



## Personality types: A twin study

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### ABSTRACT

Do human personalities fall into definite types, and if so, does this have a genetic basis? One member of each of 1314 adult Australian twin pairs was used in a cluster-analysis procedure based on resemblance across 7 personality scales. Individuals from identical twin pairs were more likely to match in their cluster membership than individuals from fraternal twin pairs, suggesting genetic involvement. Clustering was examined at 3 criterion levels: minimum mutual intercorrelations of 0.10, 0.30, and 0.50. Higher criteria tended to yield smaller clusters, and more of them. A replication obtained clusters of similar general properties but not in individual correspondence with those in the original analysis, suggesting that human personalities are far from uniformly distributed, but that they do not fall into discrete and dependable types.

### 1. Introduction

The idea of psychological types has been around for a long time, at least since Galen (2nd century AD), whose Sanguine, Choleric, Melancholic, and Phlegmatic temperaments, based on Hippocrates' theory of four humors, persist in our language until the present day. Recent empirical efforts to define personality types include those of Block (1971) and Robins, John, Caspi, Moffitt, and Stouthamer-Loeber (1996), who agreed on three such types: overcontrolled, undercontrolled and resilient. Block used a sample of 84 men studied as adolescents and as adults; Robins et al. had a sample of 300 urban adolescent boys tested at ages 12 or 13. Both studies used versions of the California Q-Sort for their basic classification. The overcontrolled cluster tended to show internalizing forms of psychopathology in Achenbach's terms (e.g., Achenbach & Edelbrock, 1983) such as anxiety, withdrawal, and depression; the undercontrolled cluster tended to show externalizing forms such as impulsive and delinquent behavior. The resilient cluster, the largest group, were relatively well adjusted, responding to their environments in a flexible and appropriate manner. Each study obtained some additional types beyond the three replicated ones. These two studies were done with males, most at adolescence. A similar study on adult females (York & John, 1992) found different types: Individuated, Traditional, Conflicted, and Assured.

The basic idea of psychological types is that humans are not uniformly distributed in psychological trait space (however defined), but tend to cluster at particular points, allowing us to characterize individuals by their membership in such clusters. As a geographical analogy, each inhabitant of the state of Texas could be located in terms

of two dimensions, latitude and longitude. However, an observer of these data might notice clustering, and find it useful to label such clusters of individuals Houston, Amarillo, Fort Worth, etc. Obviously, one may arbitrarily vary the detail of such clustering according to one's purpose: just the major population centers, or down to small towns like Bertram and Oatmeal.

Note that cluster schemes are complementary to, not in conflict with, dimensional schemes. Dimensions—latitude and longitude, personality traits—define a space within which clustering may or may not be evident. Factor analysis, for example, is concerned with deriving economical dimensions to define a space. Cluster analysis is concerned with the grouping of individuals within that space.

The strategy of the present investigation, making use of existing personality trait data from a large sample of Australian twins, was to locate replicable person clusters in that trait space using one twin from each pair, and then to examine the relative agreement of such clusters across identical and fraternal pairs to obtain evidence about the genetic or environmental basis of such clustering. Because data were available for a large sample of twins (2628 pairs), the plan was to carry out an analysis using one random half-sample of the pairs and then to do a replication with the other half-sample.

Many methods of clustering exist, as well as for deciding how many clusters are optimal—the latter, of course, can vary with the object of the clustering. For some purposes a few large clusters are desirable; for others, many smaller, tighter, clusters would be appropriate. Some schemes are hierarchical: smaller clusters are located within larger ones. Some methods require that all cases be placed in clusters, others tolerate varying degrees of non- or overlapping classification. Some

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may systematically compare 1, 2, 3, ...,  $n$  clusters for a given data set in search of a number that is in some sense optimal (e.g., Tibshirani, Walthier, & Hastie, 2001).

The method used for the present paper was one previously used to classify test items (Loehlin, 2012; Loehlin & Nichols, 1976). For classifying persons, it defines a cluster as a group of individuals that all resemble one another: each one is correlated with all the other members of the cluster above a given criterion level—the present paper compares three such levels, mutual intercorrelations of 0.10, 0.30, and 0.50. The primary focus is on replicability—whether similar clusters are found across different samples—rather than on statistical testing per se.

## 2. Method

### 2.1. The sample

A large group of adult twins in Australia had completed a 16-page questionnaire by mail in 1988–1989, as a follow-up to an earlier 1980–1981 mailing. After excluding twins if either of the pair was missing > 5 items on either questionnaire, the sample consisted of 1320 identical twin (monozygotic, MZ) pairs (396 male and 924 female), and 1308 fraternal twin (dizygotic, DZ) pairs (223 male, 526 female, and 559 opposite-sexed), ranging in age from 24 to 87 years. On questionnaires missing 5 items or less, the missing items were replaced by “don’t know” responses. The typical excess of female over male twin pairs in voluntary samples (Lykken, Tellegen, & DeRubeis, 1978) is evident. For purposes of the present analysis, the twin pairs were divided into six subsamples of 400+ pairs; subsamples 1, 3, and 5 were used for the initial clusterings, and 2, 4, and 6 reserved for the replication. The number of subsamples was determined by the largest correlation matrices (500 × 500) that were practicable with the program used. The assignment of pairs to subsamples and the choice of individual twins within pairs for the clustering was purely random.

### 2.2. The measures

Among a variety of measures, items from two personality tests were included in the questionnaire completed by the twins: Cloninger’s Tridimensional Personality Questionnaire Short Form (TPQ; 54 items forming 3 scales; Cloninger, Przybeck, & Svrakic, 1991) and the Eysenck Personality Questionnaire revised—Short Form (EPQ-R-S; 48 items forming 4 scales; Eysenck, Eysenck, & Barrett, 1985). These seven scales define the dimensional space within which the clustering was examined. The three Cloninger scales (18 items each) are labeled Harm Avoidance, Novelty Seeking, and Reward Dependence. The Eysenck questionnaire consists of four scales (12 items each), which we will call Psychopathic Tendencies (originally Psychoticism), Extraversion, Neuroticism, and Conformity (originally Lie Scale). The relabelings reflect likely interpretations for the present population, which would contain few overt psychotics. There would also be less incentive for enhanced self-presentation in a lengthy questionnaire completed for scientific purposes than, for example, in a questionnaire filled out in an employment situation. Thus descriptions of behavior that conforms to social norms may reasonably be taken as mostly reflecting such.

Table 1 provides a brief characterization of each of the three Cloninger and four Eysenck scales, in the form of two items from each scale (usually abbreviated).

It is obvious that the scales are not entirely independent of one another: for example Harm Avoidance from the Cloninger questionnaire and Neuroticism from the Eysenck questionnaire have overlapping content (they are correlated  $r = 0.33$  in these data). Nevertheless, the scales jointly provide a fairly broad view of personality as measured by typical inventories. With respect to the Big Five, for example, Neuroticism and Harm Avoidance align with Neuroticism, Extraversion is present in both cases, Reward Dependence shares a good deal with Agreeableness, Conformity with Conscientiousness, and

**Table 1**  
Characterization of Cloninger and Eysenck scales.

Cloninger scales	
<i>Harm Avoidance (HA)</i>	Tense and worried in unfamiliar situations Shy with strangers
<i>Novelty Seeking (NS)</i>	Often try new things for fun and thrills Follow my instincts, hunches, and intuitions
<i>Reward Dependence (RD)</i>	Like to discuss experiences with friends People come to me for sympathy
Eysenck scales	
<i>Psychopathic tendency (Ps)</i>	Like others to be afraid of me Prefer my own way to rules
<i>Extraversion (Ex)</i>	A talkative person Enjoy meeting new people
<i>Neuroticism (Ne)</i>	Mood often up and down Feelings easily hurt
<i>Conformity (Co)</i>	Habits good and desirable Always keep promises

Novelty Seeking with Openness.

To avoid issues of differences in scale, raw scores on all tests were converted to standard scores before analysis,

## 3. Analyses and results

### 3.1. Initial cluster analysis

The initial cluster analysis was based on one randomly-chosen member from each twin pair, and followed a procedure employed earlier for the grouping of test items (Loehlin, 2012; Loehlin & Nichols, 1976). This procedure was carried out separately in each of the three subsamples. First, the 400+ individuals in a given subsample were intercorrelated across the seven scales. The two most highly correlated individuals in a sample formed the nucleus for the first cluster. To them was added the individual whose lowest correlation with the individuals already in the cluster was highest. This process was repeated, adding individuals to the cluster until none could be found whose correlation with all the existing cluster members exceeded a threshold, arbitrarily set initially at 0.30. Thus every member of a given cluster correlated at least that highly with every other member. When this point was reached, the members of the cluster were deleted from the matrix, and the two most highly correlated remaining individuals taken as the nucleus of the next cluster. This clustering process was repeated until there were no more possible clusters, i.e., until the highest correlation between individuals remaining in the matrix fell below 0.30. Finally, any two-person clusters were dropped, as likely to be idiosyncratic or due to chance—typically there were one or two of these per matrix, emerging at or near the end of the clustering process. This clustering procedure was carried out in each of the three matrices, resulting in 27 clusters of 3 to 57 individuals in the first subsample, 27 clusters of 3 to 53 individuals in the second, and 29 clusters of 3 to 47 individuals in the third.

### 3.2. Agreement across samples

The next step was to look for clusters consistent across the three subsamples. Mean scores on each of the seven questionnaire scales were obtained for the members of each cluster in each subsample. These 83

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