in linkage disequilibrium with other functional HTR1B SNPs and part of haplotypes that have been shown to modulate gene expression (Duan et al., 2003; Jensen et al., 2009). This indicates that probably the influence of rs6296 goes through other SNPs in the HTR1B region. Previous research from animal models has also shown that HTR1B is a strong candidate gene for behaviors related to aggressiveness (e.g., Saudou et al., 1994).

Where previous studies have shown that gender moderates the effect of serotonin gene polymorphisms (Brummett et al., 2008; Williams et al., 2003), in the current study this connection was not found. This might be explained by the fact that current study concentrated on HTR1B, whereas previous studies have mainly examined the serotonin transporter promoter (5-HTTLPR).

5.2 Role of family factors in the development of hostility and anger

All hostile child-rearing style components and parental SES were found to predict the trajectories of cynicism and anger. With the exception of one of the child-rearing style components, low tolerance, these predictive associations were replicated over the second measurement point three years later, which indicates robustness of these findings.

The current results are in line with the earlier findings from the same YFS data. A hostile child-rearing style in childhood predicted higher hostility nine years later in

adolescence (Räikkönen et al., 2000), and low parental SES predicted hostility 15 years later in adulthood (Keltikangas-Järvinen & Heinonen, 2003). The results are also in line with other previous studies associating childhood family factors and low parental SES with later hostility (Gallo & Matthews, 2003; Houston & Vavak, 1991; Matthews et al., 1996). However, all the above-mentioned previous studies have adopted one single hostility-measurement point in adolescence or early adulthood, whereas the current study adopted several measurement points several years apart, enabling examination of longitudinal trajectories over time. The current findings suggest that the connection between childhood family factors and adulthood cynicism and anger persists over 27 years, if not longer. This supports the notion that family factors have a far-reaching influence on hostility and anger. Hostility and anger have both been shown to be moderately heritable (e.g., Cates et al., 1993), which might be reflected in genetic transmission manifested as parental child-rearing practices and as offspring hostility, and current findings may partly be accounted for by this common effect.

Although measures of the current study were theoretically well-based aspects of childhood risk factors, these measurements did not cover a number of childhood exposures, such as emotional, sexual, or physical abuse, or family violence. Most of the families in the current study were not "risky families" in the sense of being exposed to highly adverse childhood environments. Instead, the current study used a population-based sample of Finnish families with rather subtle differences in child-rearing practices. Thus, study findings are valuable because they suggest that even variations in typical parenting practices (that is, some parents being more insensitive and more controlling than others) may be associated with offspring levels of hostility and anger in adulthood.

An age-related accumulation of family factors, that is family factors x age interaction, was found in the development of hostility, but not anger. This indicates that individuals whose parents had a hostile child-rearing style (the parents experienced that their child had low significance for them and regularly needed strict disciplinary actions) had lower rates of change in their levels of cynical hostility, i.e., their hostility values stayed higher longer than individuals whose parents did not have a hostile child-rearing style. In addition, among individuals with high parental SES, the levels of cynicism declined faster when compared to individuals with low parental SES. Previous

studies have not investigated the accumulation of childhood environmental factors according to age, which might be especially important in case of milder risky forms of common child-rearing practices.

Including all the family factors together in the same regression model made almost no difference compared to the results estimated for each family factor in a separate analysis. This indicates that several family factors may play an independent or equal role. However, it seems that two family factors, i.e., harsh parental disciplinary style and low parental SES, are slightly stronger predictors than the other factors adopted, as far as cynicism is concerned. Despite many conceptual similarities, these findings suggest that the origins of hostility and anger are slightly different. Hostility and anger have also been shown to have a different genetic background (Merjonen, Keltikangas-Järvinen et al., 2011). Taken together, these findings highlight the importance of treating hostility and anger as separate concepts.

The current results support a risky families model (Repetti et al., 2002) that posits that early family factors have a strong and far-reaching influence on later health and psychosocial development. Accordingly, previous studies have shown that exposure to poor household functioning and poor parenting during childhood is connected to poor adulthood somatic health (Felitti et al., 1998) and to mental health problems, such as depression (Duggan et al., 1998; Gao et al., 2012; Kendler et al., 2000). It has also been quite consistently found that low SES is associated with many physical and mental health outcomes (Adler et al., 1993; Adler & Ostrove, 1999) and that SES also has a great influence on many aspects of child development (Bradley & Corwyn, 2002; Chen et al., 2002). Regarding the widespread psychosocial and health effects of hostility (e.g., Chida & Steptoe, 2009), family factors might influence somatic and psychological health through hostility.

5.3 Measurement invariance, stability and change of hostility and anger

The results show that all the final longitudinal measurement invariance models for men and women achieved partial strict measurement invariance. This implies that both anger and cynicism can be reliably measured from early adulthood to middle adulthood with

the widely used self-report instruments based on the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957) and Minnesota Multiphasic Personality Inventory (Comrey, 1957; Comrey, 1958). Current findings are supported by a recent cross-sectional study showing that anger had strong measurement invariance (Zimprich & Mascherek, 2011).

Anger and cynicism were found to have moderate rank-order stability from early adulthood to middle adulthood and this stability was similar in men and women, which indicates that individuals tend to preserve their rank-order position in relation to others over time. In addition, mean levels of cynicism and anger decreased over time. Both of these findings are in line with previous studies showing that individual differences in hostility are moderately stable over time and show a decreasing mean level trend (Adams, 1994; Siegler et al., 2003). The same results have also been found in some cross-sectional studies (e.g., Haukkala, 2002), whereas some other studies have found that hostility increases at an older age (e.g., Barefoot et al., 1993). However, mean levels of anger decreased at a faster rate in women than in men, indicating that there could be gender-specific variability, at least in anger trajectories. There were also considerable intra-individual and inter-individual differences in cynicism and anger, indicating that individuals differ in their initial anger and cynicism levels and that change in these levels also involves significant variability among individuals.

Current results are supported by studies that have conceptualized hostility in Five-Factor Model terms (Digman, 1990), which means that hostility is conceptually similar to low agreeableness or high trait antagonism (Watson & Clark, 1992). Agreeableness tends to be a relatively stable personality trait that increases as individuals age (Roberts & DelVecchio, 2000; Roberts et al., 2006). However, hostility has also been associated with high neuroticism and low extraversion (e.g., Tremblay & Ewart, 2005), so agreeableness alone does not quite capture the psychological nature of hostility. In addition, the observed changes in mean levels in anger are partly in line with studies showing that the expression of both anger and negative emotions has been found to decline with age (Galambos et al., 2006; Galambos & Krahn, 2008; McAdams & Olson, 2010). All this provides additional support for the measure-independent stability of these concepts.

There was also evidence of variance divergence with age, since variance in anger and cynicism increased over time in both genders. However, variance in cynicism increased

more in men than in women over time, indicating that people become more dissimilar to each other in levels of anger and cynicism over time in general, and that there is some gender difference in this. These results are further supported by studies showing that variance in negative affect tends to decrease in middle age (e.g., Charles et al., 2001). Together with a decrease in mean levels, the present results indicate that individuals become less angry and hostile. Probably learning mechanisms, an increase in self-control (Vazsonyi & Huang, 2010), and biological processes such as decline in testosterone levels (Archer, 2006) explain these results. However, the found faster rate of change in cynicism in men suggests that the developmental trajectories of anger and cynicism are at least partly gender-specific.

One-factor solutions fit well for both anger and cynicism measures and the standardized factor loadings were above the .40 value, except for the first item ("It takes a lot of argument to convince most people of the truth") on the cynicism scale. This item was not invariant over time either. Although this question can be seen to measure mistrust, one of the components of cynicism (Smith, 1994), there is some question whether this particular item should be removed from the cynicism scale. The scale used here is derived from the MMPI (Comrey, 1957; Comrey, 1958), and shares six items with the 13-item cynicism scale derived by Barefoot et al. (1989) from the Cook-Medley Hostility scale and five items with the 9-item cynical distrust factor derived by Greenglass and Julkunen (1989). The Cook-Medley Hostility scale was originally designed to measure teacher attitudes, which might explain why some questions do not work as well as others (Barefoot & Lipkus, 1994). In future studies that use the YFS data, the above-mentioned item with low loading could be removed from the cynicism scale, especially when conducting analyses over several time points.

The current results support the construct and concept validity of cynicism and anger – an issue that many previous studies have neglected (see: Barefoot & Lipkus, 1994). Most studies have focused on examining the outcomes of hostility and anger, although the psychometric properties of these concepts have remained somewhat unclear. Moreover, there has been a general lack of psychometric studies in behavioral medicine literature.

5.4 Hostility and unemployment

The findings of the current study suggest that there is a bidirectional relationship between hostility and unemployment. High paranoia and high cynicism were associated with a higher likelihood of being unemployed and longer unemployment duration in cross-sectional and longitudinal analyses. Unemployment, in turn, was associated with high hostility dimensions only in the short term and it did not predict high hostility dimensions in the long term when participants' own and parental education were taken into account. This suggests that unemployment affects hostility in the short term, but it does not contribute to clear personality change over a longer follow-up period.

There were small differences in cross-sectional associations between hostility dimensions with respect to short-term unemployment status in 2001. Only high paranoia was associated with a higher risk of short-term unemployment in 2001, but both hostility dimensions were associated with a higher risk of current unemployment in 2007. In longitudinal analyses, high hostility measured in 1992 did not predict short-term unemployment in 2001, but hostility measured in 2001 did predict a higher likelihood of being currently unemployed in 2007. Associations between high-hostility dimensions and history of unemployment were also clear: high hostility was associated with a history of unemployment from 1992 to 2001 and over the life course. In addition, high hostility dimensions predicted the number of unemployment months from 1992 to 2001 and also over life course. There was also evidence supporting the other direction of causality: short-term unemployment predicted higher levels of hostility in 2001 and in 2007. However, this later association did not remain significant after additional adjustments for parental and participants' own education level were made. Altogether, these findings indicate that high hostility robustly predicts unemployment, but unemployment predicts higher hostility levels only over the short term.

Current findings support the psychosocial vulnerability model, which hypothesizes that hostile individuals are at greater risk for poor social outcomes due to their hostile behavior (Kivimäki et al., 2003; Smith & Frohm, 1985; Smith, 1994). It could be that hostile individuals are more prone to have conflicts at work, which in turn could lead to unemployment. This is supported by findings where high hostility has been associated with interpersonal problems (Guyll & Madon, 2003; Larkin et al., 2002; Ozer & Benet-

Martinez, 2006) and low social support (Benotsch et al., 1997; Heponiemi et al., 2006; Smith et al., 1988). In addition, hostile individuals do not find social networks as beneficial as individuals with low hostility (Seeman & Syme, 1987; Watkins et al., 1992), while it has been shown that a high percentage of workers find their jobs through social networks (Franzen & Hangartner, 2006). Taken together, these findings might explain why hostility predicts unemployment and its duration. The current results are also partly supported by the finding that emotional stability is associated with better career success (Sutin et al., 2009). In addition, it is also possible that in times of financial crisis, hostile individuals are more likely to get laid-off due to problems that their hostile behavior can cause in the workplace.

The current results are in line with the present knowledge that unemployed individuals have poorer general mental health than employed individuals (Wanberg, 2012). Hostility has been found to predict mental health disorders such as depression (Nabi et al., 2010) and physical health problems such as coronary heart disease risk (Chida & Steptoe, 2009; Smith et al., 2004). In turn, both mental and physical health problems have been found to predict future risk for unemployment (e.g., Strully, 2009). In addition, because unemployment was found to predict hostility in the short term at least, it is also possible that it is hostility that (among other predictors) increases mental and physical health problems in unemployed individuals. These findings are also in line with the health selection model (Bartley, 1988; Bartley, 1994), although it was not directly examined here.

Aggressive behavior in childhood has been shown to be associated with long-term unemployment in adulthood (Kokko & Pulkkinen, 2000; Kokko et al., 2000). In the current study, childhood aggressive behavior was found to predict hostility in adulthood, which could also partly explain the findings. The personality dimension of high emotional negativity has been shown to predict unemployment status and duration (Hintsanen et al., 2009). Hostility and emotional negativity share some important psychological components such as cynical distrust against others (hostility) and experiences of fear and anger (negative emotionality). At least one previous study did not find an association between childhood affective hostility and adulthood unemployment (Kivimäki et al., 2003). This lack of association might reflect differences in how affective vs. cognitive hostility are associated with unemployment

risk. Although the two sides of hostility have a high correlation, they are conceptually different (Smith et al., 2004) and they may have different social consequences.

Some of the associations were attenuated by additional adjustments for participants' educational level and parental education. This indicates that socioeconomic position is a likely mediator between high hostility and increased unemployment risk. Thus, high hostility may lead to selection into lower education, or lack of it, which in turn would be related to a higher risk of unemployment. Education has also been found to moderate the impact of unemployment on well-being (Hepworth, 2011), suggesting that education plays an important role in how unemployment affects individuals' experiences of unemployment. In addition, in the current data set it has been previously found that a low educational level moderates the association between high anger and subclinical atherosclerosis (Merjonen et al., 2008) and that low parental socioeconomic position increases the risk of depressive symptoms (Elovainio et al., 2012). This indicates that especially individuals with low education might be vulnerable to the ill-health effect of hostility. Current findings are also in line with studies where the association between personality characteristics and general life outcomes has been shown to be attenuated by socioeconomic position (Chapman et al., 2010; Nabi et al., 2008).

There is naturally an association between job-search behavior and finding employment. Previous studies have shown that the FFM personality traits low extraversion and low agreeableness are associated with a lower level of job search behavior (Kanfer et al., 2001). These two traits have also been associated with high hostility (Tremblay & Ewart, 2005; Watson & Clark, 1992). Thus, differences in job search behavior are among the possible explanations for the observed association between high hostility and increased risk for unemployment.

5.5 Methodological considerations

The longitudinal YFS data is naturally a major strength of the current study, because it makes it possible to investigate the development of hostility and anger of the same individuals over 27 years. The current study is also one of the few studies that have examined hostility and anger from a life course perspective. In addition, modern missing-data methods, such as pattern mixture modelling, FIML, and multiple

imputation, were used in Studies II-IV. This increases the likelihood that selective attrition has not biased the found results.

Like all studies, the current study has some limitations. First of all, the childhood measure of aggressive behavior used in Study I was a non-standardized scale, which may have introduced measurement imprecision and thereby attenuated correlations with adulthood hostility. In Study II, some of the participants were already 18-years old when their parents answered the hostile child-rearing style questionnaire, thereby reflecting parental attitudes toward their teenage children rather than small children.

In Study III, the small changes in questions meant that only a partial strict measurement invariance model was able to be established. In general, it has been discussed that strict invariance can be difficult to achieve and researchers typically find only partial invariance (Millsap & Meredith, 2007). In addition, it has been shown that partial invariance due to differential item functioning on some specific questions does not have a great impact on the full inventory (Millsap & Kwok, 2004).

In Study IV, the main limitations are related to the measurement of unemployment. The unemployment duration from 1992 to 2001 and over the life course were based on retrospective self-reported data. This can be problematic, because it can result in common method variance (Podsakoff et al., 2003), which indicates that discovered variance in variables actually reflects the measurement method rather than the actual constructs. For example, it is possible that hostile individuals recall the duration of unemployment differently from non-hostile individuals. There is also a bias in the measurement of unemployment duration related to the measurement year: 23.7% of the participants reported higher unemployment duration from 1992 to 2001 than over the life course. Most likely individuals remember more accurately the length of recent rather than distant unemployment periods. Unemployment status was also measured differently in 2001 and 2007. Therefore, results from 2001 to 2007 are not directly comparable with each other. Another important issue is that the unemployment rate among 35 to 44-years olds in Finland was 5.0% in 2007 (Official Statistics of Finland, 2012), whereas in the current sample it was 3.5% in 2007. This suggests that the current sample does not represent the whole Finnish population. Previous studies have shown that individuals with poor health and low socioeconomic status were most likely to drop out of the current YFS data (Hintsanen et al., 2005; Raitakari et al., 2008). This could

explain why the unemployment ratio is a bit lower in the study sample when compared to the whole population. It is also worth mentioning that the youngest participants were only 24 years old in 2001. This means that many of these participants had only limited exposure to work life, and therefore limited possibilities of being exposed to unemployment in the time period from 1992 to 2001. In addition, in the 1990s there was a period of recession in Finland. This means that the risk of being unemployed in 2001 was greater than in 2007.

5.6 Conclusions and practical implications

The current results from the longitudinal prospective study suggest that childhood aggressive behavior is associated with hostility and anger in adulthood, and that the serotonergic system might moderate this association. Childhood family factors were found to contribute to the developmental trajectories of cynicism and anger. For cynicism, the effect of child-rearing practices seems to accumulate over time, indicating that individuals' levels of cynicism diverge based on their family factors. Cynicism and anger were found to be moderately stable concepts from early to middle adulthood and it was shown that the self-report instruments used here measure the same concept across time.

These findings highlight the importance of early prevention. First of all, targeting childhood aggression might also decrease the levels of adulthood hostility and anger. Second, it would be important to target preventive efforts at families where early signs of family malfunction are already present. These types of preventive measures could be achieved by designing interventions that could be used in a context where children and mothers are already present such as maternity and child health clinics, day care or elementary school. Proper preventive measures could reduce the likelihood of the development of high levels of hostility and anger, and thus lower the risk of the development of health and social problems that have been shown to be related to high adulthood hostility and anger. In addition, behavioral treatments for hostility and anger have been shown to be clinically effective (Del Vecchio & O'Leary, 2004; DiGiuseppe & Tafrate, 2003), which means that intervention in adulthood is also possible.

Current findings also support the theoretical assumption that hostility and anger represent more a trait than a state phenomena and that conducting cross-sectional studies to analyze the possible outcomes of cynicism and anger is meaningful. Previously found associations between hostility and health are also likely to be rather robust, although typically hostility has usually been assessed only once. It is also meaningful to conduct studies with long follow-ups in which later health outcomes are predicted just by one earlier assessment of hostility. Naturally, because the stability of hostility is only moderate, it is still important to use multiple measurement points when possible and so to get a more accurate assessment of hostility over time. The theoretical assumption that hostility and anger are related, but separate concepts is also supported by the current findings. Thus, future studies should further investigate the differences in the development of hostility and anger. Are there some factors that are specific to the development of hostility, but not to the development of anger?

Findings of the current study imply that personality factors such as hostility seem to play a role in the selection into unemployment, and that unemployment can modify personality at least in the short term. These findings highlight the harmfulness of high hostility to overall well-being. In practice, these findings imply that the possible effect of personality on unemployment should be acknowledged in employment services, where it would possible to target individuals that are in the high-risk group for long-term unemployment, and through that to increase of hostile affect. With proper interventions that are designed to reduce the high levels of hostility and anger, the costs of hostility and anger to the individual as well as society, could be greatly reduced.

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