# RATING SCALES WITH SMILIES AS SYMBOLIC LABELS -DETERMINED AND CHECKED BY METHODS OF PSYCHOPHYSICS

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# Abstract

Rating scales with smilles as symbolic labels are often used. But the question, whether the used faces are perceived as equidistant and unidimensional, was not raised. This piece of research will help to close this gap. Stimulus material were 17 smilles with systematically varied mouths. The perceived intensity or dissimilarity of emotional expression was measured by methods of psychophysics. The result of study 1 (direct method,  $n_1 = 108$ ) determines the scale. Study 2 (dissimilarity judgement for completely paired comparisons,  $n_2 = 131$ ) tested the 5 selected smilies. A nonmetric multidimensional scaling analysis is based on the mean values of the 10 dissimilarity judgements. The result is a unidimensional and equidistant figure.

Rating scales with smilles as symbolic labels are often used. For example in hotel and restaurant questionnaires, in which an evaluation of service, meals and atmosphere is asked for. Seven different smilles for measuring satisfaction in the field of job description were used in the questionnaire designed by Neuberger and Allerbeck (1980). Andrew & Withey (1976) used nine smilles as measuring instrument for global well-being.

Smilies are an emotional symbol. Intuitively no-one doubts the usefulness of smilies as symbolic labels in rating scales for emotional judgements with regard to the subject. The question, whether the used faces are perceived as equidistant and unidimensional, was not raised.

A smily is a symbolic representation of a smiling face with a concave arc shaped mouth. In the following, the term *smily* will be elaborated which means that now a convex shaped arc or straight line can be used to represent the mouth, too. Smilies as symbolic labels in rating scales differ in the way the mouth is formed only. The other parts of the face remain constant. Smily series (Andrew & Withey, 1976; Neuberger & Allerbeck, 1980; Bortz & Döring, 1995; MicrosoftWord version 6.0) were analyzed. The result of this analysis is that the different smily series cannot be traced back to a prototype.

The theoretical acceptance of the usefulness of smilles as symbolic rating scale labels for emotional judgements is based on studies to the assumption of universality of the emotional expression (Ekman, 1972; Ekman & Friesen, 1971; Izard, 1971) on the one hand and, on the other hand on results by Kunin (1955). In the study by Kunin two series of faces had to be evaluated with regard to the level of happiness the faces might express. In the first series a drawn circle represents the head with straight lines used for eyes and nose. An arc or line stands for the mouth. The faces of the second series were representational pictures. Only the stapes of the mouths stayed the same. The correlations between the results indicate that also the reduction of the variability of emotional expression leads to meaningfully interpretable results. Additionally, there are indications that the modification of the mouth is independent of the other parts of the symbolic faces and is perceived unidimensionally (Keren and Lewis, 1993).

When using rating scales, measurement at interval scale level is striven for. However, they can be only attained if the relations on the empirical relative meet all requirements of the corresponding axioms. That does not mean that measurement at interval scale level is automatically at the end of the measuring process. The created and used measuring instruments are not allowed to work against the structure-maintained figure. The consequence for labels of rating scales can be pointed out like this: If they are needed to represent equidistant and unidimensional conditions, they have to be also perceived as equidistant and unidimensional. The problem of the perceived equidistance and unidimensionality of smilies as symbolic labels is a problem of psychophysics. The use of methods of psychophysics requires that the modifications of the stimuli, in this case the smilles, need to be defined accurately. The response in this point is the perceived intensity of the feature emotional expression.

The experiment was carried out in two steps. Based on the results of the first study (study 1) a rating scale with five smilles will be determined. By means of a second study (study 2), this scale will be checked whether it is perceived unidimensional and equidistant. The method used in study 1 will be a direct matching question. In study 2 the method of the dissimilarity judgement for completely paired comparisons will be used.

### Study 1

#### Method

Subjects. 108 persons ( $M_{age} = 37.2$  years,  $SD_{age} = 13.2$ ) took part. The proportion of men amounted to 26%. 77% of the participants had "Abitur" (equ. "A-levels"). It was an ad hoc sample.

Stimulus material. Stimulus material was a selection of the 17 systematically varied smilies (fig. 1) with a diameter of 2.5 cm. The smilles S-7, S-3.5, S±0, S+3.5 and S+7 represent a scale with a mathematically equidistant series of mouth. Smilies with the same number have identically shaped arcs, smilles with " + " a concave shaped arc and smilles with " - " a convex shaped arc. The used smilies are uniquely defined by the combination of numbers and "+" or "-".

Procedure. The study was carried out as paper and pencil experiment and supervised by the first authoress. The smilies were copied onto small cards lying in a little box.

The task was to judge the smilles by means of graphic rating. The 202 mm long evaluation

distance was limited by both extreme smilies (S-7 on the left, S+7 on the right). This was a constant basis for all judgements. This method of the positioning of smilies between the extremes is a combination of the constant stimuli method and the absolute judgement method. In this case the combination of the two extremes creates the constant stimuli.

The sequence was randomized. Sixteen different evaluations had to be stated. One smily out of the group selected by chance, was S+4, which had to be evaluated two times. By this, it can be checked if the method is reliable.



Figure 1. Used smilies

# Results

The data of 105 of the 108 persons were analyzed. Exclusion criterion is the misunderstanding of the task, operationally defined by Kendalls  $\tau$  smaller than 0.5 with the values of the smily-numbers (-7 to +7) as anchor data and with the value of every smily on the 202 mm long evaluation distance as comparison data.

The results are presented in table 1. For all smilles the mean values including the confidence interval and the standard deviations are specified. Additionally, in table 1 the question is

answered, which smily distribution is a normal distribution.

S+4/1 and S+4/2 are smily S+4 evaluated twice. The mean values of the S+4 to both points of time do not differ (t = 0.85; p > 25%). The standard deviation of the differences of these two measurements is 21.1. It is not smaller than the other standard deviations.

In accordance with the assumption of psychophysics, for 56% of the distributions the null hypothesis, which means that the distribution is a normal distribution, cannot be rejected (Kolmogorov Smirnov, p > 25%). The distributions of S-6 and S-5 are skewed to the right, the distribution of S+6 is skewed to the left. The first distributions have a mode of 0, the last one of 202.

**Table 1.** Smily positions on the 202 mm long evaluation distance (limited by S-7 and S+7)

Tuble It Shill's positions on the 202 min long evaluation distance (minted by 5 / and 5 / /)										
Smily	М	SD	CI, p = 0.01 (+	)	Normal distribution (++)					
S-6*	7.0	12.4	$3.9 \leq \mu \leq 1$	10.1						
S-5	18.7	15.2	$14.8 \leq \mu \leq 2$	22.6						
S-4	38.8	17.2	$34.4 \leq \mu \leq 4$	43.2	yes					
S-3.5	49.9	18.3	$45.3 \leq \mu \leq 5$	54.5	yes					
S-3	57.0	20.0	$51.8 \leq \mu \leq 6$	52.2	yes					
S-2*	72.8	17.0	$68.4 \leq \mu \leq 7$	77.2	##					
S-1	84.5	13.7	$81.1 \le \mu \le 8$	37.9	##					
S±0	100.2	14.0	$96.9 \le \mu \le 10^{-10}$	)3.8	##					
S+1	113.1	14.5	$109.5 \le \mu \le 11$	16.7	##					
S+2	122.1	15.1	$118.2 \le \mu \le 12$	26.0	yes					
S+3	134.9	19.3	$130.0 \le \mu \le 13$	39.8	yes					
S+3.5	142.2	19.8	$137.3 \le \mu \le 14$	47.1	yes					
S+4/1#	152.8	18.3	$148.2 \le \mu \le 15$	57.4	yes					
S+4/2#	151.0	19.0	$146.2 \le \mu \le 15$	55.8	yes					
S+5	169.3	19.6	$164.4 \le \mu \le 17$	74.2	yes					
S+6	187.5	15.9	$183.4 \le \mu \le 19$	91.6						

n = 105; \*1 missing; (+) confidence interval, (++) Kolmogorov-Smirnov p > 0.25, # doubly evaluated smily, ## symmetrical and unimodal distribution with 78% to 85% of cases in  $M \pm SD$ 

Due to facts and results that the smilles S-7, S-3.5, S $\pm$ 0, S+4 and S+7 are recommended for a rating scale. Exclusively in the confidence interval from S-3.5, S $\pm$ 0 and S+4, the values of 50.5, 101 and 151.5 appear, which divide the total evaluation distance into four equal sections.

# Study 2

#### Method

*Subjects.* 131 persons ( $M_{age} = 41.4$  years,  $SD_{age} = 14.9$ ) took part. The proportion of men amounted to 32%. 67% of the participants had "Abitur" (equ. "A-levels"). It was an ad hoc sample.

*Stimulus material*. Stimulus material were all 10 combinations of two smilies of the smilies S-7, S-3.5, S $\pm$ 0, S+4 and S+7. Every smily had a diameter of 2.5 cm.

*Procedure.* The study was also carried out as paper and pencil experiment and supervised by the first authoress. The pairs of smilies were copied onto small cards lying in a little box. The task was to do a dissimilarity judgement for completely paired comparisons of the smilies S-7, S-3.5, S±0, S+4 and S+7. The measuring instrument was a graphic rating. The two poles were named *extremely similar* and *extremely dissimilar*. The finding of the most different pair was the first step. Then, the dissimilarity of this pair was evaluated. The following sequence was randomized.

## Results

The data of 130 of the 131 persons were analyzed. Exclusion criterion is the misunderstanding of the task, operationally defined by the fact that more than 50% of the crosses were set outside of the evaluation distance. The nonmetric multidimensional scaling analyses (NMDS; Kruskal 1964a,b and Shephard, 1962, quoted both from Bortz & Döring, 1995; Kühn, 1976) were based on the  $5 \times 5$  dissimilarity matrix. Each element of this matrix in triangular form was computed as the mean value of the 10 judgements.

The result of the NMDS is a unidimensional solution (*stress* = 0.011; *variance explanation* = 0.999). The five smilles are practically equidistant. Table 2 shows the values of the NMDS solution and their linear transformation into a scale with the minimal value 1 and the maximal value 5. With perfect equidistance the ascending numbers from 1 to 5 would stand in this line.

**Table 2.** Values of the NMDS solution for the smilles S-7, S-3.5, S±0, S+4 and S+7

	S-7	S-3.5	S±0	S+4	S+7				
Values of the NMDS solution $(x_k)$	-1.43	-0.69	-0.02	+0.75	+1.39				
Values of a scale from 1 to 5 $(y_k)$ #	1.00	2.01	3.00	4.09	5.00				
# linear transformation: $y_k = b \times (x_k + 1.43) + 1$ with $b = 4 / (1.39 + 1.43)$									

So the subordinated unidimensionality and the equidistance for the smily series S-7, S-3.5,

S±0, S+4 and S+7 were confirmed by a second sample and with another method.

### Discussion

A scale with five smilies as symbolic labels was created in this study. The scale in figure 2 is perceived as equidistant and unidimensional.



Figure 2. The smily-scale

The used basic scaling method is very reliable. The smily evaluated twice have the same mean value.

Apart from three exceptions, the distributions of data correspond to the assumption of psychophysics about the distribution of responses. This three skewed distributions are results of the used method. It is assumed that the distribution of responses is a normal or at least a unimodal symmetrical distribution around its mean value. Furthermore it is known that the evaluation distance is limited. It follows from that that a distorted response structure appears for all smilies whose response mean values are near the ends of the evaluation distance. Because the reaction possibility is reduced. This leads to a data jam at the relevant scale end and explains the phenomenon of the extreme mode.

Additionally, the comparison of the data of the smily evaluated twice confirmed the assumption of distribution of responses. If the responses remained constant, which is against the assumption of psychophysics, a variance of the differences of zero would result from that. The observed variance of the differences is as large as the one of the two variances of the single data series.

Concerning the generalization of the results the following is to be said: Age, education or sex do not show an effect in this research.

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