Chapter 22: Personality

Personality: The Phenotype and its Measurement

The word personality has various meanings that range from the qualities of an individual person to evaluative judgements about those qualities (e.g., "She has a great personality."). Genetics has studied personality almost exclusively in terms of psychological trait theory. Trait theory dissects personality into a series of variables called traits and then measures individual differences in those traits. To illustrate, consider the trait of Social Closeness measured in the Multidimensional Personality Questionnaire or MPQ[1] developed by Auke Tellegen (1985; Tellegen et al., 1998). People low on this trait are content to be by themselves and do not go out of their way to seek social interactions; people high on the trait would rather be with other people than be alone and actively pursue social situations. It is assumed that knowledge of the level of a person's Social Closeness can make predictions about the person. For example, if Sam is low on Social Closeness, then he is likely to enjoy solitary leisure habits like reading. If Betty is high on Social Closeness but also enjoys reading, then she is more apt to join a reading group than Sam.

There are various ways to rank order individuals on Social Closeness. *Behavioral assessment* focuses on the actual behavior of people like Sam and Betty. It would measure such behaviors as the number of social groups that Sam and Betty belong to, the percent of leisure time spent in solitary versus social activities, the extent to which they engage strangers in conversation, etc. Behavioral assessments of personality are often done in laboratory situations—e.g., place Sam and Betty alone together in a room and measure the amount of conversation initiated by each one. Because of the large commitment of time and

[1] Current personality theory favors the *five factor model* (Costa and McCrae, 19xx), but relatively little genetic data have been gathered using this model compared to other—albeit related—models and measuring instruments. This review will focus on data from Hans Eysenck's system (which has the most genetic data) and from the MPQ (which illustrates the relationship between higher and lower order traits).

money to behavioral assessment, there are few data on the genetics of personality measured by this technique.

A second generic way of measuring a trait like Social Closeness taps *opinions* and *perceptions* about Sam and Betty's behavior instead of the behavior itself. One example of this measurement mode is the *rating scale*. Here, a friend of Sam's is presented with a description of Social Closeness, is asked to think about Sam with relation to all the other people s/he knows, and then is requested to rate Sam on, say, a five point scale—well below average; below average; average; above average; well above average. By far the most common technique is to have the person rate him/herself in which case the technique is most often called *self-report*.

A second version of the self-report, opinion/perception mode of measurement is to present the person with a simple statement and then ask the person to indicate whether the statement is true or false of them. An example statement (or *item* as they are more commonly referred to) would be "I find it hard to think of things to say when I meet a new person." People answering true to this item are assumed to be lower on Social Closeness than those answering false. Typically, a personality questionnaire will contain a number of items relating to Social Closeness and a person's score consists of the sum of responses over all the relevant items. If Betty scores higher on this sum than Sam, then she is said to be higher on the trait of Social Closeness than Sam.

The majority of personality data on adult twins and adoptees have been gathered using self-report questionnaires or rating scales. The reason for this is simple—cost. It is much less expensive to have a person complete a questionnaire and then optically the scan the answer sheet than to bring the person into a laboratory and pay for a trained research assistant to record the person's behavior.

Finally, personality measurement and assessment depends upon the age of the person being assessed. All of the above techniques apply to adolescent and adult

personality for the simple reason that young children lack the reading and interpretive skills to complete a contemporary, standardized personality inventory. Assessment of child personality must rely on the reports of informants such as the parents or teachers of the child. This type of assessment has problems of its own. In the following review of the literature, I focus first on the adult personality (i.e., assessment in the late teens and beyond) and then discuss the issue of continuity (both of assessment and of substantive issues) between childhood and adulthood.

The Organization of Adult Personality

All omnibus personality inventories measure several different traits. For example, the MPQ measures the 11 traits listed in Table 22.1. How do these different traits relate to one another? This has been a matter of considerable—and still unresolved—debate among psychologists. The current vogue views traits as being *hierarchically organized*. The items from a single scale of a personality questionnaire (e.g., Well Being in Table 22.1) are summed to form a score on a *lower-order trait*. Because the scores on some lower order traits correlate with the scores on other lower order traits, a *higher-order trait* is postulated.

[Insert Table 22.1 about here]

Figure 22.1 illustrates the hierarchical model as applied to the MPQ. Auke Tellegen, the developer of the MPQ, noted that there were positive correlations among the traits of Well Being, Social Potency, Social Closeness, and Achievement. That is, someone who scored high on any one of these four lower-order traits had a small tendency to score above the mean on the other three traits. Using a statistical procedure called factor analysis, Tellegen postulated the existence of a higher order trait to account for this observation. He called the trait Positive Affect. Similar observations and statistical analysis led him to postulate two other higher order traits, Negative Affect and Constraint, that accounted for the correlations among the remaining scales.

[Insert Figure 22.1 about here]

It is essential to recognize two features of the hierarchical model. First, there is not always a simple correspondence between lower and higher order traits. This is illustrated by the dashed arrow from Negative Affect to Well Being. This represents the fact that the lower order trait of Well Being measures aspects of both higher order traits of Positive Affect and Negative Affect.

The second important feature about the hierarchical model is an admonition against thinking of lower order traits as being nothing more than manifestations of higher order traits. For example, Social Potency has very important attributes that are specific to it and quite different from its relationship with Positive Affect. Similarly, the relationship among the higher order trait of Negative Affect and its lower order traits of Stress Reaction, Alienation, and Aggression is not akin to the relationship between the H_2O molecule and its appearance as a liquid (water), a solid (ice), and a gas (vapor). There are aspects of, say, Stress Reaction that are unique to this lower order trait. A better analogy is to think of the higher order traits as a genus and the lower order traits as the various species belonging to that genus. Each species has characteristics that are unique to that species and make it different from the other species in the genus.

In the discussion of adult personality, we rely on two different theoretical systems, both of which use trait theory and self-report personality inventories. The first is the MPQ, and it is used to illustrate the genetics of personality for lower-order traits. The second is the personality system evolved by the late Hans Eysenck that focuses on the higher-order traits of Extraversion (which is equivalent to Positive Affect in Tellegen's MPQ) and Neuroticism (which is equivalent to Negative Affect). Finally, the term "adult personality" refers to data collected on people from their mid to late teenage years onward. It is used to avoid the cumbersome—but more exact—phrase "adult and/or late adolescent personality."

Genetics of Adult Personality Traits

The Empirical Data

First let us examine data on the higher-order dimensions of extraversion (or positive affect) and neuroticism (negative affect) to get a generic impression of how similar relatives are for personality. Also, because there are more genetic data on these two personality traits than on any others, we can examine the consistency of the data across studies.

Table 22.2 presents the correlations originally compiled by Loehlin (1992) and updated for this book from several large studies around the world using adult twins raised together. First, examine the sample sizes (i.e., number of twin pairs). They are all quite large studies. Next, for each study compare the correlation for MZ pairs with the correlation for DZ pairs for extraversion. For each study the correlation for MZs is statistically higher than the correlation for DZs. Do the same for neuroticism. Again, the MZ twins consistently resemble each other more than the DZ twins. Finally, examine the consistency of the correlations across studies. Despite the fact that the studies come from different countries and use different personality inventories to measure extraversion and neuroticism, the correlations are remarkably consistent. With one or two exceptions, identical twins have correlations that range from .40 to .60 while those for fraternal twins range from about .10 to .25. Remember these figures.

[Insert Table 22.2 about here]

The data in Table 22.2 lead us to two of the consistent findings in the personality literature. First, note that all the correlations for identical twins are significantly less than 1.0. This leads to the major conclusion that *identical twins are not identical in personality*. They are *similar* to each other, but they are far from carbon copies when it comes to their degree of shyness, forcefulness, and sociability (for extraversion) or worrisomeness, irritability, and affective lability (for neuroticism). The second conclusion is that *identical*

twins are more similar than fraternal twins despite the fact that both types of twins have been raised together, day-in and day-out, for all of their childhood, adolescence, and early adulthood.

Although the second conclusion is consistent with a genetic influence on personality, an informed critic could raise several objections before concluding that the patterning of correlation does indeed imply genetics. Identical twins are often treated as a unit, share the same friends, and the sheer fact that they physically resemble each other so much may induce some behavioral similarity. Could these factors contribute to the greater similarity within MZ pairs than within DZ pairs?

One answer to this question is to examine the data on twins raised apart. Table 22.3 presents the correlations for extraversion and neuroticism for studies of twins raised apart and together. For a single trait and for a single zygosity compare the two columns of correlations for twins raised together and apart. For both extraversion and neuroticism, there is a slight—but only slight—tendency for twins raised together to be more similar than twins raised apart. However the difference in correlations between twins raised together and apart does not reach overall statistical significance. This leads to a quite startling conclusion—*twins who are raised together in the same household for the better part of 20 years are no more or only slightly more similar to each other than twins who are raised in different households!* This has very important implications for the role of the family environment in making relatives similar in personality, a topic that will be dealt with later.

[Insert Table 22.3 about here]

Is there any independent way to verify this striking and unexpected conclusion? The clearest and most salient way is to examine the similarity of genetically unrelated individuals who live in the same family. If the rearing environment has little influence on making relatives similar, then the correlations for adoptive relatives should be small and

close to 0.0. Of course, there is seldom a real-world equivalent to adoptive twins, but it is possible to examine the correlations for adoptive parents and their adopted children and the correlations for adoptive siblings. Table 22.4 presents these data.

[Insert Table 22.4 about here]

For extraversion, there is virtually no resemblance between adoptive parents and their adopted children—all three correlations differ only trivially from 0.0. Statistically, none of the three correlations for adoptive siblings is significantly different from 0.0. All of the correlations for neuroticism are positive—something that one would not expect if the true correlation were really 0.0. However, none of these correlations differ significantly from 0.0. (The correlation of .23 for adoptive sibs in study 1 shows a trend toward significance but because of small sample size fails to reach it.) The conclusion from the adoption data verifies the data on twins raised apart: *if the family environment does make relatives similar to one another for personality, the effect is very, very small*.

Perhaps the level at which personality is studied contributes to these conclusions. After all, extraversion and neuroticism are two higher-order traits, each composed of several lower-order traits. Perhaps there is considerable variability in the lower-order traits. Some lower-order traits may be highly heritable; others may have little heritability. Maybe the family environment influences a few—but not all— of lower-order traits. Some of these influences could cancel each other out when looking at higher-order traits and lead to the data in Tables 2, 3, and 4.

We can examine this possibility by concentrating on the lower-order traits of the MPQ, data for which are presented in Table 22.5. There are several salient aspects of Table 22.5 that are obvious from eyeball inspection of the correlations. First, note that the correlation between spouses is effectively 0.0 for every trait except for Alienation and Traditionalism. This pattern was independently replicated in a much larger study (Finkel &

McGue, 1997) and reinforces the conclusion given in an earlier chapter that there is little assortative mating for personality.

[Insert Table 22.5 about here]

Second, compare the column for *MZA* to the column for *DZA*. In all cases, the correlations for identical twins raised apart (*MZA*) exceed those for fraternal twins raised apart (*DZA*). This suggests that genetics play some part in twin resemblance; otherwise, the two columns should have similar numbers. Third, compare the column for the correlations for identical twins raised together (*MZT*) to the column of fraternal twins raised together (*DZT*). Once again, the correlations for identical twins exceed those for fraternal twins. This is an independent argument for the heritability of personality traits. Fourth, compare the correlations between twins raised apart and twins raised together, i.e., the column for *MZA* versus *MZT* and the column for *DZA* versus *DZT*. How different are these estimates? A simple eyeball inspection of these figures suggests that overall there is not much difference—the correlations for twins raised apart are quite similar to those for twins raised together. These data, along with other twin data on lower-order personality traits (refs) suggest that the pattern for the higher-order traits is not the result of "cancellation." The genetics of lower-order traits parallel those for high-order traits—identical twin correlations are in the .40 to .60 range; fraternal twin correlations are in the .10 to .50 area; and correlations for twins raised apart are similar to those for twins raised together.

Before discussing the implications of these results, it is important to comment on the lower-order MPQ trait of traditionalism. The post World War II era witnessed considerable interest in this trait when psychologists researched the question of why so many people in Germany and German-occupied territories became ardent followers of Nazism. What emerged from the research was a personality trait—termed Authoritarianism at that time (Adorno, 19xx)--which is tapped by the traditionalism scale of the MPQ. People high on the trait place important emphasis on established morality, religion, and

obedience to authority. Low scores are not amoral and unreligious; rather, they tend to be more freethinking about social issues and obedience to established authority. The key point here is that personality dimensions that tap social attitudes are still heritable, but unlike most other lower-order traits they are influenced by family environment. It should also be realized that this is a replicable finding that has been reported in other samples using other inventories (Beer et al., 1998; Eaves et al., 1989; Eaves et al., 1999; Truett et al., 1992).

The Loehlin and Nichols Observations

The generalizations made above about the genetics of adult personality are not new. A quarter of a century ago, John Loehlin and Robert Nichols (1976) published the results of a study on 850 pairs of twins. In summarizing their findings, they stated:

"The differences between identical and fraternal twin correlations did not appear to be consistently greater for some traits than for others. . . . the body of data we have surveyed is substantial enough so that it becomes difficult to defend the proposition that large and consistent trait-to-trait differences in the resemblance of identical- and fraternal-twin pairs are characteristic of traits in the personality . . . domain." (Loehlin & Nichols, 1976, p. 86).

Because heritability is a function of the difference between identical and fraternal twin correlations, the Loehlin and Nichol's hypothesis may be succinctly restated in the following form: *there is little differential heritability across personality traits*. That is, personality traits have heritabilities in the moderate range of .40 to .60. It is simply *not* the case that some personality traits have very high heritabilities (i.e., .80 or above) while others have low heritabilities (i.e., .20 or less).

In the same work, Loehlin and Nichols also commented upon the role of family environment:

"Thus, a consistent—though perplexing—pattern is emerging from the data (and it is not purely idiosyncratic to our study). Environment carries substantial weight in determining personality—it appears to account for at least half the variance—but that environment is one for which twin pairs are correlated close to zero" (Loehlin & Nichols, 1976, p. 92).

This conclusion, again offered 25 years ago, implies that there is little influence of family environment on personality traits. Otherwise, the correlation between the environments of twins would be substantial. We witnessed the lack of evidence for family environment in creating similarity among relatives for the extraversion and neuroticism. Although this theme has been continually echoed throughout the behavioral genetics literature (e.g., Rowe & Plomin, 1981; Rowe, 1994; Scarr & McCartney, 1983), it has only recently gained attention from the wider audience of behavioral scientists (Harris, 19xx; 19xx). Arguably, it is one of the most important findings of behavioral genetics.

As we examine other issues about personality, it is very important to keep in mind both of these observations from Loehlin & Nichols—little differential heritability and the lack of evidence for strong family-environment effects for making relatives similar in their personalities.

Sex differences in the heritability of personality

It is obvious that young boys and girls are treated differently simply because of their gender. Does this differential treatment result in some traits being more heriTable 22.in males than in females? The discussion of heritability in Chapter X stressed the importance of environmental variation. If everyone is treated the same environmentally, then individual differences are mostly genetic and heritability will be large. But if individuals receive very different environmental treatments, then heritability will decrease. It is perfectly plausible that young girls may be treated more similarly than young boys for one personality trait, but the opposite may happen for a different trait.

The literature is very consistent in finding that males and females can have different heritabilities for personality traits ([Carey, 1983 #327; Eaves, 1989 #326; Eaves, 1999 #21; Finkel, 1997 #98]). But this is only part of the story. Table 22.6 presents estimates of broad-sense heritability for males and females along with the results of statistical tests of differences in heritability (the data are from Finkel & McGue, 1997). Of the 11 lower-order traits, three have significant differences in heritability. On two of the traits, Alienation and Control, males have a greater heritability than females. For the third trait, Absorption, heritability is greater in women than men.

[Insert Table 22.6 about here]

But examine the magnitude of the differences in heritability. The largest difference is for Alienation where the heritabilities are .39 (females) and .61 (males). Both of these numbers are within the limits of the Loehlin and Nichols observations. In short, although these differences are statistically significant, heritabilities for both males and females fall into the moderate range.

We can now summarize the issue of differential heritability in a single statement—males and females are much more similar in terms of the magnitude of genetic influences for personality than they are different. The Loehlin and Nichols hypothesis holds equally well for males and females. Whatever sex differences have been found and reported, albeit statistically significant, are not large. It is certainly not the case that one personality trait has a very large heritability in males and an insignificant heritability in females.

Continuity and Change in Adult Personality

The empirical data.

Consider Sam and Steve, a pair of siblings close in age who have recently moved out of their parent's home and begun their adult lives in separate households. As they develop

their own circle of friends, embark on different occupations, marry, and have children, will their personalities diverge? Or might age and the absence of their intense sibling rivalry in childhood and adolescence make Sam and Steve more similar to each other? Or maybe both effects cancel each other out so that with a large number of Sams and Steves there is no change in similarity over time.

From a scientific perspective, we should ask whether the correlation for relatives changes with age. A small but rather convincing literature suggests that there is indeed change but that during the adult years the magnitude of change is relatively small. Studies of large samples have been able to find statistically significant effects in the form that DZ twins become less similar over time, but the magnitude of the change is small and of little practical value (Eaves & Eysenck, 1976; Martin & Jardine, 1986). Twins past their retirement age have correlations that are not appreciably different than younger twins (Pedersen & Reynolds, 1998).

A second related issue is the extent to which Sam's and Steve's individual personalities stay the same or change with time. Do the "slings and arrows of outrageous fortune" change personality or do we remain fundamentally the same? The answer to this question varies according to the age of maturity of the individuals in the study, the type of personality inventory used, the time period between observations, and other factors. In general, however, studies of adults from about age 30 onwards show rather strong contiguity in personality in the sense that correlations between time points varying from 5 to 10 years are often .60 or higher (Costa & McCrae, 1988; Pedersen & Reynolds, 1998)[2]. Stability from the late teens to early adulthood may be somewhat lower but not by much (McGue & Lykken, 1993).

---

[2] It is important not to confuse stability in a trait's mean with stability in individual differences. The average value of a trait may change over time but the rank-ordering of people at the different time points may remain quite sTable 22.(e.g., height measured at age 15 and again at age 25). Also, the mean may remain sTable 22.over time, but the rank-ordering of individuals could change. The discussion herein involves stability only in terms of the rank-ordering of individuals over time.

A more pertinent question explores the reasons for the continuity and change in adult personality. To what extent do genes contribute to continuity and change? Perhaps early experiences act as a glue that "cements" personality early on so that most of the adult continuity is due to the environment. On the other hand, perhaps genes are a major source of continuity and the immediate environment induces small changes in personality. There is not an overwhelming body of empirical data that addresses this important issue, but the results of the few available studies are consistent (McGue & Lykken, 1993; Pederson & Reynolds, 1998; Viken et al., 1994)—the long term stability of personality is due mostly to genes.

[Insert Table 22.7 about here]

Table 22.7 illustrates the type of data used to make this conclusion. The sample is a small number of twins who initially took the MPQ between ages 17 and 30 and were then tested 10 years later. The correlations in the column labeled "Stability" treats each twin pair as two separate individuals; the numbers indicate how well we can predict adult personality over a ten-year period. The two columns labeled "Same Time" give the correlations for MZ and DZ twins when both twins are measured at the same time. Notice that the MZ and the DZ correlations are on the same order as the respective columns in Table 22.5, although the DZ correlations tend to vary a bit more because of small sample size. The column labeled "Different Times" gives the correlation between one twin's score at the first testing and his/her twin partner's score ten years later—i.e., how well does Sam's score at time 1 predict Steve's score measured 10 years later.

Now run your eyes over the first three correlations of a row—i.e., the stability correlation, the MZ (Same Time) correlation, and the MZ (Different Time) correlations. Do you notice a pattern as you move from one lower-order trait to another? Generally, the Stability coefficient is the highest and the Different Time correlation is the lowest of the three entries. Although this pattern stands out, the fundamental observation is that the three

values *do not differ very much*. This tells us that MZ twins are almost as similar when they are measured ten years apart as when they are measured at the same time. Sam's personality right now can predict Steve's personality ten years later almost as well as it can predict Steve's personality right now. Furthermore, the extent to which members of MZ twin pairs can predict each other's personalities over time is lower than—but not *much* lower than—the extent to which an individual's own score can predict his/her own score ten years later. That is, Sam's score can predict Steve's score 10 years later only slightly less than Sam's score can predict his own later score.

The correlations for DZ twins are lower than those for MZ twins, and both sets of DZ correlations (Same Time and Different Time) are considerably lower than the Stability coefficients. Perhaps because of the small sample size, the correlations for DZ twins tested at the same time are not significantly higher than the correlations over the ten-year interval, but there is a faint patterning similar to that of the MZ twins. If Sam and Steve were fraternal twins, then Sam's score at time 1 could predict Steve's score ten years later almost as well at it could predict Steve's score right now.

What do these patterns mean? The meaning is best illustrated by making up correlation coefficients under different models for the source of stability in personality. Examine Table 22.8 which does just that. If the stability of adult personality were due exclusively to the factors involved with the early family environment, then the twin correlations should equal the stability coefficients and the MZ correlations should equal the DZ correlations. If the stability came from the environment, but *not* the *family* environment, then the pattern should be a high stability coefficient but twin correlations at different times that are close to zero. Finally, if stability were a matter of the genes, then the patterning of the last row of Table 22.8 would be evident in the empirical data.

[Insert Table 22.8 about here]

Because the patterning of the data is closest to this last row, the data suggest that the major source of personality stability resides in genes with a small contribution from the environment (but not the family environment). This is not a result peculiar to this study. Both Viken et al. (1994) and Pedersen and Reynolds (1998) replicated this finding using much larger samples of twins on the traits of extraversion and neuroticism.

Before discussing theories that can account for these findings a cautionary word is necessary. There is a great deal of difference between the phrase "genes are the major source for personality stability" and its frequent misinterpretation "genes fix one's personality." While it is true that genes are the principal reason for stability, it is equally true that adult personality is *not* 100% sTable 22.over long periods. The stability coefficients in Table 22.7 are on the order of .50; if personality were sTable 22.within the limits of measurement error, then these correlations would be on the order of .85 (see McGue et al., 1993). Environmental factors definitely influence personality, but they appear largely responsible for personality *change* over time.

The Set Point Model.

The Set Point model (SPM) is an attempt to explain the empirical results about genetics and the continuity and change in adult personality. Like most such models, it has been informally bantered about by behavioral geneticists for many years and claims multiple authorship[3]. The account of the model here is illustrated using Lykken and Tellegen's (1996) work on the MPQ trait of Well Being.

The SPM assumes that genes contribute very strongly to a person's "set point" for a personality trait like Well Being and that fluctuations in the environment produce short-term changes in the phenotype of Well Being. To illustrate this model, suppose that we had the equivalent of a psychometric thermometer to measure Well Being every day for a very

[3] For example, the ideas presented here emerged in informal teatime chatter among, Lindon Eaves, Andrew Heath, Nick Martin, Jeffery Long and me in 1985.

long period of time. The SPM holds that a single person's phenotypic Well Being will fluctuate over the time period because of positive and negative environmental experiences. For example, getting an A on an exam that you were worried over could increase Well Being, while getting a speeding ticket might decrease it. If the effect of the environmental experience is large—like getting dumped in a significant relationship—then a person's phenotype could be altered for a considerable period of time. Depending on factors like the length and intensity of the original relationship, a person's Well Being phenotype could be lowered for a few day, a few weeks, or maybe even several months. The key feature of the SMP is that *after these positive and negative experiences a person will tend to regress back to his/her original set point*.

The model is illustrated in Figure 2 for two hypothetical people, Abel and Zed. Abel's set point is one standard deviation above the mean and is denoted in the figure by the straight, solid horizontal line at that value. Zed's set point is one standard deviation below the mean and is depicted by the straight dashed line. The fluctuating solid and dashed lines give Abel's and Zed's respective phenotypes over time. It is assumed that Abel and Zed have the same positive and negative experiences every day—an implausible situation but one that helps to explain the model.

Both Abel and Zed start out the time period very close to their respective set-points. For the first 30 days, the typical fluctuation of "good days" and "bad days" changes their state of Well Being. Note that there are some days when Zed is happier than Abel is on other days. For example, Zed's Well Being on days 11 and 14 exceed Abel's score on days 17 and 18. On day 30, something extraordinarily positive happens to Abel and Zed. Zed's phenotype now exceeds Abel's set point. Because the event is so important, its effects carry over for a number of days afterwards. However, by day 45, both Abel and Zed have returned to their respective set points. Thereafter, day to day fluctuations occur until day 75 when very negative events occur to both Abel and Zed. Once again, these events are

so salient that they alter mood for a number of days afterwards. But slowly, both Abel and Zed recover and eventually reach their set point by the day 99.

Now imagine Abel and Zed both completing the Well Being scale of the MPQ. Both read a question like "Basically, I am a happy person." Both are likely to look over their past experiences and mentally take an average of their level of happiness, ignoring the real high and low points. Abel is more likely to answer "true" to this item than Zed. For an item like "I am not as optimistic as most people I know," both are again likely to average their mood. This time, Zed is more likely to answer "true" than Abel. Hence, if Zed and Abel are given the Well Being measure twice over a long period of time, Zed's score is likely to be lower than Abel's on both occasions. They are both responding in terms of their average behavior or something close to their set point.

The SPM is quite useful and explains the genetic data on the stability of personality. It also explains many other attributes about happiness such as the tendency for lottery winners to report that being an unexpected recipient of a financial fortune increases happiness but after a year or so, they are just as happy as they were before winning the lottery (Myers and Diener, 1995). However, much more data need to be gathered before the SPM is verified. For example, no one has taken daily measures of MZ and DZ twins over a long time to see if the predictions of the model hold.

Development and Personality

Thus far, the discussion of personality has been restricted to the adult years. But what about infants, children, and young adolescents? What is called personality in adults is often called "temperament" in infants and young children (Goldsmith, Buss, & Lemry, 1997; Plomin & Caspi, 1999) with the precise age at which temperament changes to personality deliberately left vague. Table 22.9 presents kinship correlations for various types of genetic and environmental relatives on the EASI questionnaire (Buss & Plomin,

1975), its updated version, the EAS Temperament Survey (Buss & Plomin, 1984), or its clone, the Colorado Child Temperament Inventory (Rowe & Plomin, 1977). These instruments measure the higher-order dimensions of emotionality (an almost identical construct to neuroticism), sociability (very similar to extraversion) and activity. Although there are a considerable number of correlations in this table, many of them have been gathered on the same sample but at different ages.

First examine the MZ correlations. They are not terribly different from those for adults. The problem in childhood personality comes when one examines the correlations for all other types of relationships. Simply put, they do not make any sense. Look at the correlations for DZ twins and then compare then with those for adult DZ twins given in Table 22.2. With the odd exception, the correlations for adult DZ twins are significantly greater than 0. On the other hand, the correlations for DZ children are all over the place. Some are significantly positive (e.g., those for Emotionality and Activity in Study 5), many are close to 0.0, but others are significantly negative (i.e., Activity in Study 1). Correlations for siblings appear more in agreement with a simple genetic model than those for DZ twins.

Parent-offspring correlations are also confusing. If there is something genetic to childhood personality and if that something genetic follows a simple model, then we should expect that the correlations for biological parents who give their children up for adoption and their genetic offspring should be significant. Instead, the observed correlations (Bio PO Apart in Table 22.9) are very close to 0.0. Again, if a simple genetic model holds, then correlations for genetic parents who raise their own children (Bio PO Tog.) should be higher than those for adoptive parents and their adopted offspring (Adoptive PO). They are not.

So how should these data be interpreted? The answer is that there is no way to know, although there is little shortage of speculation. Let us list the potential difficulties that might contribute to this pattern of data. They are:

(1) Sample size. Data on adults are easy and relatively inexpensive to collect because one can mail out questionnaires. Much of the childhood data, on the other hand, involves bringing families into a laboratory, greatly increasing the cost of and the time to complete the research. Just compare the sample sizes in Table 22.2 with those in Table 22.9. Correlations based on smaller-sized samples will be more variable and "bounce around" more than those calculated from larger Ns.

(2) Problems in measuring childhood personality. Assessment for infants and young children is almost always done through a second-party, most often a parent, teacher, or tester involved in the research field work. Agreement among these three different sources is often poor, and the limited available evidence (Phillips & Mathaney, 1997) suggests that the poor agreement is due to some combination of rater bias and the simple fact that children act differently in different situations.

(3) Age-dependent genetic effects. It is clear that genes are regulated over the course of development. Perhaps this also applies to some of the genes for individual differences in personality. If the genetic effects in young children are not the same as those in adults, then correlations between genetic parents and their offspring will be reduced. This may contribute to some of the low parent-offspring correlations in Table 22.9. But it cannot account for the low correlations for DZ twins or for some of the full sib data in the table.

(4) Non-additive genetic effects. In the simple genetic model, all gene action is assumed to be additive. To the extent that there is dominant and epistatic gene action, the resulting dominance and epistatic variance may lower correlations for first-degree relatives (see Chapter X). Plomin et al. (1998) have proposed this as a major culprit for the confusing childhood data. However, none of the quantitative experts in the field have ever been able to develop a plausible biological model in which the majority of the variance is due to dominance and epistatic variance. Nonadditive genetic effects certainly occur but they are not likely to explain the whole pattern of these data.

(5) Contrast effects. There are two different types of contrast effects which will be called *sibling contrast effects* and *rater contrast effects*. Sibling contrast effects are the opposite of imitation. Sibling imitation is just what it sounds like—siblings imitate each other's behavior, increasing their similarity. Sibling contrast occurs when one sib does just the opposite of the other, resulting in decreased sibling similarity.

Rater contrast effects involve the raters of children and not the actual behavior of the children. Imagine two mothers who are rating their twin children on sociability. Mama number 1 looks at her two MZ girls, says to herself that there is not much difference between them, and gives them an identical rating. Mama 2 looks at her two DZ girls and recalls that Susie is more talkative and outgoing than Sally. Hence, she rates Susie as higher than average on sociability and Sally as lower than average on the trait. This subtly illustrates a rater contrast effect. Instead of rating Sally relative to all other girls her age, mama 2 is comparing her with her twin sister to arrive at a rating.

Statistically, the effects of sibling contrast are identical to those of rater contrast. Hence, there is no practical way to distinguish the two from the data in Table 22.9. Regardless of their source, contrast effects will lower correlations among siblings.

To give an example, suppose that sociability had a heritability in infants of .40, giving an MZ correlation of .40 and a DZ correlation of .20. As the twins get a bit older, a small contrast effect of -.10 occurs. Using a mathematical model of contrast, the resulting correlation in MZ twins becomes .22 while the correlation in DZ twins reduces to 0.

There is convincing evidence that contrast effects are present in some studies (e.g., Saudino et al., 1995), although they are just as convincingly absent in others (e.g., Neale & Stevenson, 1989). Perhaps the contrast is mostly of the rater variety and the care of the researcher in instructing raters on how to complete a questionnaire is an important issue. The problem with contrast effects is that they cannot explain the low correlations between

genetic parents and their adopted away offspring. In the hypothetical example, that correlation should be close to .20.

The discussion has been tedious so let us end by giving three quick bottom lines to the genetics of personality development in children. First, the empirical literature is very messy and confusing because of the inconsistent patterning of the correlations for first-degree and adoptive relatives. Second, no single explanation can account for this pattern; the answer is likely to reside in some combination of the five difficulties mentioned above and undoubtedly other problems that have not been mentioned. Third, the genetics of temperament and personality development will remain mysterious until the measurement problems can be identified and corrected. It is sad to see so much data being collected in this important area and so little effort devoted to sorting out the measurement issues[4].

[4] Some of the measurement problems can be addressed with much of the data already collected. Examples include the following. Insight into contrast effects might be gained by comparing data from single-child families (where there is no opportunity for contrast) to multi-child families. Better description of the methods of data collection might help to examine why some studies find contrast while other studies do not. The approaches utilized by Neale & Stevenson (1989) and Phillips & Mathaney (1991) could be applied to examine rater bias.

References

Beer, J. M., Arnold, R. D., & Loehlin, J. C. (1998). Genetic and environmental influences on MMPI factor scales: joint model fitting to twin and adoption data. J Pers Soc Psychol, 74(3), 818-827.

Buss, A. H., & Plomin, R. (1975). A temperament theory of personality development. New York: Wiley.

Buss, A. H., & Plomin, R. (1984). Temperament: Early developing personality traits. Hillsdale, NJ: Lawrence Erlbaum.

Carey, G., & J., R. (1983). Genetics and personality temperament: Simplicity or complexity? Behavior Genetics, 13, 43-63.

Eaves, L. J., & Eysenck, H. J. (1976). Genotype x age interaction for neuroticism. Behavior Genetics, 6, 359-362.

Eaves, L. J., Eysenck, H. J., & Martin, N. G. (1989). Genes, Culture and Personality: An Empirical Approach. San Diego CA: Academic Press.

Eaves, L., D'Onofrio, B., & Russell, R. (1999). Transmission of religion and attitudes. Twin Res, 2(2), 59-61.

Finkel, D., & McGue, M. (1997). Sex differences and nonadditivity in heritability of the Multidimensional Personality Questionnaire Scales. J Pers Soc Psychol, 72(4), 929-938.

Floderus-Myrhed, B., Pederson, N., & Rasmuson, I. (1980). Assessment of heritability for personality, based on a short form of the Eysenck Personality Inventory. Behavior Genetics, 10, 153-162.

Goldsmith, H. H., Buss, K. A., & Lemery, K. S. (1997). Toddler and childhood temperament: expanded content, stronger genetic evidence, new evidence for the importance of environment. Dev Psychol, 33(6), 891-905.

Goldsmith, H. H., Lemery, K. S., Buss, K. A., & Campos, J. J. (1999). Genetic analyses of focal aspects of infant temperament. Developmental Psychology, 35 , 972-985.

Harris, J. R. (1995). Where is the child's environment? A group socialization theory of development. Psychologogical Review, 102(3), 458-489.

Harris, J. R. (1998). The nurture assumption: Why children turn out the way they do. New York: Touchstone.

Heath, A. C., Neale, M. C., Kessler, R. C., Eaves, L. J., & Kendler, K. S. (1992). Evidence for genetic influences on personality from self-reports and informant ratings. J Pers Soc Psychol, 63(1), 85-96.

Jang, K. L., Livesley, W. J., Vernon, P. A., & Jackson, D. N. (1996). Heritability of personality disorder traits: A twin study. Acta Psychiatrica Scandinavica, 94 , 438-444.

Loehlin, J. C., & Nichols, R. C. (1976). Heredity, Environment, and Personality. Austin TX: University of Texas Press.

Loehlin, J. C. (1992). Genes and environment in personality development. Newbury Park, CA: Sage Publications.

Lykken, D., & Tellegen, A. (1996). Happiness is a stochastic phenomenon. Psychological Science, 7(186-189.).

Martin, N. G., & Jardine, R. (1986). Eysenck's contributions to behavior genetics. In S. Modgil & C. Modgil (Eds.), Hans Eysenck: Consensus and controversy. (pp. 13-62). Lewes, Sussex: Falmer Press.

McGue, M., Bacon, S., & Lykken, D. T. (1993). Personality stability and change in early adulthood: A behavioral genetic analysis. Developmental Psychology, 29(1), 96-109.

Myers, D. G., & Diener, E. (1995). Who is happy? Psychological Science, 6, 10-19.

Neale, M. C., & Stevenson, J. (1989). Rater bias in the EASI temperament scales: A twin study. Journal of Personality & Social Psychology, 56(3), 446-455.

Pedersen, N. L., & Reynolds, C. A. (1998). Stability and change in adult personality: Genetic and environmental components. European Journal of Personality, 12(5), 365- 386.

Phillips, K., & Matheny, A. P., Jr. (1997). Evidence for genetic influence on both cross-situation and situation-specific components of behavior. Journal of Personality & Social Psychology, 73 , 129-138.

Plomin, R., Coon, H., Carey, G., DeFries, J. C., & Fulker, D. W. (1991). Parent-offspring and sibling adoption analyses of parental ratings of temperament in infancy and childhood. J Pers, 59(4), 705-732.

Plomin, R., Emde, R. N., Braungart, J. M., Campos, J., Corley, R., Fulker, D. W., Kagan, J., Reznick, J. S., Robinson, J., Zahn-Waxler, C., & et al. (1993). Genetic change and continuity from fourteen to twenty months: the MacArthur Longitudinal Twin Study. Child Dev, 64(5), 1354-1376.

Plomin, R., Corley, R., Caspi, A., Fulker, D. W., & DeFries, J. (1998). Adoption results for self-reported personality: Evidence for nonadditive genetic effects? Journal of Personality & Social Psychology, 75(1), 211-218.

Plomin, R., & Caspi, A. (1999). Behavioral genetics and personality. In L. A. Pervin & O. P. John (Eds.), Handbook of personality: Theory and research (2nd ed.). (pp. 251-276). New York, NY, US: The Guilford Press.

Riemann, R., Angleitner, A., & Strelau, J. (1997). Genetic and environmental influences on personality: A study of twins reared together using the self- and peer-report NEO- FFI scales. Journal of Personality, 65 , 449-475.

Rowe, D. C., & Plomin, R. (1977). Temperament in early childhood. Journal of Personality Assessment, 41, 150-156.

Rowe, D. C., & Plomin, R. (1981). The importance of nonshared (E1) environmental influence in behavioral development. Developmental Psychology, 17, 517-531.

Rowe, D. C. (1994). The limits of family influence: Genes, experience, and behavior. New York: Guilford Press.

Saudino, K. J., McGuire, S., Reiss, D., Hetherington, E. M., & Plomin, R. (1995). Parent ratings of EAS temperaments in twins, full siblings, half siblings, and step siblings. J Pers Soc Psychol, 68(4), 723-733.

Scarr, S., & McCartney, K. (1983). How people make their own environments: A theory of genotype --> environment effects. Child Development, 54, 424-435.

Schmitz, S., Saudino, K. J., Plomin, R., Fulker, D. W., & DeFries, J. C. (1996). Genetic and environmental influences on temperament in middle childhood: analyses of teacher and tester ratings. Child Dev, 67(2), 409-422.

Tellegen, A. (1985). Structure of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma & J. Maser (Eds.), Anxiety and the anxiety disorders. Hillsdale, NJ: Lawrence Erlbaum Associates.

Tellegen, A., Lykken, D. T., Bouchard, T. J., Jr., Wilcox, K. J., Segal, N. L., & Rich, S. (1988). Personality similarity in twins reared apart and together. J Pers Soc Psychol, 54(6), 1031-1039.

Truett, K. R., Eaves, L. J., Meyer, J. M., Heath, A. C., & Martin, N. G. (1992). Religion and education as mediators of attitudes: a multivariate analysis. Behav Genet, 22(1), 43-62.

Viken, R. J., Rose, R. J., Kaprio, J., & Koskenvuo, M. (1994). A developmental genetic analysis of adult personality: Extraversion and neuroticism from 18 to 59 years of age. Journal of Personality & Social Psychology, 66(4), 722-730.

Table 22.1. Lower-order personality traits measured by the Multidimensional Personality Questionnaire.

Trait:	Low scorers say true to:	High scorers say true to:
Well-Being	I am seldom "really happy."	I am a happy person.
Social Potency	On social occasions, I like to stay in the background.	I like to take charge of things.
Achievement	I usually work hard enough to just get by.	I like to put in long hours to accomplish something.
Social Closeness	I would be happy to live alone.	I prefer living with other people than living alone.
Stress Reaction	I seldom get worried.	I easily get upset.
Alienation	People treat me fairly.	Life has given me a raw deal.
Aggression	I prefer to turn the other cheek.	If someone crosses me, I will let them know about it.
Control vs. Impulsivity	I usually act before thinking.	I like to have detailed plans before doing something.
Harm Avoidance vs. Danger Seeking	I like to do something dangerous just for the thrill of it.	I prefer to remain safe and sound in most things.
Traditionalism	Traditional values of obedience and morality need to be rethought.	People should have more respect for authority than they do.
Absorption	Music never reminds me of colors, smells, or sights.	I can loose contact with reality watching a beautiful sunset.

Table 22.2. Studies of extraversion and neuroticism in twins raised together, adapted and updated from Loehlin (1992).

Twins raised together:						
			Correlations:			
	Sample Size		Extraversion		Neuroticism	
Study	MZ	DZ	MZ	DZ	MZ	DZ
1	303	172	.51	.20	.46	.07
2	481	312	.60	.24	.52	.24
3	4987	7790	.51	.21	.50	.23
4	1799	1103	.52	.17	.50	.23
5	2320	4824	.48	.14	.39	.15
6	453	362	.39	-.04	.35	.10
7	123	127	.55	.23	.41	.18
8	600	304	.56	.28	.53	.13

Study Code: 1 = Eaves, Eysenck, and Martin (1989); 2 = Loehlin & Nichols (1976); 3 = Floderus-Myrhed, Pederson, and Rasmuson (1980); 4 = Martin and Jardine (1986); 5 = Rose, Koskenvuo, Kaprio, Sarna, and Langinvainio (1988); 6 = Heath, Neale, Kessler, Eaves, & Kendler (1992); 7 = Jang, Livesley, & Vernon (1996); 8 = Riemann, Angleitner, & Strelau (1997).

Table 22.3. Studies of extraversion and neuroticism in twins raised apart, adapted from Loehlin (1982).

	Extraversion:				Neuroticism			
	MZ		DZ		MZ		DZ	
Study	Together	Apart	Together	Apart	Together	Apart	Together	Apart
1	.33	.38	.13	.12	.32	.25	.10	.11
2	.54	.30	.06	.04	.41	.25	.24	.28
3	.63	.34	.18	-.07	.54	.61	.41	.29
4	.42	.61			.38	.53		

Table 22.4. Studies of extraversion and neuroticism in adoptive families, adapted from Loehlin (1992).

Adoptive parent - adopted offspring:			
		Correlations:	
Study	N	Extraversion	Neuroticism
1	220	-.02	.07
2	369	.01	.02
3	504	.01	.06
Adoptive Siblings:			
1	58	-.11	.23
2	75	.07	.05
3	125	-.13	.09

Study Codes: 1 = Eaves, Eysenck, and Martin (1989); 2 and 3 = Loehlin (1992), Tables 2.4 and 3.5. N is the number of pairings, not the number of families.

Table 22.5. Kinship correlations for the lower order scales of the Multidimensional Personality Questionnaire[1].

		Together:				**Apart:**	
	Spouses N =	Parent-Offspring N=	Sibs N=	DZ Twins N=114	MZ Twins N=217	DZ Twins N=27	MZ Twins N=44
Well-Being	-.02	.16	.19	.23	.58	.18	.48
Social Potency	-.20	.19	.21	.08	.65	.27	.56
Achievement	-.02	.11	.05	.13	.51	.07	.36
Social Closeness	.12	.14	.07	.24	.57	.30	.29
Stress Reaction	-.04	.24	.23	.24	.52	.27	.61
Alienation	.54	.27	.16	.38	.55	.18	.48
Aggression	.01	.18	.28	.14	.43	.06	.46
Control	.05	.13	.08	-.06	.41	.03	.50
Harm Avoidance	.06	.15	.19	.17	.55	.24	.49
Traditionalism	.42	.27	.37	.47	.50	.39	.53
Absorption	.08	.13	.19	.41	.49	.21	.61

Family data from Carey (unpublished) and Carey & Rice (1983), twin data from Tellegen et al. (1988)

.

Table 22.6. Sex differences in heritability for the MPQ[1].

	heritability:		
	females	males	significant sex differences?
Well-Being	.40	.40	no
Social Potency	.54	.53	no
Achievement	.38	.32	no
Social Closeness	.47	.44	no
Stress Reaction	.45	.43	no
Alienation	.39	.61	yes
Aggression	.39	.35	no
Control	.33	.47	yes
Harm Avoidance	.45	.46	no
Traditionalism	.55	.52	no
Absorption	.44	.26	yes

[1] From Finkel & McGue (1997).

Table 22.7. Twin correlations in adult personality when measured at the same time and at different times[1].

		MZ (N = 79)		DZ (N = 48)	
	Stability	Same Time	Different Time	Same Time	Different Time
Well-Being	.50	.42	.40	.15	.07
Social Potency	.62	.64	.54	.09	.09
Achievement	.48	.40	.24	-.08	-.03
Social Closeness	.55	.53	.47	.20	.10
Stress Reaction	.53	.46	.41	.03	.01
Alienation	.40	.48	.27	.34	.06
Aggression	.54	.60	.43	-.11	-.11
Control	.55	.49	.45	.10	.01
Harm Avoidance	.64	.54	.43	.30	.30
Traditionalism	.47	.45	.30	.32	.12
Absorption	.69	.60	.53	.46	.40

[1] adapted from McGue & Lykken (1993).

Table 22.8. Hypothetical correlations for longitudinal twin data under different models of stability.

	Correlations:				
		MZ		DZ	
Stability due solely to:	Stability	Same Time	Different Time	Same Time	Different Time
Family Environment	.60	.60	.60	.60	.60
Nonfamily Environment	.60	.40	.00	.20	.00
Genes	.60	.60	.60	.30	.30

Table 22.9. Kinship correlations for the higher-order traits of Emotionality (Neuroticism), Activity, and Sociability (Extraversion) involving children. Age may be either exact age or average age of the sample. Sample sizes (N) have been interpolated or averaged when exact sizes were not given in the original publication.

						Correlation:		
Relationship:	Study	Sample	Age in months	Rater	N	Emotion-ality	Activity	Socia-bility
MZ Twins	1	1	14	Parents	100	.35	.50	.35
MZ Twins	1	1	20	Parents	100	.51	.59	.53
MZ Twins	2	2	42	Parents	100	.54	.61	.57
MZ Twins	5	4	164	Parents	86	.58	.73	.52
DZ Twins	1	1	14	Parents	100	-.02	-.25	.03
DZ Twins	1	1	20	Parents	100	-.05	-.24	.11
DZ Twins	2	2	42	Parents	97	.15	-.01	.15
DZ Twins	5	4	164	Parents	91	.27	.20	.05
Full Sibs	6	3	30	Parent	77	.13	.11	.09
Full Sibs	3	3	84	Teacher	70	.18	.37	.03
Full Sibs	3	3	84	Tester	86	-.06	.27	.32
Full Sibs	4	3	140	Self	101	.04	.05	.11
Full Sibs	5	4	164	Parent	154	.14	-.07	.08
Bio PO Tog.	6	3	48	Parent	470	.11	.07	.15
Bio PO Tog.	4	3	140	Self	184	.03	.06	.13
Bio PO Apart	6	3	48	Parent	267	.02	.01	.09

Bio PO Apart	4	3	140	Self	162	-.04	.05	.02
Half-Sibs	5	4	164	Parent	105	.16	-.02	.06
Adoptive PO	6	3	48	Parent	444	.11	.07	.17
Adoptive PO	4	3	140	Self	162	.04	-.03	.06
Adoptive Sibs	6	3	30	Parent	68	.15	-.04	.02
Adoptive Sibs	3	3	84	Teacher	63	-.15	-.10	-.10
Adoptive Sibs	3	3	84	Tester	73	.15	.08	-.06
Adoptive Sibs	4	3	140	Self	92	.08	-.04	-.05
Adoptive Sibs	5	4	164	Parents	124	.00	-.19	-.26

Code for Study: 1 = Plomin et al. (1993); 2 = Neale and Stevenson (1989); 3 = Schmitz et al., (1996); 4 = Plomin et al (1998); 5 = Saudino et al (1995); 6 = Plomin et al. (1991)

Code for Sample: 1 = McArthur Longitudinal Twin Study; 2 = Stevenson's English twins; 3 = Colorado Adoption Project; 4 = Nonshared Environment in Adolescent Development Project.

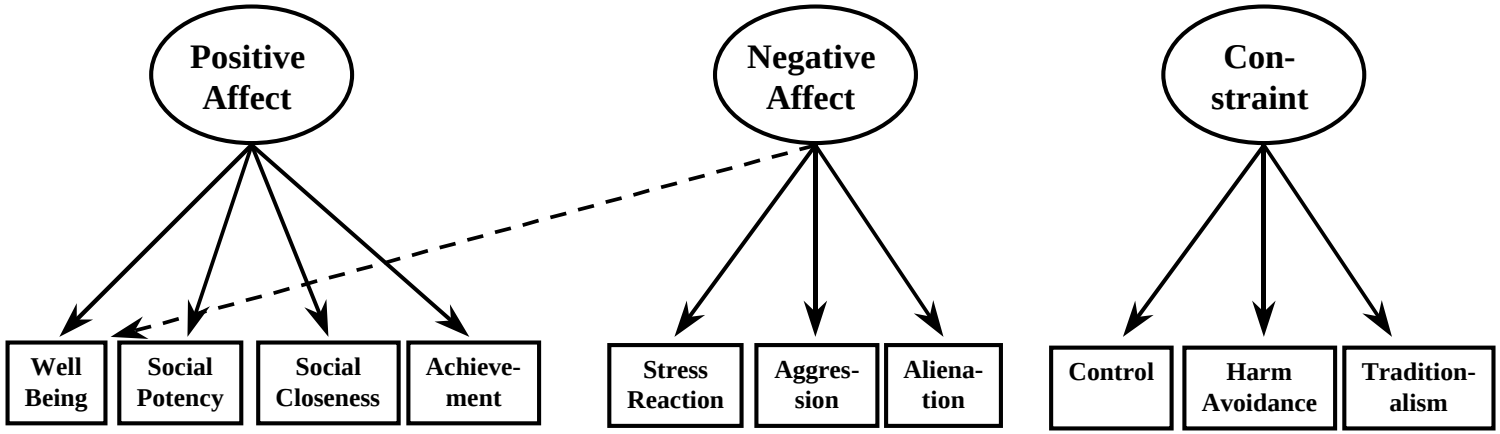

Figure 22.1. An example of the hierarchical model of personality according to Tellegen's Multidimensional Personality Questionnaire (MPQ)

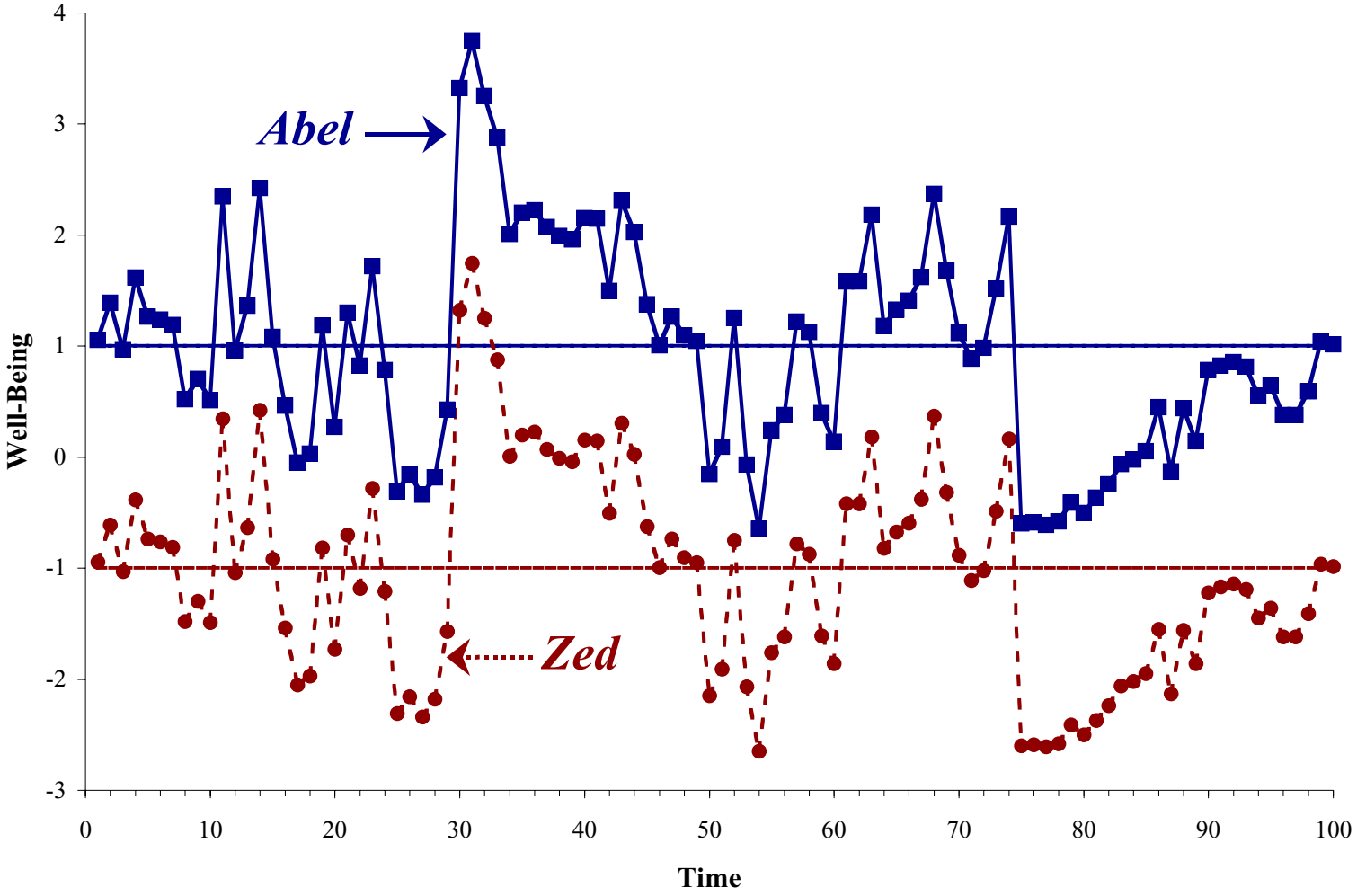

Figure 22.2. An example of the set-point model for two hypothetical individuals, Abel and Zed.