STABILITY OF LIFE-SATISFACTION OVER TIME
Analysis of change in ranks in a national population [1]

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Summary

This paper is about constancy of differences in life-satisfaction in society. It analyzes data of a large panel study in Germany, which involved yearly interviews between 1984 and 1994. Year-to-year correlation started at +.45 and increased gradually to +.54. The correlation between the first and later reports declined through the years, the correlation between the 1st and the 11th report was only +.29.

Observed overtime correlation may result from six effects: Firstly the correlation is attenuated by error: 1) common measurement error, such as haphazard responding, and 2) error in estimating general satisfaction due to passing uplifts and hassles. Both errors may shrink as 3) respondents get experienced in answering questions about life-satisfaction and 4) when they mature. Next, 'true' correlation will depend on: 5) mayor changes in life, such as loss of job or getting married, and 6) stable stocks, such as personal capabilities and social relations. This paper develops models to disentangle these effects.

The best fitting model suggests that almost half of the initial variance in life-satisfaction was due to error: 23% to error in responding (effect 1) and 19% to error in estimating one's satisfaction with life (effect 2). In 10 years the error component shrinks by 10%, largely due to learning effect 3) and partly due to aging (effect 4). In the end, life-changes explained 30% of the variance (effect 5) and stable stocks another 29%. (effect 6).

These results mark a considerable mobility along the life-satisfaction ladder in a modern society: over a lifetime less than 30% of the original rank order in life-satisfaction will be left. That outcome is at odds with common theories of class and personality.

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§ 1 INTRODUCTION

The dream of greater happiness
In common philosophy of life 'happiness' or 'life-satisfaction' is a mayor goal. In utilitarian moral philosophy it is even the ultimate goal in human life. This ambition assumes that happiness is susceptible to change. To pursue happiness would be senseless if it were a fixed matter.

Hence advocates of this view believe that happiness is variable and dependent on human action. Their belief involves two assumptions: Firstly, that the general level of happiness depends on the quality of society, and hence that average happiness can be raised by social reform. Secondly, that relative happiness within society depends on how well we cope with the given conditions, which implies that we can improve our lot by developing our capabilities. Both these articles of faith are called into question.

Doubts about chance to change
The assumption that we can improve the absolute level of happiness in society is often denounced as naïve utopism. The criticism is based on several grounds:

The most radical critique is that there is little view on happiness at all. Existentialists have claimed that the inherent meaninglessness of the human condition leaves no ground for enjoying life. Likewise several Freudians think that the functional demands of society contradict with human nature, and therefore require that we repress our deepest longings. In these views we taste happiness only in stray moments of delusion and are chronically dissatisfied most of our life. (Freud 1953)

A less radical objection holds that happiness is relative. In assessing our satisfaction with life we would compare with standards of the good life, based on reality expectations and social comparison. These standards would shift with failure and success, and correct satisfaction accordingly. In this view, satisfaction and dissatisfaction are transient experiences (Brickman and Campbell 1971). A persons life-satisfaction oscillates around a neutral level, and the average in populations tends to be zero. Hence, social progress will not add to life-satisfaction, and neither will social decay detract to it. (e.g. Unger 1970)

Recently, these spectacular objections have been submitted to empirical tests, and were proven false. Unhappiness appears to be exception rather than rule. Most people enjoy life, at least in affluent societies (Veenhoven 1991, 1994).

Still, there is doubt about the second assumption, the notion that we can improve our satisfaction relative to others. This supposition is also called in question. It is argued that there is in fact little mobility on the ladder of happiness.

Sociologist argue that the chances for a happy life depend on one's position in society, and that positional differences tend to be persistent: Enduring class difference is not only seen in economic assets, but also in 'social capital' such as access to supportive networks, education and lifestyle. These hard dying differences in life-'chances' are seen to reproduce differences in life-'satisfaction' over and over again e.g. Sennet & Cobb 1972; Willis 1977). Born unhappy, there is thus little view on dying happy.

Likewise, psychologist tell that life-satisfaction is very much a matter of stable character. Differences in capability would make that some people do consistently better than others:

have better careers, more successful marriages, etc. Likewise, differences in emotional disposition would make that some people take more pleasure from the same life. Some of these psychologists emphasize innate traits (e.g. Lykken 1999), while others stress acquired dispositions (e.g. Lieberman 1970). In this view, a melancholic will never become a 'Happy Hans'.

This psychological view adds to the above sociological theory. Together these theories predict that the happiness hierarchy in society will change little over time, even if the general level of living improves.

The issue of change in rank

This paper deals with this latter issue, the question whether the rank order of happiness in society tends to be static. In other words, whether there is any mobility along the happiness ladder.

This issue is relevant in other contexts as well. The stability of life-satisfaction is indicative for the reality value of the above mentioned notions of social and psychological determination. If there appears to be more change than stability, then there is something wrong with these theories. Society could be more open than assumed or class-membership less decisive for life-chances. Also could psychological development be more varied than most psychologists think, or could personality be less decisive for the quality of life. As such, the topic touches on basic discussions in sociology and psychology.

Given the relevance of this issue, it is no surprise that attempts have been made to assess the constancy of happiness empirically. Most of these studies estimate stability by the size of overtime correlation. The reported correlations are typically in the realm of +.50, which is usually interpreted as evidence for high stability. In this vein Lieberman (1970: 74) writes: ".. at some point in life, before even the age of 18, an individual becomes geared to a certain satisfaction with life, which - within a rather broad range of environmental circumstances - he maintains throughout life". There is also an attempt to express stability in a ratio of stable and variable variance in life-satisfaction over time. Stones et. al. (1995) report S-V ratio's ranging from 50:1 to 4:1, and conclude that "Happiness is more traitlike than statelike" (pp. 135).

Veenhoven challenged these conclusions. On the basis of a meta-analysis, he showed that overtime correlations are indeed high on the short term, but drop considerably after five years and are likely to shrink to zero over a lifetime (Veenhoven 1994: 111). He rejected the reported S-V ratios on methodological grounds (Veenhoven 1998: 219-20).

Goal of this study

Empirical settlement of the issue is thwarted by two conditions. One is that the available studies concern mainly specific groups, such as students (Block 1971), people in transition (Chiriboga 1989), and mothers (Mussen et. al., 1980). These subjects are not representative for the average citizen, particularly not with respect to the probability of change in happiness. What we need is a long-term follow-up in a general population sample. There are some studies of this kind. Eels (1985) followed a sample in Nebraska USA over 4 years, and Headey & Wearing followed a sample in Victoria Australia during 8 years. A panel study by Costa et al (1987) covered 9 years, but unfortunately, the measure of wellbeing used in that study is too far from life-satisfaction as conceived here. We need longer panels with the right items.

The second obstacle is in the method for assessing change. Simple overtime correlations provide no good estimate of stability, because they are biased in several ways. One problem is that correlations are attenuated by error, not only by common measurement error, but probably also by specific error involved in estimating life-satisfaction. Another problem is that these errors may change over time, as a result of panel effects and mental maturation.

This paper reports an attempt to solve these problems. It presents a method to disentangle these effects and applies that model on the data of a long-term panel study in a national population.

Below in § 2 we will first specify in more detail how we conceptualize 'life-satisfaction' and 'stability', and how we measure these phenomena. Next in § 3 we will present the raw data. Then in § 4, we will present two basic models for analyzing such data and in § 5 refine these models by taking into account diminishing error. The results of the best fitting model will be presented in § 6 and the implications of the results discussed in § 7.

§ 2 CONCEPTS AND MEASURES

Life satisfaction

'Happiness' or 'life-satisfaction' is the degree to which an individual judges the overall quality of his/her own life-as-a-whole favorably or unfavorably. In other words: how much one likes the life one leads. As life-satisfaction is an 'overall' judgment of life, it should not be mixed up with aspect judgments, such as the contention that life is 'thrilling' or 'meaningful'. As the judgment concerns *life-as-a-whole* it also differs from evaluative appraisals of life-domains, such as satisfaction with one's work or marriage. The concept is delineated in more detail in Veenhoven (1984: ch. 2).

Life can be judged in retrospect (past life), in prospect (future life), and in the present (current life). The stability of these judgments is probably not the same. The evaluation of the past is likely to be more constant than the estimation of the future. In this study we focus on satisfaction with *present life*.

Life-satisfaction is thus a subjective state of mind. As such it can only be measured by asking people. Questions on the matter can be framed in various ways. Current survey studies on life-satisfaction use simple direct questions such as: 'Taking all together, how satisfied would you say you are with your life-as-a-whole these days?"[2] Empirical tests have shown that the responses to these questions are quite valid and fairly reliable (Veenhoven 1984: ch. 3, Scherpenzeel 1995).

Stability

Change in life satisfaction can be studied by comparing responses on identical questions at different points in time. The less change observed, the more 'stable' happiness is said to be. Temporal stability can be assessed in two ways.

Firstly one can consider the degree to which the life satisfaction of an individual does remain unchanged in the course of time. For instance, whether people who are dissatisfied in adolescence tend to be equally dissatisfied with life in old age. This is called 'absolute stability'.

Secondly we can consider permanence in the difference to other people. For instance, whether the least happy person in a family remains the least happy all his life. This is called 'relative stability' or 'rank stability'. Relative stability does not necessarily imply absolute stability. The continuously least happy person in a cohort may actually have got somewhat happier, but remained at the bottom of the rank because all members of the cohort got happier.

In this paper we aim on relative stability of life-satisfaction through time. The question is to what extent the most satisfied maintain their lead and the least satisfied remain at lag. The focus is thus on permanence in *life-satisfaction rank* in society.

Relative stability of life-satisfaction can be assessed if repeated reports of the same people (panel data) are available. Its degree can best be expressed in a Pearson's correlation coefficient $r_{i.j}$, which by its nature is insensitive for changes in the absolute level. If $r_{i.j} = 1$, there is perfect rank stability during the time-interval from year i to year j. In that case the relative positions of the different people with respect to each other remained the same.

§ 3 DATA ON LIFE-SATISFACTION THROUGH TIME

Life-satisfaction is followed over time in the German Socio-Economic Panel. In 1995 this study had gathered data over 11 years for an initially representative sample of people aged 18 years and older, living in West Germany. The data have been collected between 1984-1994; the interval between the observations is one year. Life-satisfaction is measured by a single question rated on a 0-10 numerical scale: "What do you think, how satisfied are you at present- all things considered- with your life?" [2].

The study started with more than 9000 respondents, of which 5483 responded to the question on life-satisfaction in all 11 interviews. These latter people were selected for this study. Analysis of panel dropout did not reveal any effect of happiness[3]. In table 1 the complete correlation matrix of this panel is presented[4].

Table 1
Overtime-correlations of life satisfaction in Germany 1984 - 1994

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1984	1.00										
1985	.45	1.00									
1986	.38	.47	1.00								
1987	.36	.42	.50	1.00							
1988	.34	.39	.46	.51	1.00						
1989	.32	.37	.42	.47	.53	1.00					
1990	.34	.36	.42	.44	.46	.53	1.00				
1991	.32	.34	.40	.42	.44	.47	.55	1.00			
1992	.31	.32	.39	.40	.41	.46	.51	.58	1.00		
1993	.28	.30	.34	.36	.38	.43	.46	.52	.55	1.00	
1994	.29	.30	.35	.38	.39	.42	.46	.49	.53	.56	1.00

A look at the left vertical column in table 1 shows that the correlation between the first and the second report of life-satisfaction was +.45. The correlation with each consecutive observation is slightly lower. The correlation between the first and the last (11^{th}) observation is only +.29. This is the stability decay, which we will model in § 4.

A look along the line from left top to right bottom reveals another pattern. Now we see year to year correlations that gradually increase during the course of the study. The row starts again with the +.45 correlation between the first and the second observation. The correlation between the second and the third observation is slightly higher. So are successive correlations, the correlation between the 10^{th} and the 11^{th} amounting to +.56. This is the effect of diminishing error, to be discussed in § 5.

The first impression is that life-satisfaction is not very constant through time. The correlations in the left vertical column start at a rather low level (+.45), and decline each year, though at an abating rate. Yet that is clearly not the whole story. The correlations are likely to be attenuated by measurement error. True correlation is higher. Further these data do not tell us how stable life-satisfaction will be in the longer run. Linear extrapolation would suggest that the rank order of life-satisfaction dissipates within the next 20 years, but possibly stability decline is not linear and reaches an asymptote at some point. Estimation of stability of life-satisfaction over the lifetime requires understanding of the substantive effects behind these correlations. This paper explores some models for that purpose.

§ 4 TWO BASIC MODELS

Two basically different models are formulated. The first model assumes that the life-satisfaction of a person depends mainly on turns in life, while the second model assumes that life-satisfaction depends also on the person's stable stocks. Both models fit Veenhoven's view of the life-appraisal process, in which life-satisfaction results from the stream of daily events. When nice things happen to us all the time we feel good, when odious things happen we feel bad. Life-satisfaction reflects the balance of affective experience over some period (Veenhoven 1997: 46). Likewise Kanahan (1999) recently described life-satisfaction as 'remembered instant utilities'.

In the first model, the stream of gratifying experiences, and hence life-satisfaction, depends on the course of life. If life changes to the better, the stream of nice events grows, and hence the number of positive experiences. For instance, when one gets married one becomes typically more comfortable at breakfast and less lonely at diner. On the other hand, turns to the worse reduce the number of uplifts and bring in a lot of hassles. Fe. if one gets sacked, one meets less respect and runs more often in the problem of making ends meet. In this model, life-satisfaction follows the balance of turns to the good and the bad. In other words, life-satisfaction is predicted by the sum of changes in conditions that affect the daily flow of experiences. Because that balance changes over time, we call it the ‘shifting equilibrium model'.

The second model adds to the first one by taking also into account that life-satisfaction is not only influenced by changes in life, but also or even more so by stable ‘stocks’ embodied in one's body, personality and social position. Such resources influence the course of events, for instance, the chance of being robbed in the street is lower for people in good mental health, and is also lower at the top of the social ladder than at the bottom. Some stocks also influence the affective impact of events. Healthy people cope better with the experience of being mugged and members of a warm family meet more social support after such an event. This model will be called the 'stable component' model.

These models resemble the 'dynamic equilibrium model' of Headey & Wearing (1991). In that model a stable equilibrium is presumed, while in our models the balance is gradually shifting as a result of ongoing turns in life. A person who gets married, finds a good job and wins a lottery, achieves a more profitable balance of conditions, which will reflect in a more positive balance of experiences.

4.1 Error component

Both models involve an error component. This component combines two kinds of error, next to common measurement error also error in estimating the satisfaction with life in general.

Error in response to questions

Firstly, there is the measurement error that is common to all survey assessments, i.e. the error due to contextual suggestion, haphazard responding and situational distraction. This kind of error is short lived. It does not even completely reappear in the answers to the same question later in the interview (unfortunately not available in this study), and certainly not in the next year's response.

Error in appraisal of life

Next, there is also error specific to the issue of life-satisfaction. When people make up their mind on how satisfied they are with their life on the whole, they typically estimate how well they feel generally. This appraisal of average experience is vulnerable to distortion by the condition of the moment, such as current mood and by bits of good and bad luck. For instance, the estimate of general satisfaction will be more positive right after a good business deal than after one's car being stolen [5]. These effects are short lived as well. At the next year's interview, the earlier bad mood and the stolen car do not affect the estimate of general satisfaction anymore.

The effect of passing moods on appraisals of life-as-a-whole is well documented. For instance, Schwartz & Strack (1991) showed that people tend to overestimate their general life-satisfaction when they are in good mood, in particular when they are not aware of their mood of the moment. Abbey and Andrews (1985) showed that the effects of mood vanish after a number of weeks, but according to Chamberlain (1985) this is the case within 3- 6 months. Moum (1988, p.133) compared the explained variance in an overall life-satisfaction by concurrent variables with that of lagged variables. He found a difference of 10.3%, which he attributed to mood. Similarly, Ehrhardt estimated the effect of mood on the correlations of life satisfaction of .12 (Ehrhardt 1995 12-13).

So we distinguish two error-components: common measurement error and short-lived effects on the appraisal of life. For the time being these will be treated as one factor. In the models below this error factor will be represented by the symbol E.

4.2 The shifting equilibrium model

The shifting equilibrium model assumes that the life-satisfaction at time t, indicated as LS_t, depends on the life-changes (LC), which have happened up to that point in time. The sum of this life history at a certain point in time is represented by a variable ΣLC_t. As noted above, the report of life-satisfaction at a specific point in time will also be effected by measurement error.

So we formulate:

$$LS_t = p_t \Sigma LC_t + E_t \quad (1a)$$

where p_t is a parameter indicating the strength of the effect of the "sum of changes variable" on the momentary life satisfaction at time t while E_t represents the effect of measurement error at time t. This model suggests that the 'life satisfaction' of a person is equal to the balance of changes to the good and the bad, except for the effect of error.

The sum variable ΣLC_t is not stable through time. It is expected that specific events between time t and t-1, denoted by ($LC_{t-1,t}$), will change this 'sum of changes variable' from one point in time to another. This leads to the following formulation of the change in the sum of events variable:

$$\Sigma LC_t = s_{t,t-1} \Sigma LC_{t-1} + LC_{t-1,t} \quad (1b)$$

where $s_{t,t-1}$ denotes the stability of the sum variable through time. If one goes through storm and shine, the stability is lower. Also, if the time interval between t and t-1 gets longer, the stability will become less.

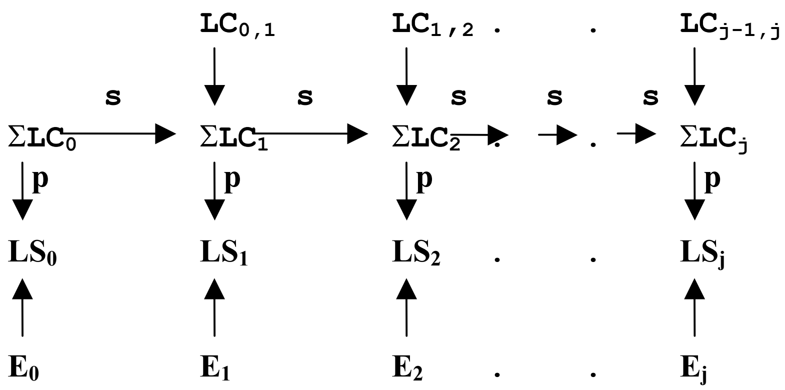
Additional assumptions

In this model, originally suggested by Heise (1985), the following assumptions are made:

a. The effect of the sum of changes on momentary life satisfaction p_t does not change during the investigation: Subjects are not more or less affected by turns in their life when they get older. Thus $p_0 = p_1 = \ldots = p$
b. There is no serially correlated error. This means that life-satisfaction is determined by *one single factor,* the sum of changes which occur in a persons life so that there is no omitted variable. See also Kessler & Greenberg (1981)
c. An additional assumption (not suggested by Heise) is that the year-to-year stability coefficient $s_{j.j+1}$ is independent of the time of measurement: The society is in a dynamic equilibrium so that the pattern of intervening circumstances remains unaltered. Thus the aging of the subjects in the course of the investigation has no influence on the stability of the process. So $s_{0.1} = s_{1.2} = .. = s$.[6]

The model specified using these assumptions is presented in figure 1.

Figure 1
Path model for the shifting equilibrium model



From the path-diagram in figure 1 it can be seen that there is only one path between LS_0 and LS_j. Following that path and multiplying the encountered coefficients, leads to the following result for the correlations ($r_{o,j}$) between the life satisfaction at time 0 and other points in time :

$$r_{0.j} = p * s^j * p. \qquad (1c)$$

This equation can be transformed to a linear one by taking the logarithm:

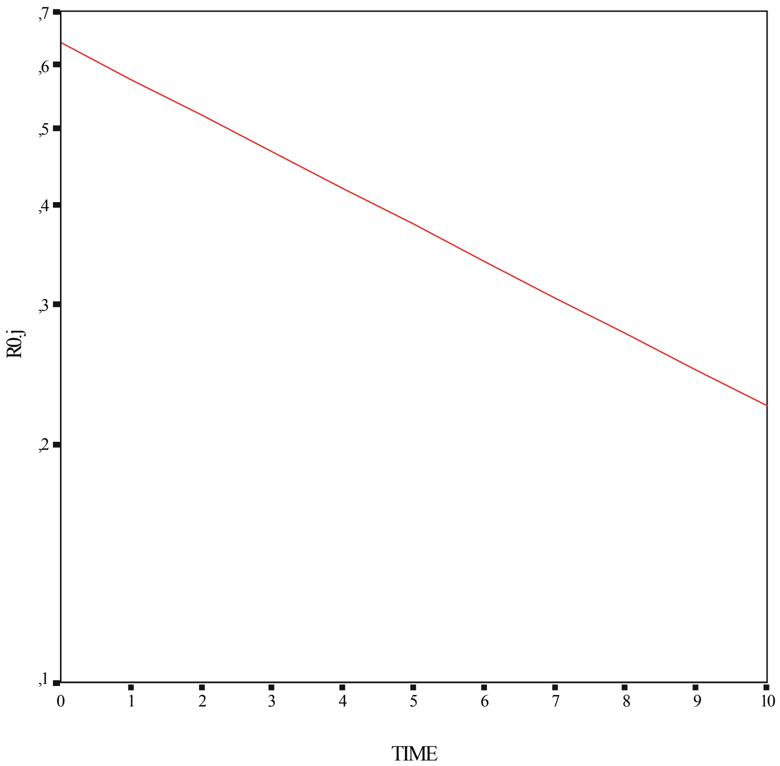
$$\log r_{0.j} = \log p^2 + j * \log s \qquad (1d)$$

This formula has the form of a linear regression equation: $\log r_{0.j}$, the log of the predicted correlation coefficient, is the dependent variable and j, the number of years since the start of the analysis, is the independent variable. In this regression the intercept will have the value of $\log p^2$ which can be interpreted as the effect on the initial life satisfaction of the life-condition before change, and the slope of the log of the stability coefficient; the lower the stability, the greater the change in life satisfaction [7].

A hypothetical example is presented in fig.2. In this example p=.8 and the year-to-year stability coefficient s=. 9. Equation (1d) becomes a straight line using a logarithmic scale for the y-axis.

Figure 2

Hypothetical example of the shifting equilibrium model: The overtime correlations of life-satisfaction during 10 years, assuming p = .8 and s = .9, where the y-axis is a logarithmic scale.



This picture indicates that the strength of the effect of the sum of changes on the incidental life satisfaction determines only the start of the process. If the effect of the sum of changes (p) is .8, the start of the curve is on p^2 which is in this case .64. If the coefficient is larger the curve starts at a higher level.

The log of the correlation of the life satisfaction goes down each year with log (s), the logarithm of the stability coefficient while the log correlation between the life satisfaction at the start of the observations (t = 0) till a time point (t = j) goes down with j times log(s).

4.3 The stable component model

It was shown that if there is only one component of stability, the log(r) versus time plot will be a straight line. The question is however whether that assumption is realistic. Let us now consider the possibility that there is also a stable component in life-satisfaction. Several psychologists, for example Costa and McCrae (1980, 1984) have suggested this possibility. It has been described in terms of 'personality', 'resilience' and 'art of living'. Similarly, sociologists have denoted a stable component in terms of 'life-chances' and 'social capital'. We will refer to these stable assets as the 'stock' factor.

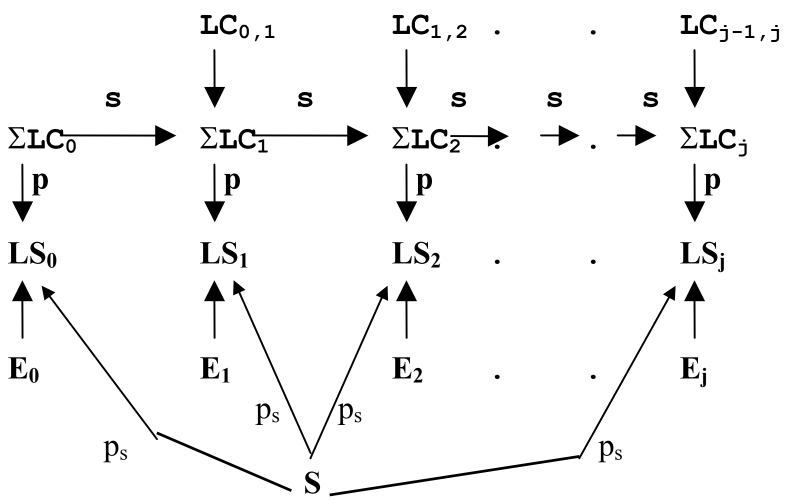
There are then four components affecting the stability of the measured life-satisfaction of a person: 1) ordinary measurement error, 2) appraisal error (or short-lived events), 3) the sum of life-changes, and 4) the 'stock' of stable resources.

These four components reflect the following chapters of theory: 1) measurement theory (measurement error), 2) 'inference' theory (appraisal error), 3) 'need/adaptation' theory (effect of life-changes) and 4) 'resource' theory (enduring yields of social and psychological assets).

The components work on a different time scale: 1) most of the common measurement error fades at the instant, 2) the incidents that distort the appraisal of life in general last no longer than some months, 3) the mayor life turns affect life-satisfaction over years, and 4) the stable stocks possibly work over the lifetime.

Introduction of the stock-component leads to the model of figure 3. This model is similar to the 'trait-state-error'model proposed by Kenny and Zautra(1995).

Figure 3
Path model for the stable component model as formulated in equations 2a and 2b



This extension of the model would require that the model be reformulated as follows:

$$LS_t = p\Sigma LC_t + E_t + p_s S \qquad (2a)$$

where S is the stocks and p_s is a parameter indicating the strength of the effect of stable stock on the momentary life satisfaction. This model suggests that the life-satisfaction of a person might be strongly affected by life turns if p is large or strongly effected by a stable component if p_s is large. The formulation of the change in the sum of turns remains as was specified in equation 1b which is used here again as equation 2b;

$$\Sigma LC_t = s.\Sigma LC_{t-1} + LC_{t-1,t} \qquad (2b)$$

where s denotes the stability of the sum of events through time.

In this model the same assumptions are made as in the first model, except that we add one.

We assume that also a stable component has an effect next to the life-changes.

The correlation between the life-satisfaction variable at the first point in time (t = 0) and the life satisfaction variable at time j (t = j) is equal to

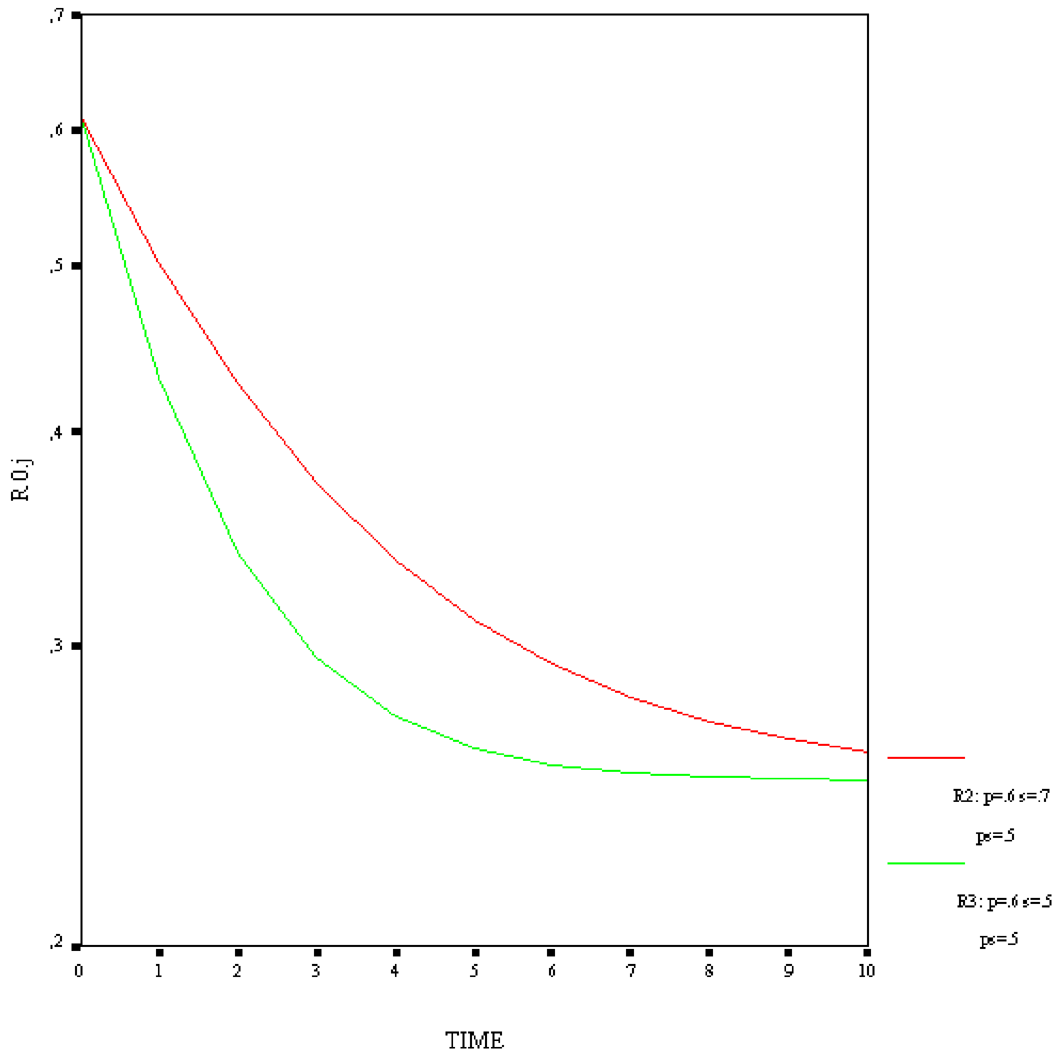
$$r_{0j} = p^2.s^j + p_s^2. \qquad (2c)$$

As a consequence the log-curve will be convex. This can be explained as follows:

In the first part of the process the curve will go down because the stability coefficient is smaller than 1. With greater time-intervals the variance in satisfaction due to the sum of changes will gradually disappear, so that this can no longer play a role; only the stable component (S) remains, causing the slope to become horizontal. The combination leads to a convex initial part of the curve and an asymptote later in the process. In other words: if j is very large, $r_{0.j}$ reaches the asymptotic value of p_s^2 due to the stable component. If j = 0, $r_{0.j} = p^2 + p_s^2$, representing the influence of the slowly varying component plus that of the stable component in the initial variance; $p^2. s^j$ is that part of the variable component that has not changed up till year j. The sum of the contributions to the components to the initial variance is made 1: var. E + $p^2 + p_s^2 = 1$.

If the two effect parameters p and p_s are known together with the stability coefficients, the expected curve can be drawn. In figure 4 two examples have been given with varying stability coefficients. In both cases the p coefficient is the same but in one case the stability is specified to be much stronger than in the other case.

Figure 4
Hypothetical example of stable component model: The overtime correlations of life-satisfaction during 10 years, assuming p = .6 and s is respectively .7 (R2) and .5 (R3) where the y-axis is a logarithmic scale.

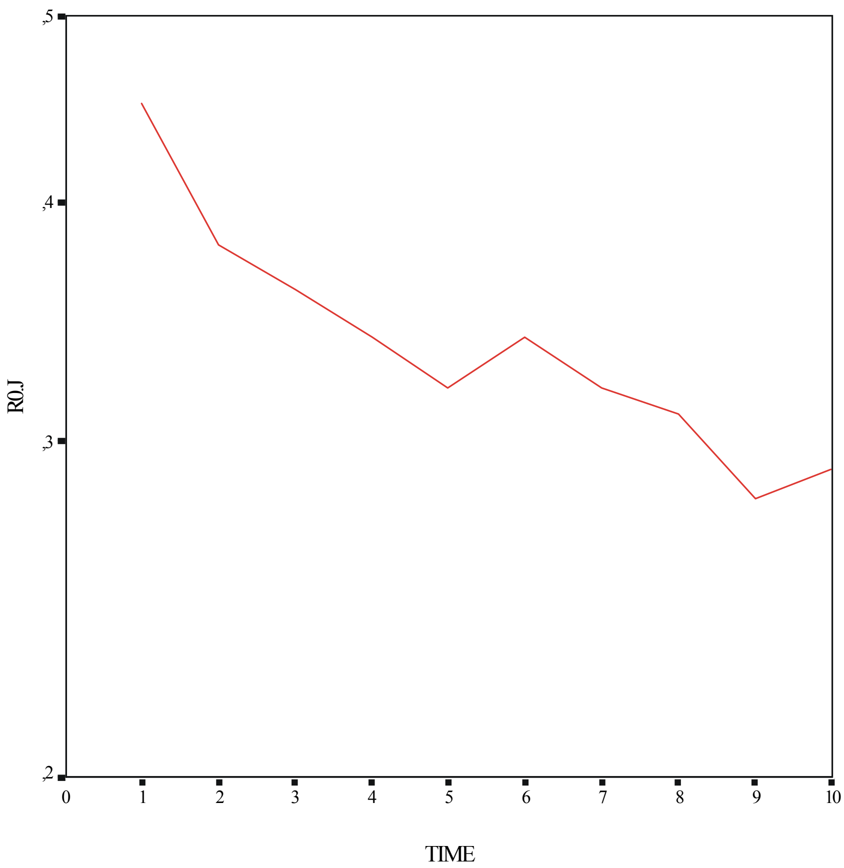


If the stability is very high (few life-changes), the curved part can be quite long, but the process goes to an asymptotic value in the end. If the stability is relatively low the curve reaches faster its asymptotic value. If the effect of the stable component is zero the second model will produce the same curve for the correlations through time as the first model.

4.4 Fit with the data

So the shifting equilibrium model predicts a straight line in the logarithmic chart, while the stable component model predict a convex pattern. Now we can apply the data in table 1 to see which of the models fits best. Let us first consider the correlations with the first observation, in the second left column of table 1. The logarithm of these correlations is plotted in figure 5.

Figure 5
The overtime correlations between first report of life-satisfaction and successive observations from the German panel where the y-axis is a logarithmic scale



This figure and the data in table 1 indicate clearly a nonlinear relationship and also a tendency of the function to reach an asymptote. This result suggests that there is indeed a fast changing component and a stable component.

§ 5 ADJUSTED MODELS: taking into account diminishing error.

But before we draw premature conclusions we have to discuss the problem of measurement error. In figure 5 we presented only the correlations $r_{0.j}$ between the first wave and all the others. Further examination of the correlation matrix of Table 1 showed that the correlations between variables with one year in between are increasing through time. This suggests that the amount of correlation depends not only on the length of the time-interval between waves, but also on the place of this interval in the progressing panel-analysis.

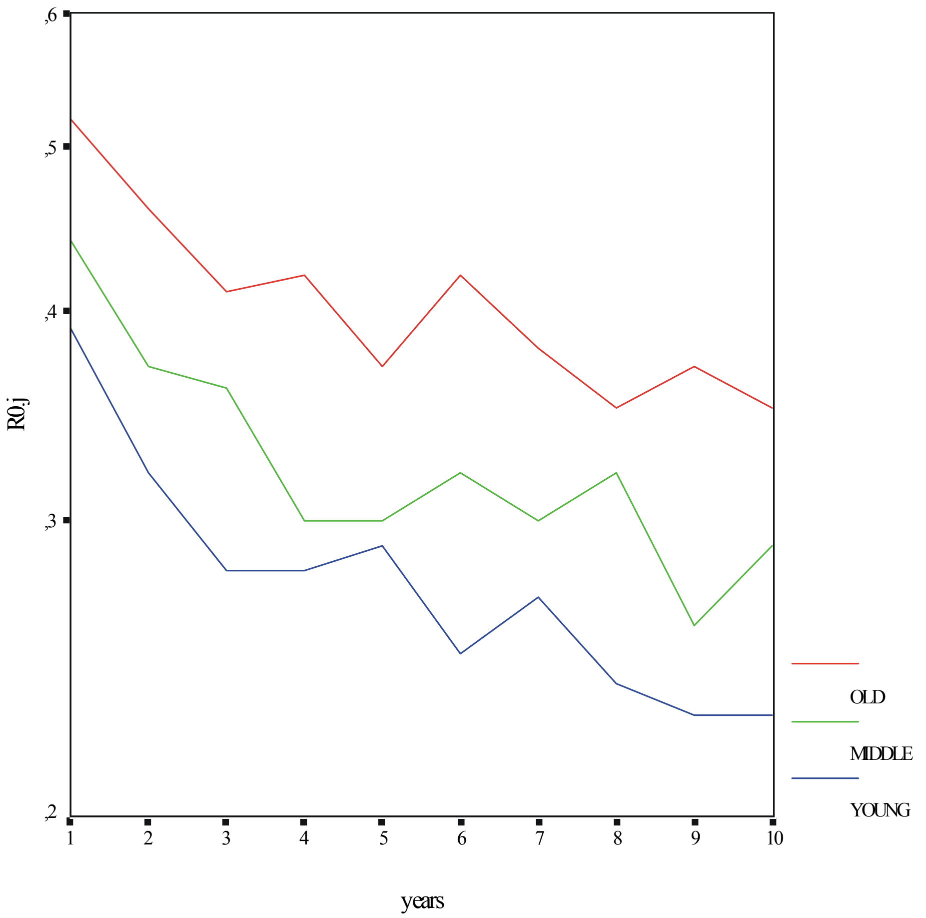
There are two possibilities to explain this effect: As no newcomers are entering the group, participants will grow older during the course of the research. Possibly they will become more life-wise and therefore better able to estimate their general satisfaction with life. Life-experience is likely to reduce the effects of passing moods and bits of luck on the evaluation of life-as-a-whole. If so, maturation will reduce appraisal error and hence produce more stable life-satisfaction scores.[8]

The second possibility is that it is not the aging of the subjects that counts, but their participation in the panel. After having answered the question over and over again, they may learn to evaluate their satisfaction better and produce less measurement error. Below, we will check which of the two explanations fits the data best.

5.1 Increasing overtime correlations due to aging?

This first explanation was investigated by considering the stability-curves of different age groups (figure 6). The picture shows indeed lower $r_{0,j}$ values among younger people. As the curves seem to be more or less parallel, the stability-decline is apparently independent of age. Yet the effect of the error-component seems variable across age groups, given the different starting values of the curves. Is this effect large enough to explain the deviations in the correlations for the different years in the correlation matrix for the whole population?

Figure 6
The overtime correlations of life-satisfaction during 10 years on a logarithmic scale for three ages groups.



Let us compare the correlations with a time-interval of one year among new and experienced participants in the panel. A split-up is presented in table 2. The mean correlation appears to have augmented between 1984-85 and 1989-90, an increase of .0818 in five years. Can this be explained by aging? The direct effect of aging can be estimated by comparing the columns of different age groups. From young to middle the mean correlation increased with .0619 in 18.4 years, that is .016 in 5 years and from young to old the mean correlation did increase with .0944 in 38.6 years and thus .012 in 5 years. This is far less then the required amount of .0818. *So aging is only for a small part (20%) responsible for the growing year-to-year correlation.*

Table 2
Effect of aging on observed overtime correlations of life-satisfaction.

	Young *> 35* *N=2649*	*Middle* *35-54* *N=2928*	*Old* *<55* *N=1514*	*Mean r*	*Increase r*	*Increase age*
r(84-85)	.3867	.4725	.4855	.4482	0	0
r(89-90)	.4874	.5253	.5773	.5300	+.0818*	+ 5
Mean r	.4370	.4989	.5314			
Increase of r	0	+.0619*	+.0944*			
Mean age	25.6	44.0	64.2			
Increase of age	0	+18.4	+38.6			

* p<.01

5.2 Increasing overtime-correlations due to learning*?*
The second possibility is learning by participation. This effect can be confirmed by the following reasoning. If the subjects can indeed evaluate their life-satisfaction better after having participated a number of times in the panel, the measurement error will be less in successive waves. This increase in reliability leads to higher measured correlations. On the other hand less error-variance results in smaller total variance - or standard deviation- in the later waves. The covariance, calculated from: $COV_{i.j} = r_{i.j} * stdev_i * stdev_j$, should therefore be unchanged.

The data of German panel do indeed show these effects: In Table 3 we see that the standard deviation diminishes in later years. Table 3 also shows that the measured overtime-correlation for 1-year intervals increases with time, but the covariance merely shows a fluctuation. Bring back in mind the complete matrix of table 1. This analysis shows indeed that an increase in reliability may explain the observed rise in year-to-year correlations. *Hence, the observed increase in year-to-year correlations seems largely due to a learning effect.*

Table 3
Overtime correlations of life-satisfaction in the total sample
Mean standard deviations, co-variances and correlations

wave	SD	Mean	Interval	R	COV
1984	2.055	7.541	84-85	.4450	1.834
1985	2.005	7.332	85-86	.4703	1.793
1986	1.902	7.337	86-87	.4933	1.770
1987	1.887	7.182	87-88	.5155	1.840
1988	1.892	7.109	88-89	.5207	1.870
1989	1.898	7.099	89-90	.5263	1.784
1990	1.786	7.240			

5.3 Correcting for decrease of measurement error.
This latter learning effect occurs in the participants of the panel, but not in the population it is presumed to represent. Hence if we want to know what happened to the average German, we have to correct for this effect. One way to do so is to estimate the learning effect and add that to the observed variances in the diagonal of the covariance matrix. This may seem a dubious medicine, because we add in fact error to the observations rather than reduce error. Still, it helps to create comparability with wave 1, when respondents answered the question for the first time.

The learning effect was estimated by the trend in variance (R in table 3). The regression effect is .111 * t. These values were added to the original covariance matrix. Appendix 1 presents that original covariance matrix, the corrected covariance matrix, as well as the new correlation matrix computed on the basis of that by means of LISREL. This corrected correlation matrix is used in the following analyses.

5.4 Four models compared
Now we have seen that the error component can change overtime, we can introduce that possibility in our models. Both models can be considered with equal variance in E_t and without**.**

Model 1 is the shifting equilibrium model specified before. Model 1' is the same model corrected for decreasing measurement error in E_t. Model 2 is the stable component model. Model 2' is the same model corrected for decreasing measurement in E_t.

Table 4 The design of the analysis

	No stable factor	With stable factor
No correction	model 1	model 2
With correction	model 1'	model 2'

All 4 models[9] specified were estimated with the program LISREL8 of Jöreskog and Sörbom (1993) using the Quasi Maximum Likelihood estimation procedure given the robustness of this estimator against non-normality of the data (Satorra, 1989). This procedure also provides a chi-square test of the different models against each other given that these different models are nested. However, due to the large sample size it is difficult to use the test in the usual way taking as a criterion the critical value for the 5% significance level test. Therefore we will present the chi-square test statistics mainly to illustrate the relative fit of the different models. An evaluation of the fit of the best model will be based on the expected change parameters as suggested by Saris, Satorra and Sörbom (1987).

The results of these calculations are shown in table 5. According to the assumptions noted in § 3.1, s, p^2 and p_s^2 were not allowed to change over time.

Table 5
The test of the different models against each other using the chi² test[10]

	No stable factor	With stable factor	Difference
No correction	153 (53)	98 (52)	55
With correction	100 (53)	62 (52)	38
Difference	53	34	

(The degrees of freedom of the tests are presented in brackets)

Table 5 shows that the use of corrected data-matrix provides a better fit (lower chi^2), independent of the models used. So we will proceed with the corrected variants. Table 5 also shows that model 2' has a better fit to the data ($Chi^2 = 62$ with df=52) than model 1' (Chi^2=100 with df=53). This result suggests that the former model should be preferred [11].

Table 6 presents the variances explained by the components in both models. In model 1' slightly more than half of the variance in life-satisfaction over time is due to changes in life

(55%), and slightly less than half to error (45%). In model 2' stable stocks explain 29%, events 294% and error 42%. As we had already seen in table 5, model 2' produces a better fit. Chi^2 62 is quite acceptable given DF 52.

In model 1' the year to year stability coefficient s is 0.93. In model 2' s is lower (0.79), because stable stocks explain part of the stability. In model 2' we can also express overtime stability in the ratio of stable stocks and variable events. In this data-set SV is 0.79:1.

Table 6
Variance of life satisfaction explained by different factors

	Model 1	**Model 2**			
Factor	Total	Total	Young	Middle	Old
Stable stocks: p_s^2	-	29%	26%	26%	36%
Sum of changes: p^2	55	29	31	30	30
Error: E*)	45	42	42	44	34
Total	100	100	100	100	100
S-V ratio **)	-	0.98	0.84	0.86	1.21
Stability s	0.93	0.79	0.68	0.79	0.84
CHI^2	100	62	125	132	137
DF	53	52	52	52	52

*) With the present lisrel model it is not possible to distinguish between sources of error.
**) Ratio: stable stocks/ sum of changes

5.5 Specification by age-group

In the last three columns of table 6, model 2' is applied to separate age groups. This split-up produces small but well interpretable differences. The difference is mainly between the old and the not old. The stable component is greater among the old, and the error component smaller. Probably this is because the elderly have a more established attitude to life and lead more predictable lives.

5.6 Split-up of the error-component

The error component in table 6 involves two sources random bias in the measurement, next to common measurement error, the effects of short-lived events. Remember § 4.1. Up to now, we could not separate these effects. Fortunately, there is an estimate of the size of the common measurement error on this variable. On the basis of a panel study by Krebs and Schmidt (1995), Scherpenzeel (1995) has estimated that size on 23% of the total variance in life-satisfaction [12]. If we assume that the size is about the same in this study, the error due to passing ups and downs is about 20%, slightly higher in model 1' (21.6%) than in model 2' (18,7%). This is more than the error observed in the studies mentioned in § 4.1, but still imaginable.

Table 7
Decay of the original ranking; total sample, corrected models
Variance explained in %

	Model 1'			**Model 2'**			
Time	changes p^2*st	error E appraisal +	measurement	stocks p_s^2	changes p^2*st	errror E appraisal +	measurement
0	55	21	23	29	29	19	23
1	51.5	51.5		28.9	23.2	52.1	
2	47.8	47.8		28.9	18.2	47.1	
3	44.4	44.4		28.9	14.4	43.3	
4	41.3	41.3		28.9	11.3	40.2	
5	38.3	38.3		28.9	8.9	35.9	
7	33.0	33.0		28.9	5.5	34.4	
8	30.7	30.7		28.9	4.3	33.2	
9	28.6	28.6		28.9	3.4	32.3	
10	26.5	26.5		28.9	2.7	31.6	
Extrapolation to t=20							
20	12.7	12.7		28.9	0.3	29.2	

5.7 Estimation of stability decay curves

Now we can quantify the hypothetical graphs in figure 2 and 4. The estimated values per year are presented in table 7.

The left half of the table 7 describes the linear decay line of figure 2. Due to the big error terms, the line starts with a modest percentage of explained variance (55,7%). In ten years this percentage drops to 26.5%. Extrapolation predicts that in 20 years only 12,7% of the original rank order of life-satisfaction will be left in this population.

The right half of table 7 describes the pattern of declining decay in figure 4. This line also starts at an explained variance of 55,7% and shows a convex decline to 31.6% in ten years. This is close to the stable component. Hence extrapolation to 20 years shows little difference, at that time 29,2% of the original rank order will be left.

§ 6 DISCUSSION

Best model
On the basis of this analysis we can choose between a model with one slowly changing component (shifting equilibrium model) and a model with an additional stable component (the stable component model). The last model fits the present data best. Time will learn whether it is also fits the data of the next waves of this panel study.

The latter model suggests that the effect of stable stocks is nearly as strong as the effect of summed life-changes. The effect of error on the reported life-satisfaction was quite large.

Degree of stability
In the stable component model, the long-term stability is about the size of the stable component, which is 29% [13]. This means that only 30% of the original rank order in life-satisfaction will be left.

The stable component model allows another estimate of stability as well. It enables us to compute the ratio of stable and variable components. As noted in the introduction, Stones et. al. (1995) report S-V ratio's ranging from 50:1 to 4:1. Our data and method show more variability. On the basis of table 6 we computed S-V ratio's for the three age-groups, among the young the ratio is then 0.84:1, among the middle aged 0.86:1 and among the aged 1.21:1.

Substantive implications
These results differ from the expectations of psychologists who think that satisfaction with life is largely determined by stable personality traits, in particular for those who see it as an innate disposition. Our data indicate that there is indeed a lot of stability, but about as much variability. On the longer term, the variable component may appear to be greater.

One of the reasons for this result may be that personality 'traits' are less durable in the long run than most psychologists think. Another reason could be that personality does not always affect life-satisfaction in the same way. A trait that is conductive in life-satisfaction in young adulthood may be detrimental to it in old age, for instance: aptness to control one's fate. This point is in agreement with our finding that the effects of the stable component is larger for the older people than the younger.

The results are also at odds with the common view in sociology of inequality. As noted in the introduction many sociologists stress the importance of differences in social positions, such as access to income, education and social prestige. The term 'social capital' suggest lasting effects on life's outcomes such as happiness. One challenge to this view was the finding that socio-economic position bears little relationship with subjective appreciation of life, at least not in advanced industrial society (e.g. Veenhoven & Saris 1996). The results of this analysis are another indication that chances for a good life may be less fixed: the once happiest appear not to be the happiest forever. Seen in this light, our findings suggest in fact that (western) society is quite open with respect to chances for happiness.

Further research

These results concern a particular country in a particular period. The German unification took place in these years, and has possibly created more turmoil in individual lives than usual in present day Western nations [14]. So a first challenge is to apply this method on other populations.

This study considered a ten-year period. Though that is the longest follow-up of a national population ever made, the time span is still limited. We need much more years to assess stability of life-satisfaction over the lifetime. So a second task is to follow this panel longer in time and to include measures of life-satisfaction in other long-term follow-ups.

A further challenge is to improve the estimates of error, aging and learning, and to identify possible differences in other populations.

Lastly, it would also be worth to get a closer look at the actual life-changes and resources that are involved. That would require a focussed panel study like the Victoria Quality of Life panel by Headey and Wearing (1992). Hopefully, more such studies are made in the future.

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Appendix 1

Uncorrected covariance matrix: total population

4.191										
1.861	4.055									
1.479	1.796	3.560								
1.373	1.593	1.786	3.548							
1.304	1.492	1.643	1.814	3.561						
1.219	1.406	1.479	1.636	1.852	3.471					
1.190	1.258	1.359	1.445	1.493	1.716	2.990				
1.080	1.145	1.265	1.301	1.394	1.452	1.590	2.767			
1.054	1.069	1.227	1.266	1.301	1.433	1.477	1.608	2.786		
1.031	1.112	1.153	1.245	1.313	1.448	1.450	1.565	1.670	3.303	
1.072	1.095	1.200	1.296	1.335	1.408	1.441	1.463	1.596	1.829	3.242

Corrected covariance matrix: total population

4.191										
1.861	4.17									
1.479	1.796	3.78								
1.373	1.593	1.786	3.88							
1.304	1.492	1.643	1.814	4.01						
1.219	1.406	1.479	1.636	1.852	4.03					
1.190	1.258	1.359	1.445	1.493	1.716	3.66				
1.080	1.145	1.265	1.301	1.394	1.452	1.590	3.54			
1.054	1.069	1.227	1.266	1.301	1.433	1.477	1.608	3.67		
1.031	1.112	1.153	1.245	1.313	1.448	1.450	1.565	1.670	4.30	
1.072	1.095	1.200	1.296	1.335	1.408	1.441	1.463	1.596	1.829	4.34

Uncorrected correlation matrix, total population

1.00										
0.451	1.00									
0.383	0.473	1.00								
0.356	0.420	0.503	1.00							
0.338	0.393	0.462	0.510	1.00						
0.320	0.375	0.421	0.466	0.527	1.00					
0.336	0.361	0.416	0.444	0.458	0.533	1.00				
0.317	0.342	0.403	0.415	0.444	0.469	0.553	1.00			
0.309	0.318	0.390	0.403	0.413	0.461	0.512	0.579	1.00		
0.277	0.304	0.336	0.364	0.383	0.428	0.461	0.518	0.551	1.00	
0.291	0.302	0.353	0.382	0.393	0.420	0.463	0.489	0.531	0.559	1.00

Corrected correlation matrix: total population

1.00										
0.445	1.00									
0.372	0.452	1.00								
0.341	0.396	0.467	1.00							
0.318	0.365	0.422	0.460	1.00						
0.297	0.343	0.379	0.414	0.461	1.00					
0.304	0.322	0.365	0.384	0.390	0.447	1.00				
0.280	0.298	0.346	0.351	0.370	0.385	0.442	1.00			
0.269	0.273	0.329	0.336	0.339	0.373	0.403	0.446	1.00		
0.243	0.263	0.286	0.305	0.316	0.348	0.366	0.401	0.421	1.00	
0.251	0.258	0.296	0.316	0.320	0.337	0.362	0.373	0.400	0.423	1.00

NOTES

[1] We thank Bruce Headey, Jan Koster , Wim Kalmijn and Peggy Schyns for their useful advice and Willem Schinkel for his assistance in the last stage of this project.

[2] 'Wie zufrieden sind Sie gegenwartig - alles im allem - mit Ihrem Leben?'

[3] Personal communication Thomas Bulhmann, Wissenschafts Zentrum Berlin

[4] We thank Th. Buhlmann, Wissenschafts Zentrum Berlin, who suppli ed correlates and other useful information

[5] Another interpretation could be that one is really less happy after the care being stolen In that view we do not deal with error, but with short lived situational effects.

[6] This assumption of equality of stability coefficients was made for technical reasons in the first place (less degrees of freedom), but can also be defended on substantive grounds: 1) Since s is an estimate of average life-change in the population, there is little reason to expect that these coefficients change much over time. 2) The focus of this study is not on incidental change in society, but on the general ratio of stable and variable components. Further, the assumption is not essential, and can be relaxed if the model does not fit.

[7] In the more general case with intervals not only beginning at T=0, equation 1) has to be adapted by introducing the new time-intervals (j-i). Log $r_{0.j} = \log p^2 + (j\text{-}i) * \log s$ The diagram is the same as in the more simple case, except that every interval corresponds with several correlations.

[8] An alternative explanation is that short-lived events happen less often to the elderly.

[9] We also tested a 5th model, namely the extreme case where there is only a stable component introduced as explanation for the life satisfaction at different points in time.

[10] It might have been better to use a nonlinear regression in this case, but we wanted only a rough estimate of the relationship and this was already obtained with linear regression, which simplifies matters considerably.

[11] The fifth model mentioned above fitted very badly with a chi2 value 2194.2 for a model with DF=54.

[12] There were in fact two estimates for the reliability; one based on a direct MTMM analysis of German data and another on the basis of a meta-analysis of several similar studies. We have chosen the last one, because this is probably more robust and corrected for the repeated observations in the MTMM design. More detail can be found in Saris and Münnich (1995) and in Scherpenzeel (1995)

[13] For two reasons, this estimate can be considered maximal: 1) the mood-component is not included, though it may contain variable variance in life-satisfaction. 2) Further research may show that the shifting equilibrium model is after all to be preferred above the stable component model.

[14] Yet in the data-matrix we do not see a change in the years 1989-90