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Some personality traits converge gradually by long-term partnership through the lifecourse – Genetic and environmental structure of Cloninger's temperament and character dimensions

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ABSTRACT

Temperament and Character Inventory (TCI) is a comprehensive personality inventory that is widely used in behavioral genetics. The original theory suggested that temperament traits were under genetic influences, whereas character traits were gradually built by an interaction between temperaments and environment until early adulthood. This study attempted to evaluate TCI by examining the genetic and environmental contributions to personality with particular attention to spousal effects. From 687 families, a total of 3459 Korean adult individuals completed the survey. Among them, there were 542 Monozygotic (MZ) twin pairs and 122 Dizygotic twin pairs. Intraclass correlation coefficients (ICCs) and heritability were calculated to examine the genetic and shared environmental contributions to personality. Moderate genetic contributions (0.17–0.43) were found for all TCI traits along with the evidence of shared environment (0.11–0.31) for harm avoidance (HA) and all characters. The ICCs of TCI in MZ pairs ranged 0.36–0.46. Spouses' had little resemblance for temperament, whereas for character dimensions, spouses (0.27–0.38) were more similar than first degree relatives (0.10–0.29). Resemblance between spouses increased with duration of marriage for most characters and HA. When the growing similarities between spouses were compared with their MZ cotwins' for subgroup of 81 trios, self-directedness (SD) of character showed even more similarities toward their spouses than cotwins as partnership duration increased ($r = 0.32$). Our findings with regard to change in SD into late adulthood support the psychobiological theory of temperament and character, which suggests that both personality domains have distinct developmental trajectories despite equally large genetic influences.

1. Introduction

The influence of genetic and environment on human personality is a crucial question for a scientific understanding of the basis for healthy living. Many researchers have tried to explain individual personality as a set of cross-culturally reproducible traits, and developed inventories to assess these models. Among the personality taxonomies, Cloninger's Temperament and Character Inventory (TCI) (Cloninger et al., 1994) is widely used in behavioral genetics because it distinguishes between temperament traits that are emotion-based and developmentally stable on average, from

Abbreviations: NS, Novelty Seeking; HA, Harm Avoidance; RD, Reword Dependency; PS, Persistence; SD, Self-Directedness; CO, Cooperativeness; ST, Self-Transcendence.

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character traits that develop in a stepwise fashion toward socially-favored norms (Josefsson et al., 2013a). When compared to other multi-dimensional inventories, the validity of the TCI is as great as or greater than others, showing particular strength in measuring healthy maturation of character (Grucza and Goldberg, 2007).

The current version of the TCI has seven dimensions (Cloninger, 1998; Cloninger et al., 1993). TCI measures four dimensions of temperament; harm avoidance (HA), novelty seeking (NS) reward dependence (RD), and persistence (PS) (Cloninger et al., 1993; Heath et al., 1994; Stallings et al., 1996). Temperament dimensions distinguish subtypes of personality disorders, but do not specify whether or not a person had a healthy personality or a personality disorder. Therefore, a second domain of personality described as “character” was also proposed in order to measure individual differences in achieving their goals and values intentionally, suggesting the predominant influence of socio-cultural environment on character development (Loehlin, 1992). Three dimensions of character are self-directedness (SD), cooperativeness (CO), and self-transcendence (ST).

The original theory claimed that temperament and its components are mainly genetically determined with distinct biological basis of specific neurotransmitter responses; NS an expression of a behavioral activation system influenced by dopamine; HA, a behavioral inhibition system influenced by serotonin; RD, a behavioral maintenance system influenced by norepinephrine; and PS, a behavioral extinction system involving glutamate interacting with other neurotransmitters (Cloninger, 1987, 1998; Gusnard et al., 2003).

In contrast, character traits were hypothesized to change with the age and maturation, and were thought to be strongly affected by the surrounding psychosocial environments and education; SD, as the executive component of an individual's mental self-government; CO, the legislative aspect of mental self-government, allowing people to act according to principles; ST, the judicial aspect of self-government, allowing insight into when rules apply through awareness of a person's connections to the world as a whole (Cloninger et al., 1993).

According to Cloninger's hypotheses, social norm-favoring was expected to be crucial for character development, whereas genetic differences to be more important for temperament. However, current theory considers the distinction between temperament and character to be grounded in differences in the type of learning regulated by these domains: temperament is regulated by individual differences in behavioral conditioning whereas character is regulated by individual differences in semantic learning and self-aware consciousness (Cloninger, 2004; Loehlin and Gough, 1990).

Individual differences in personality have major significance for all aspects of health, including physical, mental, and social aspects of well-being (Cloninger and Zohar, 2011). Cluster C disorders are related to high anxiety proneness (i.e., high HA); Cluster B disorders to impulsivity (i.e., high NS), and Cluster A disorders to social aloofness (i.e., low RD) (Cloninger, 2004; Cloninger et al., 2010). Personality is also strongly involved in vulnerability to stress and physical disorders related to lifestyle, including heart disease (Hintsanen et al., 2009; Rosenström et al., 2012).

Low or high scores of character dimensions have been associated with personality disorders. Lower SD scores showed strong relationship with presence of personality disorders (Cloninger, 2000). Low CO score was also independent predictor of all types of personality disorder clusters, whereas high ST score suggested moderately increased risk of schizotypal and Cluster B personality disorders (Cloninger et al., 1998; Svrakic et al., 2002).

Given the influence of personality traits on a wide range of human behaviors, understanding the contribution of genes and environments to personality traits is an important topic. Previous studies on the genetic contributions to personality have suggested that most personality traits measured by TCI are influenced by genes to varying degrees, depending on the study (Ando et al., 2004; Gillespie et al., 2003; Isen et al., 2009; Keller et al., 2005). A Japanese study reported that TCI's additive genetic factors ranged 0.22–0.49 and both character and temperament traits showed a substantial genetic influence. However despite the evidence of non-additive genetic effects on personality (DZ's correlation being lower than half of MZ correlation), only PS showed a significant non-additive estimate of 0.37 (Ando et al., 2004). A study of temperament traits in Caucasians in Australia found broad sense heritabilities of 0.53–0.56 with the evidence of a non-additive genetic component of 0.11–0.35 (Keller et al., 2005); a subsequent study showed that character traits were also as heritable (Gillespie et al., 2003). Studies using Five Factor Model (Costa and McCrae, 2008) reported similar findings with the heritability of personality traits ranging 0.36–0.61 (Distel et al., 2009; Jang et al., 1996). Some points, however, are not consistent and need replications. In particular, the genetic influence in terms of heritability has been estimated to be lower in Asians than Caucasians, and for TCI, it is not clear whether Cloninger's distinction between temperament and character is adequately supported by empirical results.

Most studies dissecting personality traits have been carried out in studies that compare only monozygotic (MZ) and dizygotic (DZ) twins. Studies involving twin pairs have an advantage over studies with singletons because they assure close comparability of “shared environments” for MZ and DZ twins, who are born at the same time and reared together. On the other hand, heritability estimates from twin studies tend to be inflated because of difficulty distinguishing additive and non-additive genetic effects in MZ twins. Therefore, we have carried out a study including both types of twins and other family members, including spouses so that we can more reliably discriminate sources of family resemblance such as assortative mating and specific environment shared by a variety of family relationships.

The main goal of this study is to probe the biological basis of Cloninger's theory of temperament and character by estimating genetic contributions to personality traits and by examining the influence of “shared environment” throughout the life course. Multiple family relationship types were all systematically observed in order to investigate different sources of resemblance across diverse relationships. We also distinguished the shared environmental effect within a household, within sets of siblings, and spouses in order to further dissect the complex effects of environment shared within families on personality traits.

2. Material and methods

2.1. Participants

A total of 3459 individuals (1411 men, 2048 women, 687 families) from the Healthy Twin Study in Korea completed TCI measures. This study includes 542 MZ pairs (199 male and 343 female pairs) and 122 DZ pairs (53 male–male and 69 female–female pairs). The Healthy Twin study has recruited adult like-sex twins using a nation-wide twin-family register since 2005. Detailed protocols and characteristics of study participants have been described previously (Gombojav et al., 2013; Sung et al., 2006). Individual twins and their first degree relatives who participated in the Healthy Twin study completed a set of questionnaires and visited one of three medical centers across the country in order to complete a physical examination, clinical tests, and biochemical tests.

In order to ascertain the zygosity of samples, 16 short tandem repeat markers were used for 406 twin pairs. For the remaining