Chapter 13

Happiness and Satisfaction: An Application of a Latent State-Trait Model for Ordinal Variables

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1. Introduction

Moods and emotions are prototypes of psychic states. In contrast to relatively stable personality traits, emotional states are characterized by fluctuation. In state-trait theories of moods and emotions these fluctuations are defined as deviations from a stable mood trait caused by situational and/or interactional effects (Csikszentmihalyi & Wong, 1991; Eid, Notz, Steyer, & Schwenkmezger, 1994). The assessment of mood states and of mood traits is important for many research questions in General as well as Differential Psychology (for an overview, see Morris, 1989; Thayer, 1989). In General Psychology especially, the influence of mood states on thought and behavior is analyzed. In Differential Psychology, among other things, the relationships between personality variables on the one hand and the average hedonic level (the mood trait) as well as the fluctuations of mood states on the other hand have been considered in many studies since Wessman's and Ricks' (1966) early work on this topic.

According to Nesselroade's (1991) distinction between *variability* and *change*, the fluctuation of moods is an example of variability, which is characterized by short-term, relatively reversible fluctuations. Intraindividual *change* on the other hand refers to long-term changes, which are relatively irreversible. Examples for *change* are alterations in attitudes or traits due to learning, therapeutic interventions, development, etc. As a consequence of the different characteristics of *variability* and *change* their assessment requires different measurement models. To illustrate this, both classes of models are to be sketched next.

In models analysing *change*, e.g., autoregressive models (cf. Jöreskog, 1979), the value of a person measured on a specific occasion of measurement depends on his/her score measured before, i. e., the process of change is modeled as a function of time. To assess the variability of moods and emotions this concept of change does not make sense, if the interval between repeated measurements is longer than a few minutes or hours: The mood of a person on a specific occasion of measurement does not (causally) depend on her or his mood (for example) two weeks ago; rather it depends on her or his *average mood level* (mood trait), the situation and the person-situation interaction (Csikszentmihalyi & Wong, 1991; Eid et al., 1994). Therefore, models measuring *change* are not suitable to analyse interindividual differences in mood states over time (Hertzog & Nesselroade, 1987).

According to models for the measurement of *variability*, e. g., models of latent state-trait theory (Steyer, Ferring, & Schmitt, 1992), interindividual differences on one occasion of measurement (interindividual state differences) are caused by three sources of variance: (a) stable interindividual *trait* differences, (b) differences in the *situations* that have been realized for different persons, and (c) the *interaction* between the persons and the situations. In state-trait theories intraindividual differences in test or item scores between occasions of measurement are explained by the *variability* of the situations (and/or the interactions of persons and situations) between these occasions. As there is one stable trait variable in these models, (trait) change is not taken into consideration. Therefore, these models are not suitable to measure trait change, but they form the methodological basis for the measurement of (mood) states and traits as well as of the degree of variability caused by situational and/or interactional effects.

As the latent state-trait models described by Steyer et al. (1992) are models for continuous variables, they are not applicable to categorical variables. In this paper an application of a new state-trait model for ordinal variables to the measurement of mood is presented. This model, called *multistate-multitrait model* (Eid 1995, 1996), is formally introduced in section 1.10 and will be described only roughly in the next section.

2. The Multistate-Multitrait Model

In the multistate-multitrait model (*msmt* model) - an extension of the graded response model (Samejima, 1969) - the response probabilities of the item categories are functions of an item-specific latent state variable characterizing a person in a specific situation on an occasion of measurement. This latent state variable is decomposed into a stable trait variable and a variable representing situational and/or interactional effects specific for the focused measurement occasion. The *msmt* model is defined by two assumptions (see Figure 1 and section 1.10): (1) In order to consider item-specific effects often present in longitudinal analyses, it is assumed that different items measure different traits, but that every item measures the same trait across the occasions of measurement. (2) Furthermore, it is supposed that the items administered on the same occasion of measurement measure the same situational and/or interactional effects.

Whereas the latent trait variables may be correlated, it is assumed that the situation-interaction variables are uncorrelated. As a consequence, stability in answering an item is completely explained by the existence of the latent trait variable of this item. In this model intraindividual differences in item scores between occasions of measurement are explained by the variability of situations. The *msmt* model does not require that the situations be randomly selected from a universe of situations like the models of generalizability theory (Cronbach, Gleser, Nanda, & Rajaratnam, 1972). Therefore, this model is suitable for ecologically valid studies where persons are measured in natural or self-chosen situations (Diener, Larsen, & Emmons, 1984).

In the *msmt* model two item coefficients are defined (see equations (33) and (34) in section 1.10): (a) *Consistency* indicates the degree to which true interindividual state differences are influenced by interindividual trait differences. (b) *Occasion specificity* represents the degree to which true interindividual state differences depend on differences in the situations (and/or interactions) that have been realized on an occasion of measurement. Therefore, in order to construct a psychometric test (e.g., a mood scale) sensitive to the variability of interindividual differences caused by situational and/or interactional effects, items have to be selected with specificity coefficients as high as possible and consistency coefficients as low as possible.

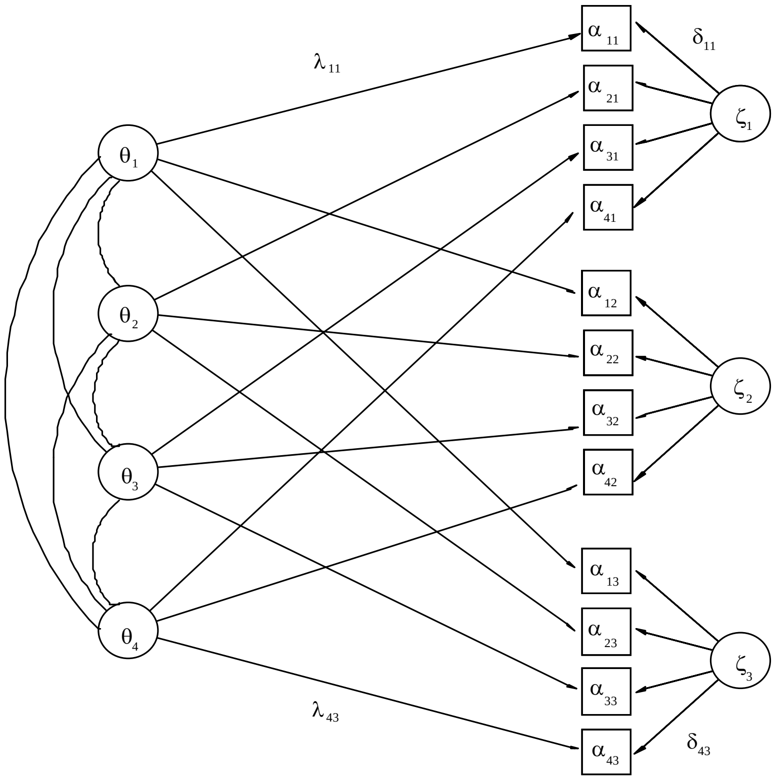

Figure 1: A multistate-multitrait model fo four items and three occasions of measurement. α_{ik} : latent state variables; θ_i: latent trait variables; ζ_k: latent situation-interaction variables; λ_{ik}, δ_{ik}: loadings on the latent variables; the index i indeicates the item; the index k the occasion of measurement.

The consistency and specificity coefficients can be estimated and the assumptions of the model can be tested with structural equation models for ordinal variables (Jöreskog & Sörbom, 1993; Muthén, 1988), when some further independence assumptions hold (Eid 1995, 1996).

3. An Application of the Model: Happiness and Satisfaction

Variables

In the application presented four items of the *Multidimensional Mood Questionnaire* (MMQ; Steyer, Schwenkmezger, Notz, & Eid, 1994), a German mood questionnaire, are analysed with the *msmt* model. The items are „happy," „unhappy," „satisfied," and „dissatisfied". The subjects rated each item on a five-point scale ranging from „... is not true of me at all ..." to „... is exactly true of me ... ." These items were selected, because *happiness* and *satisfaction* are the main indicators of subjective well-being, *happiness* characterizing the emotional and *satisfaction* measuring the cognitive component of subjective well-being (see Andrews & Robinson, 1991).

Design and sample

The sample consisted of n = 292 females and n = 211 males between 17 and 78 years of age (mean age: 31.2). The items of the MMQ were administered repeatedly (four occasions of measurement) with a time lag of three weeks between occasions. This time lag was chosen because the distance between two occasions of measurement was to be large enough to minimize memory effects and short enough to exclude changes in mood traits. For a more detailed description of the design and sample see Steyer et al. (1994). The analyses reported are based on the data sets of those persons (N = 490) not having any missing value in one of the four items.

Method of data analyses

The data were analysed with the computer program LISCOMP (Muthén, 1988) and the *cvm*-estimation procedure (categorical variable methodolgy). As this methodology is based on asymptotic properties, a simulation study was carried out to investigate whether or not a satisfactory analysis of the data was possible with the sample size considered. With regard to the likelihood-ratio-test and the standard errors of estimates a satisfactory analysis of the four items was only possible by skipping one occasion of measurement (Eid, 1995). Therefore, the *msmt* model was applied to two combinations of occasions: (a) the first to third and (b) the second to fourth occasion of measurement. Hence, the results will be reported with regard to these two applications of the model.

Results

A *msmt* model with equal item parameters between occasions of measurement fits the data relatively well in both applications (see Table 1). Regarding the *category parameters* κ_{isk} there is an interesting difference between the positive resp. negative valent items: For the positive valent items the differences between the third and fourth category parameters are much higher than those of the other neighbouring category parameters. This indicates that distances between the category parameters (especially) for positively formulated items are not equal and that the fourth category is more preferred by the respondents than the others. As a consequence, a relatively high value of positive mood is needed to give an answer in the last category. For the (recoded) negatively formulated items the category parameters have relatively equal distances.

The loadings λ_{ik} of the same repeatedly administered items on their item-specific latent trait variable are equal between occasions of measurement (as a result of a priori restrictions), i.e., the occasions do not differ in the effects the latent trait variables have on the latent state variables.

The loadings δ_{ik} of the negative mood items on the latent situation-interaction variables are higher than those of the corresponding positively formulated variables indicating that interindividual differences on the latent situation-interaction variables go along with larger differences on the latent state variables for the negatively formulated variables than for the positively formulated ones. Thus, the negatively formulated items discriminate better between interindiviudal differences on the latent situation-interaction variables.

The estimated *consistency* and *specificity coefficients* indicate that interindividual differences on one occasion of measurement are determined by both (a) personal and (b) situational and/or interactional effects. Hence, all items are suitable for measuring fluctuating emotional states. Furthermore, the results illustrate that interindividual differences in positive mood states (happiness and satisfaction) depend to a larger degree on situational and/or interactional effects than interindividual differences in negative mood states (unhappiness

(a) 1st to 3rd occasion of measurement: $\chi^2_{84} = 98.194$, p = 0.138								
Item	κ_{i1k}	κ_{i2k}	κ_{i3k}	κ_{i4k}	λ_{ik}	δ_{ik}	$\mathrm{Con}(\alpha_{ik})$ $\mathrm{Var}(\theta_i)$	$\mathrm{Spe}(\alpha_{ik})$ $\mathrm{Var}(\zeta_k)$
satisfied	-3.38	-1.73	-0.11	2.21	2.00	2.00	*0.34*	*0.66*
		1.65	1.63	2.32			0.25	0.50
dissatisfied	-4.92	-3.02	-1.39	0.46	2.82	2.55	*0.54*	*0.47*
		1.90	1.63	1.85			0.47	0.50
happy	-3.39	-1.70	0.45	3.01	2.38	2.21	*0.48*	*0.52*
		1.69	2.15	2.56			0.40	0.50
unhappy	-5.81	-4.18	-2.16	-0.42	3.16	2.83	*0.56*	*0.44*
		1.62	2.02	1.75			0.50	0.50
(b) 2nd to 4th occasion of measurment: $\chi^2_{84} = 98.984$, p = 0.126								
Item	κ_{i1k}	κ_{i2k}	κ_{i3k}	κ_{i4k}	λ_{ik}	δ_{ik}	$\mathrm{Con}(\alpha_{ik})$ $\mathrm{Var}(\theta_i)$	$\mathrm{Spe}(\alpha_{ik})$ $\mathrm{Var}(\zeta_k)$
satisfied	-3.77	-2.05	-0.24	2.10	2.10	2.10	*0.44*	*0.56*
		1.73	1.81	2.34			0.34	0.43
dissatisfied	-4.80	-3.08	-1.43	0.33	2.67	2.41	*0.59*	*0.41*
		1.72	1.65	1.76			0.51	0.43
happy	-3.72	-1.86	0.45	3.25	2.59	2.43	*0.55*	*0.45*
		1.85	2.32	2.79			0.47	0.43
unhappy	-6.89	-4.99	-2.71	-0.69	3.69	3.28	*0.63*	*0.37*
		1.89	2.29	2.02			0.59	0.43

Table 1: Results of the LISCOMP-analyses: Fit of a msmt model with equal item parameters between occasions of measurement as well as estimated item parameters and coefficients of consistency and specificity

The values of the negative formulated items were recoded. Reported are the estimated category parameter κ_{isk} (first row) as well as the differences $\kappa_{i,s+1,k}$ - κ_{isk} (second row), the consistency coefficients *Con*(α_{ik}) (first row) as well as the corresponding variances Var(θ_i) of the latent trait variables θ_i (second row) and the occasion specificity coefficients *Spe*(α_{ik}) as well as the corresponding variances Var(ζ_k) of the latent situation-interaction variables ζ_k.

and dissatisfaction): The specificity coefficients of the positively formulated items are larger than those of the corresponding negatively formulated items and - logically - the opposite is true of the consistency coefficients (as both coefficients add up to one). Note that there is an important difference between the loading parameters λ_{ik} and δ_{ik}, which are discrimination parameters, and the consistency resp. specificity coefficients. Although the negatively formulated items have higher discrimination parameters δ_{ik} than the positively formulated items, they have lower specificity coefficients. This difference is caused by the fact that the consistency and specificity coefficients depend not only on the item parameters, but also on the variances of the latent trait resp. situation-interaction variables. Whereas the consistency and specificty coefficents depend on some characteristics of the sample considered, the item parameters have to be invariant across different (sub-)populations, if the model is true.

	satisfied	*dissatisfied*	*happy*	*unhappy*
satisfied		0.801	0.762	0.739
dissatisfied	0.820		0.616	0.915
happy	0.825	0.696		0.609
unhappy	0.779	0.916	0.672	

Table 2: Correlations of the latent trait variables

Above diagonal: correlations for the first to third occasion of measurement;
below diagonal: correlations for the second to fourth occasion of measurement.

Finally, the *intertrait correlations* (see Table 2) between items of the positive pole (*satisfied* and *happy*) as well as between items of the negative pole (*dissatisfied* and *unhappy*) are higher than the correlations between the opposite poles of one mood domain (*happy/unhappy* and *satisfied/dissatisfied*, respectively): The items of the same mood *valence* have much more in common than the items of one mood *domain*.

4. Discussion

This application shows that the *msmt* model is a quite suitable model (a) to analyse the degree to which interindividual differences are influenced by situational and/or interactional effects and (b) to analyse the relationships between different items on the state as well as on the trait level. All items are suitable for the assessment of variable mood states. But, according to the results reported, there are important differences between the four mood items: Whereas all items are homogeneous (unidimensional) with regard to the latent situation-interaction variables, they differ in their latent trait variables. As a consequence, the four items do not measure the same latent state variables on each occasion of measurement (there are four latent state variables on each occasion of measurement, see Figure 1). That means that mood states as well as mood traits are monopolar, whereas the situation-interaction variables are bipolar. In the *msmt* model presented, the monopolarity of mood states is explained by the monopolarity of mood traits, i.e., (stable) situation-unspecific effects. Possible explanations for this monopolarity are stable interindividual differences in the connotation of different mood terms or item specific differences in the focus on which the judgement of one's positive or negative mood is based on (for a further discussion, s. Eid, 1995).

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