Psychology, 2023, 14, 1070-1084
https://www.scirp.org/journal/psych
ISSN Online: 2152-7199
ISSN Print: 2152-7180

A Validation Study of the German Versions of the Feeling Scale and the Felt Arousal Scale for a Passive Relaxation Technique (Autogenic Training)

Kristin Thorenz[1]*, Andre Berwinkel[2], Matthias Weigelt[1]

[1]Department of Sport & Health, University of Paderborn, Paderborn, Germany
[2]University Clinic for Psychiatry and Psychotherapy (EvKB), University of Bielefeld, Bielefeld, Germany
Email: *kristin.thorenz@upb.de

How to cite this paper: Thorenz, K., Berwinkel, A., & Weigelt, M. (2023). A Validation Study of the German Versions of the Feeling Scale and the Felt Arousal Scale for a Passive Relaxation Technique (Autogenic Training). *Psychology, 14,* 1070-1084.
https://doi.org/10.4236/psych.2023.146058

Received: April 13, 2023
Accepted: June 27, 2023
Published: June 30, 2023

Abstract

To measure the affective responses during high-intensity and moderate-intensity exercises, the single-item questionnaires Feeling Scale (FS) and Felt Arousal Scale (FAS) are often used. The aim of the present study was to examine the validation of the German versions of the FS and the FAS by Maibach et al. (2020) for autogenic training (AT), which is an exercise addressing the lowest end of physical activation. Therefore, 224 participants (135 females and 89 males, mean age = 21.8 ± 2.2) took part in a 45-minute AT exercise. Before and after the exercise, they completed three questionnaires: The FS and the FAS by Maibach et al. (2020) and the Self-Assessment Manikin (SAM) by Bradley and Lang (1994). The subscale pleasure (SAM-P) and the subscale arousal (SAM-A) of the SAM were used for a self-other comparison to proof the construct validity for the FS and the FAS. For the convergent validity, the results show positive significant correlations between the FS and SAM-P ($r = 0.62$, $p < 0.001$, $R^2 = 0.38$) and the FAS and SAM-A ($r = 0.25$, $p < 0.001$, $R^2 = 0.06$). For the discriminant validity, the FS and SAM-A, as well as the FAS and SAM-P did not correlate significantly, whereas a negative significant correlation was found between the FS and the FAS ($r = -0.20$, $p < 0.01$, $R^2 = 0.04$). The pattern of results confirms the validity of the German translations of the FS and the FAS for the passive relaxation technique AT.

Keywords

Feeling Scale, Felt Arousal Scale, Autogenic Training, Affective Responses

1. Introduction

Physical inactivity is an increasing thread to the health of people around the world. According to the World Health Organization (WHO), "1 *in* 4 *adults, and* 3 *in* 4 *adolescents* (*aged* 11 - 17 *years*)*, do not currently meet the global recommendations for physical activity*" (WHO, 2018: p. 6), which advice adults to exercise for at least "150 - 300 *minutes of moderate-intensity aerobic physical activity; or at least* 75 - 150 *minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits*" (WHO, 2020: p. 4). In this regard, the WHO emphasizes the important role that regular physical activity plays for the subjective well-being of people (WHO, 2018). Therefore, much research has investigated the affective responses related to different kinds of physical activity (for a systematic review and meta-analysis, see Bok et al., 2022; Chan et al., 2019; Niven et al., 2020), with a focus either on high-intensity exercises that are performed up to the level of subjective exhaustion (i.e., above the ventilatory threshold; e.g., Niven et al., 2018, Stork et al., 2018) and/or on moderate-intensity exercises (i.e., around the ventilatory threshold, respectively, a lactate steady-state; e.g., Rose & Parfiff, 2008; Van Landuyt et al., 2000). The kinds of exercise studied most are endurance exercises, e.g., running on the treadmill (e.g., Hall et al., 2002; Rose & Parfiff, 2008) or riding the bicycle ergometer (e.g., Maibach et al., 2020; Niven et al., 2018) in the laboratory. Thereby, the affective responses depend on the intensity of the exercise (e.g., Ekkekakis et al., 2005; Ekkekakis et al., 2011; Hall et al., 2002). In general, high-intensity exercises, which are performed above the ventilatory threshold, are perceived as more strenuous and less pleasant than moderate-intensity exercises, which are performed around the ventilatory threshold. This pattern of affect has been explained with the dual-mode model (DMM; Ekkekakis, 2003), which assumes an interaction of cognitive parameters (such as appraisals of the self-perceptions, including self-efficacy) and interoceptive cues emerging from the body (such as muscular and respiratory cues) during the (subjective) evaluation of the exercise experience. Accordingly, during a moderate-intensity exercise, cognitive parameters dominate the evaluation, and the exercise is perceived as either a positive or a negative experience, depending on the subjective evaluation outcome (high inter-individual variability). During high-intensity exercises, interoceptive cues become more and more salient as the physical load increases and physiological steady-states cannot be maintained, which leads to a reduced experience of pleasure (low inter-individual variability). Furthermore, important for the present study, the perception of pleasure in low-intensity exercises can also be explained with the dominant processing of interoceptive cues (low inter-individual variability) (cf. Brand & Kanning, 2021; Ekkekakis, 2003).

In accordance with the circumplex model by Russell (1980), the affective responses to physical exercise have been measured along the dimension of pleasure (from unpleasant to pleasant) with the Feeling Scale (FS; Hardy & Rejeski, 1989) and along the dimension of arousal (from low activation to high activation) with the Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985). An important benefit of these two measurements is that they are single-item scales, which are very economical and easy to use. The orthogonal combination of the two dimensions (valence and arousal) measured with these scales results in four meaningful quadrants of different affective states: unactivated-pleasant affect, unactivated-unpleasant affect, activated-unpleasant affect, and activated-pleasant affect (Ekkekakis & Petruzzello, 2002; Hall et al., 2002). In their systematic review and meta-analysis, Niven et al. (2020) listed six studies that have used both, the FS and the FAS to examine the affective responses to moderate-intensity and high-intensity exercises. In line with the DMM (Ekkekakis, 2003), these six studies found higher scores for the FS (signifying a more pleasant response) after moderate physical activity and lower scores (indicating reduced pleasure) after strenuous physical activity, while the opposite was observed for the FAS, with higher scores (showing a stronger activation) after strenuous physical activity and lower scores (reflecting a lower activation) after moderate physical activity.

Currently, however, there seems to be a lack of studies that capture the affective responses to low-intensity exercises or relaxation techniques, such as autogenic training (AT). Most studies that have used AT as an intervention refer to clinical outcomes for different types of physical diseases; mostly, neurological (e.g., headaches), musculoskeletal (e.g., low back pain), or cardiovascular (e.g., hypertension) (see Kanji, 1997; Stetter & Kupper, 2002). Studies with a focus on the psychological effects of AT mainly measured anxiety (e.g., Kanji et al., 2006) or stress (e.g., Seo & Kim, 2019). The latter studies used a categorical approach to measure the emotional states, e.g., the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). Questionnaires based on different categories typically involve a larger number of verbal items for each category. The evaluation process is therefore time consuming. This is markedly different for questionnaires, which are design based on a dimensional approach, such as the FS (Hardy & Rejeski, 1989) and the FAS (Svebak & Murgatroyd, 1985). These require the evaluation of only a single item and are thus, very economical in the handling and easy to apply in the field of sport and exercise in relation to well-being.

Important for the present study, the FS and the FAS have been translated and validated for two German versions (Maibach et al. 2020). To this end, Maibach et al. (2020) tested 82 participants during a bicycle ergometer task in which physical load was increased stepwise until subjective exhaustion. Overall, they observed an increase of arousal and a decrease of pleasure when examining the affective responses before and after the high-intensity exercise, a pattern, which is in line with previous studies testing participants above the ventilatory threshold (e.g., Oweis & Spinks, 2001; Welch et al., 2007). To examine the construct validity for the German translations of the FS and the FAS, respectively, the affective responses were also measured for a self-other comparison with the (corresponding) valence and arousal dimensions of the Self-Assessment Manikin (SAM) by Bradley and Lang (1994). Maibach and colleagues found significant correlations with a large effect size for the valence dimension between the FS and the subscale SAM-P ($r = 0.73$, $R^2 = 0.53$) and for the arousal dimension between the FAS and the subscale SAM-A ($r = 0.50$, $R^2 = 0.25$). As a follow-up of the study by Maibach et al. (2020), Thorenz and colleagues (Thorenz et al., under review) further validated the German versions of the two scales for a moderate-intensity exercise (i.e., a jogging exercise). In their study, 179 participants were asked to run at a self-selected pace at which they felt pleasant for 45 minutes. The self-paced jogging exercise led to an increase of the positive affect (i.e., a stronger pleasure experience) and an increase of the arousal level, which is in line with previous studies for self-paced tasks below the ventilatory threshold (e.g., Ekkekakis et al., 2000; Van Landuyt et al., 2000). Construct validity for the translated scales was provided by significant positive correlations for the valence dimension between the FS and the SAM-P ($r = 0.42$, $p < 0.001$, $R^2 = 0.18$) and for the arousal dimension between the FAS and the SAM-A ($r = 0.15$, $p < 0.05$, $R^2 = 0.02$).

Purpose of the Present Study

Flake et al. (2017) emphasized that diagnostic tools must be validated for the specific setting in which they will be used. The German translations of the Feeling Scale (FS) and the Felt Arousal Scale (FAS) have been already validated for a high-intensity bicycle ergometer task (Maibach et al., 2020) and for a moderate-intensity jogging exercise (Thorenz et al., under review), while, so far, such a validation is missing for a low-intensity exercise. Therefore, the present study aims to proof the validity of both scales for an exercise addressing the lowest end of physical activation. The exercise chosen is autogenic training (AT), which is a well-researched passive relaxation technique based on autosuggestion that was first instructed 100 years ago by the German psychiatrist Johannes Heinrich Schultz (Schultz, 1932; cf. Irnich, 2013). Today, AT is used by standard in different applied fields, such as in psychotherapy and sport psychology (cf., Kanji, 1997; Kellmann & Beckmann, 2020; Mikicin & Kowalczyk, 2015; Stetter & Kupper, 2002), and thus, provides for an excellent target exercise to be considered for a further validation study of the FS and the FAS.

In the present study, participants signed up for a 45-minute AT exercise in which they were instructed from an audio CD according to a procedure by Grasberger (2014). The affective responses were captured immediately before and after the exercise with the FS and the FAS by Maibach et al. (2020). In addition, the Self-Assessment Manikin (SAM) by Bradley and Lang (1994) was also administered to proof the construct validity of the FS and the FAS, respectively. To answer the question of whether construct validity can be assumed statistically, convergent validity and discriminant validity is tested among the different (sub)scales following the traditional Multitrait-Multimethod (MT-MM) matrix approach (Campbell & Fiske, 1959; cf. Schermelleh-Engel et al., 2020). Convergent validity (i.e., two scales test the same construct) can be assumed for as long as a (positive) high correlation is observed between any two (sub)scales measuring the same construct (Hypothesis 1), while the criterion of discriminant validity (i.e., two scales test different constructs) is satisfied when any two (sub)scales testing different constructs are either not correlated or when they show a smaller (or negative) correlation than the correlation between two scales that test the same construct (Hypothesis 2).

Furthermore, the means of the posttest values (after the AT exercise), the magnitude of change between the pretest and posttest, and the number of zero variations (i.e., no change for the affective responses) for each (sub)scale are considered to get an impression of the sensitivity of the different scales regarding the affective responses accompanying the AT exercise and to further compare the descriptive statistics with the results of the study by Maibach et al. (2020). In this regard, the following predictions were made: In the present study, participants should experience the low-intensity AT exercise as more pleasant and less strenuous than the participants of Maibach et al. (2020), who performed all the way up to the level of subjective exhaustion in the high-intensity bicycle ergometer task. If this were the case, then the mean posttest values should be higher for the FS (Hypothesis 3) and lower for the FAS (Hypothesis 4) after the AT exercise as compared to the posttest values observed in the bicycle ergometer task of Maibach et al. (2020), because of the different levels of physical intensity between the two exercises (cf. Ekkekakis, 2003; Ekkekakis et al., 2011). Also, the magnitude of change is expected to be smaller for the AT exercise for the FS (Hypothesis 5) and for the FAS (Hypothesis 6), respectively, because the passive relaxation exercise of the present study is of no physical challenge for the participants, whereas the stepwise increase of physical load during the bicycle ergometer task in Maibach et al. (2020) came along with larger changes in the affective experience during the high-intensity exercise. Furthermore, the direction of change of the affective responses from pretest to posttest should be positive for the FS and negative for the FAS in the present study, as relaxation techniques cause a shift on the activation-deactivation continuum toward the calm end, and this shift positively influences the valence dimension (Ebert & Kowalsky, 2012; Irnich, 2013; Kanji, 1997). Last, due to the complete absence of physical load during the AT exercise, there should be more zero variations in the present study than in the study by Maibach et al. (2020) (Hypothesis 7).

2. Method

2.1. Participants

The data collection period of the study started in the university's summer semester of 2017 and went on until the summer semester of 2019 at the University of Paderborn. The present study was conducted as a part of the undergraduate bachelor course called "Sport Psychological Training" within the 2nd year of the study program in applied sport science. A total of 236 sport science students participated in different undergraduate bachelor courses on sport psychological training, where the AT exercise was performed. The participation in the study was voluntary and had no effect on passing or failing the course. In this way, the registration for the study was anonymous by a self-generated code, which could not be traced back to the individual participant. The university's local ethics committee approved the study before it started. Due to incomplete sets of data, 12 participants were excluded from the study. Hence, the final sample included 224 participants (135 females and 89 males, mean age = 21.8 ± 2.2).

2.2. Measurements

To assess the affective responses, three questionnaires were used in a pretest-intervention-posttest-design, using paper-and-pencil tests: The German translations of the Feeling Scale and the Felt Arousal Scale by Maibach et al. (2020), and the Self-Assessment Manikin by Bradley and Lang (1994).

The Feeling Scale (FS; German scale provided by Maibach et al., 2020; original scale from Hardy & Rejeski, 1989) was used to measure the valence dimension of the affective responses. It is a numerical bipolar 11-points rating scale, ranging from −5 to +5, in which the odd numbers and zero are verbalized in the following way: −5 ("very bad"), −3 ("bad"), −1 ("fairly bad"), 0 ("neutral"), +1 ("fairly good"), +3 ("good"), to +5 ("very good").

The Felt Arousal Scale (FAS; German scale provided by Maibach et al., 2020; original scale from Svebak & Murgatroyd, 1985) measured the arousal dimension of the affective responses. It is a numerical 6-points rating scale, ranging from 1 to 6, with 1 representing "low arousal" and 6 representing "high arousal."

The Self-Assessment Manikin (SAM; Bradley & Lang, 1994) is a non-verbal scale based of pictures (i.e., manikins), portraying five different emotional states along the three dimensions pleasure (subscale SAM-P), arousal (subscale SAM-A), and dominance (subscale SAM-D), respectively. For the present study, only the subscale SAM-P and the subscale SAM-A were of interest to test construct validity, while the subscale SAM-D was not considered. In the subscale SAM-P, the manikins range from happy smiling (5) to unhappy frowning (1). In the subscale SAM-A, the manikins range from wide-eyed excitement (5) to sleepy relaxed (1).

2.3. Design

On the first meeting, all participants were informed about how the study was conducted (e.g., about the anonymous registration, the procedure, and data storage), upon which they signed the informed consent forms and provided additional personal data. On the second meeting, the study took part in a gymnasium, where the participants performed the AT exercise. To this end, they laid down in a supine position on exercise mats and listened to the instructions of Grasberger (2014), presented via loudspeakers by an audio CD for 45 minutes. The whole procedure included three complementary parts: 1) A basic stress reduction exercise (including short formulas: heaviness formula, warmth formula, solar plexus formula, cool forehead formula, visual imagination formula, and a take-back formula in six steps), 2) an exercise to increase concentration (including heaviness-warmth formula, solar plexus formula, and cool forehead formula in the first 5 minutes, focusing attention on a self-selected object and visual imagination formula in the next 8:30 minutes, and a take-back formula in three steps at the end), and 3) an exercise to improve self-confidence (including heaviness-warmth formula, solar plexus formula, and cool forehead formula in the first 4:35 minutes, main part visual imagination formula, and a take-back formula in three steps at the end). The participants completed the three questionnaires immediately before and after the AT exercise.

2.4. Data Analysis

The software IBM SPSS Statistics (Version 28) was used for data analysis. To evaluate the overall construct validity of the German versions of the FS and the FAS by Maibach et al. (2020), both scales were correlated with the subscale SAM-P and the subscale SAM-A of the SAM by Bradley and Lang (1994). For convergent validity, the correlation between the pairs of the same construct (e.g., FS and SAM-P), and for discriminant validity, the pairs of the different constructs (e.g., FS and SAM-A) were calculated, respectively. Fisher's z-transformations (Charter & Larsen, 1983) were used to compare the effect sizes of the correlation coefficients between the values of the Maibach et al. (2020) study and the values of the present study. Also, the descriptive statistics were examined for all (sub)scales, including the means of the posttest values, the magnitude of change between pretest and posttest, and the direction of change, as well as the number of zero variations.

3. Results

3.1. Correlation of (Sub)Scales

For the convergent validity, the FS and SAM-P for the valence dimension (r = 0.62, $p < 0.001$, $R^2 = 0.38$) and the FAS and SAM-A for the arousal dimension (r = 0.25, $p < 0.001$, $R^2 = 0.06$) were positively correlated. According to Cohen (1988), these correlations were of a large (valence dimension) and of a small (arousal dimension) effect size, respectively. For the discriminant validity, the FS and SAM-A ($r = -0.09$), the FAS and SAM-P ($r = -0.10$), and the SAM-P and SAM-A ($r = -0.10$) were not significantly correlated, while the FS and FAS (r = −0.20, $p < 0.01$, $R^2 = 0.04$) were negatively correlated, with a small effect size. The correlations are presented in **Table 1**. In the present study, the correlation coefficients for the valence dimension were of similar size (no significant difference; $z = 1.55$, $p > 0.05$) as in the study by Maibach et al. (2020) but were significantly smaller for the arousal dimension ($z = 2.24$, $p < 0.05$) and for the discriminant analysis of the correlation between the FS and the FAS ($z = 4.78$, $p <$ 0.001).

3.2. Analyses of Affective Responses

For the valence dimension, the mean of the affective responses after the AT exercise (i.e., at the posttest) was for the $FS_{post} = 2.24 \pm 1.58$ and was for the $SAM\text{-}P_{post} = 3.81 \pm 0.67$. The magnitude of change from pretest to posttest was significant for the $FS_{change} = 0.41$ [$t\,(223) = 3.652$, $p < 0.001$, $d = 0.24$], but not significant for the $SAM\text{-}P_{change} = 0.07$. The number of participants displaying zero variations was 66 for the FS and was 110 for the SAM-P. For the arousal dimension, the mean of the affective responses after the AT exercise (i.e., at the posttest) was for the $FAS_{post} = 2.04 \pm 0.87$ and was for the $SAM\text{-}A_{post} = 2.03 \pm 0.90$. The magnitude of change from pretest to posttest was significant for the $FAS_{change} = -0.81$ [$t\,(223) = 10.778$, $p < 0.001$, $d = 0.72$] and for the $SAM\text{-}A_{change} = -0.46$ [$t\,(223) = 7.553$, $p < 0.001$, $d = 0.51$]. The number of participants displaying zero variations was 59 for the FAS and was 90 for the SAM-A (cf. Table 3). The descriptive statistics are provided in Table 2 (mean values, standard deviations, range of answers) and Table 3 (zero variations, direction of change).

Table 1. Correlations between the different scales for the magnitude of change between the pretest and posttest (N = 224).

Variables	FS	FAS	SAM-P	SAM-A
FS	-			
FAS	−0.20**	-		
SAM-P	0.62**	−0.10	-	
SAM-A	−0.09	0.25**	−0.10	-

a. FS = Feeling Scale, FAS = Felt Arousal Scale, SAM-P = pleasure dimension of Self-Assessment Manikin, SAM-A = arousal dimension of Self-Assessment Manikin. **The correlation is significant at the level of 0.01 (2-sided).

Table 2. Descriptive statistics of the pretest and posttest data (N = 224).

Scale Used	Range of the Scale	Mean Values	Standard Deviations	Range of Answers
FS [pre]	−5 - 5	1.83	1.74	−3 - 5
FS [post]	−5 - 5	2.24	1.58	−3 - 5
FAS [pre]	1 - 6	2.85	1.06	1 - 6
FAS [post]	1 - 6	2.04	0.87	1 - 5
SAM-P [pre]	1 - 5	3.74	0.81	1 - 5
SAM-P [post]	1 - 5	3.81	0.67	2 - 5
SAM-A [pre]	1 - 5	2.48	0.88	1 - 5
SAM-A [post]	1 - 5	2.03	0.90	1 - 4

a. FS = Feeling Scale, FAS = Felt Arousal Scale, SAM-P = pleasure dimension of Self-Assessment Manikin, SAM-A = arousal dimension of Self-Assessment Manikin.

Table 3. Descriptive statistics of the pretest and posttest data (N = 224).

Variables	Zero Variation *n* (*in* %)	Increase *n* (*in* %)	Decrease *n* (*in* %)
FS	66 (29.5)	111 (49.6)	47 (20.9)
FAS	59 (26.3)	25 (11.1)	140 (62.5)
SAM-P	110 (49.1)	67 (29.9)	47 (20.9)
SAM-A	90 (40.2)	26 (11.6)	108 (48.2)

a. FS = Feeling Scale, FAS = Felt Arousal Scale, SAM-P = pleasure dimension of Self-Assessment Manikin, SAM-A = arousal dimension of Self-Assessment Manikin.

4. Discussion

Recently, Maibach et al. (2020) provided for German translations of the FS and the FAS, which are frequently used to measure people's affective responses to exercise in accordance with the dual-mode model (DMM; e.g., Ekkekakis, 2003; Russell, 1980). While both scales have been validated for a high-intensity exercise (i.e., bicycle ergometer task, Maibach et al., 2020) and a moderate-intensity exercise (i.e., self-paced jogging, Thorenz et al., under review), a validation of the FS and the FAS for a low-intensity exercise is missing. Therefore, the present study examined participants' affective responses in a 45-minute AT exercise. Before and after this intervention, they completed the three questionnaires: The FS and the FAS by Maibach et al. (2020) and the SAM by Bradley and Lang (1994). Overall, the pattern of results confirms the validity of the German translations of the FS and the FAS for the low-intensity AT exercise.

4.1. Analysis of Correlation

Construct validity is evaluated according to the criteria of the Multitrait-Multimethod (MT-MM) analysis (Schermelleh-Engel et al., 2020). For convergent validity, a significant correlation must be demonstrated between pairs of the same construct using different methods (i.e., FS and SAM-P, and FAS and SAM-A). The data analysis of the present study revealed a significant correlation with a large effect size for the valence dimension between the FS and the SAM-P and a significant correlation with a small effect size for the arousal dimension between the FAS and the SAM-A (interpreted according to Cohen, 1988). Thus, convergent validity can be assumed for the FS and the FAS (Hypothesis 1).

For the discriminant validity, all three criteria of the MT-MM analysis (cf., Schermelleh-Engel et al., 2020) are satisfied for the (sub)scales of the valence and the arousal dimension. First, the correlation coefficients between the pairs of the same construct using different methods (FS and SAM-P or FAS and SAM-A) are higher than the correlation coefficients between the pairs of different constructs using same methods (FS and FAS or SAM-A and SAM-P). Second, the correlation coefficients between the pairs of the same construct using different methods (FS and SAM-P or FAS and SAM-A) are higher than the correlation coefficients between the pairs of different constructs using different methods (FS and SAM-A or FAS and SAM-P). Third, the correlations follow a plausible pattern within the same and between different dimensions, i.e., the pairs of the same construct have a positive sign and the pairs of different constructs are either not correlated or have negative signs. This was the case in the present data and therefore, discriminant validity can be assumed (Hypothesis 2). The effect size of the correlation coefficient for the valence dimension was of a similar size as the one found in Maibach et al. (2020), whereas the effect size for the correlation coefficient for the arousal dimension was somewhat lower. Please note, however, that the FAS and the SAM-A correlated significantly in the present study, and this correlation was positive (like in the study by Maibach et al., 2020).

The lower effect size of the correlation coefficient for the arousal dimension may be due to the larger sample size in the present study, leading to a more stable estimate, while the smaller sample size in the study of Maibach et al. (2020) may have overestimated the effects (Schönbrodt & Perugini, 2013). Another explanation (which is somewhat related to the larger sample size) may be the high percentage of zero variations for the SAM-A in the present study. When taking a closer look at the data, already 54 out of the 90 participants with a zero variation (i.e., no change from pretest to posttest) specified their level of activation with a value of 1 or 2 on the subscale SAM-A at the pretest. Thus, for those participants, a further decrease of arousal during the AT exercise was either not very likely (for those with a value of 2) or impossible (for those with a value of 1). Also, it may be argued that the subscale SAM-A (ranging from 1 - 5) may not have been as sensitive as the FAS (ranging from 1 - 6) to reveal any changes in these participants, which may (in turn) have been responsible for the lower effect size of the correlation coefficient.

4.2. Analyses of Affective Responses

For the comparison with the bicycle ergometer task of Maibach et al. (2020), higher mean values for FS_{post} and lower mean values for FAS_{post} were expected for the AT exercise in the present study. This was clearly reflected in the data. Therefore, Hypothesis 3 and Hypothesis 4 can be confirmed. Based on the DMM (Ekkekakis, 2003), the increase of pleasure during the AT exercise, as compared to the decrease in the bicycle ergometer task (Maibach et al., 2020), can be explained with the lower intensity level and a relaxation response, which was also shown in the decrease of arousal (cf. Irnich, 2013). This reciprocal influence was further corroborated by the negative correlation between the FS and the FAS, which is illustrated within the circumplex model in **Figure 1** (Russell, 1980, cf. Ekkekakis, 2003, Ekkekakis & Petruzzello, 2002). Hypothesis 5 and Hypothesis 6 can also be confirmed, as the magnitudes of changes and the directions of changes for the valence dimension and the arousal dimension were as expected and thus, differed markedly between the low-intensity AT exercise of the present study and the high-intensity bicycle ergometer task of Maibach et al. (2020). In

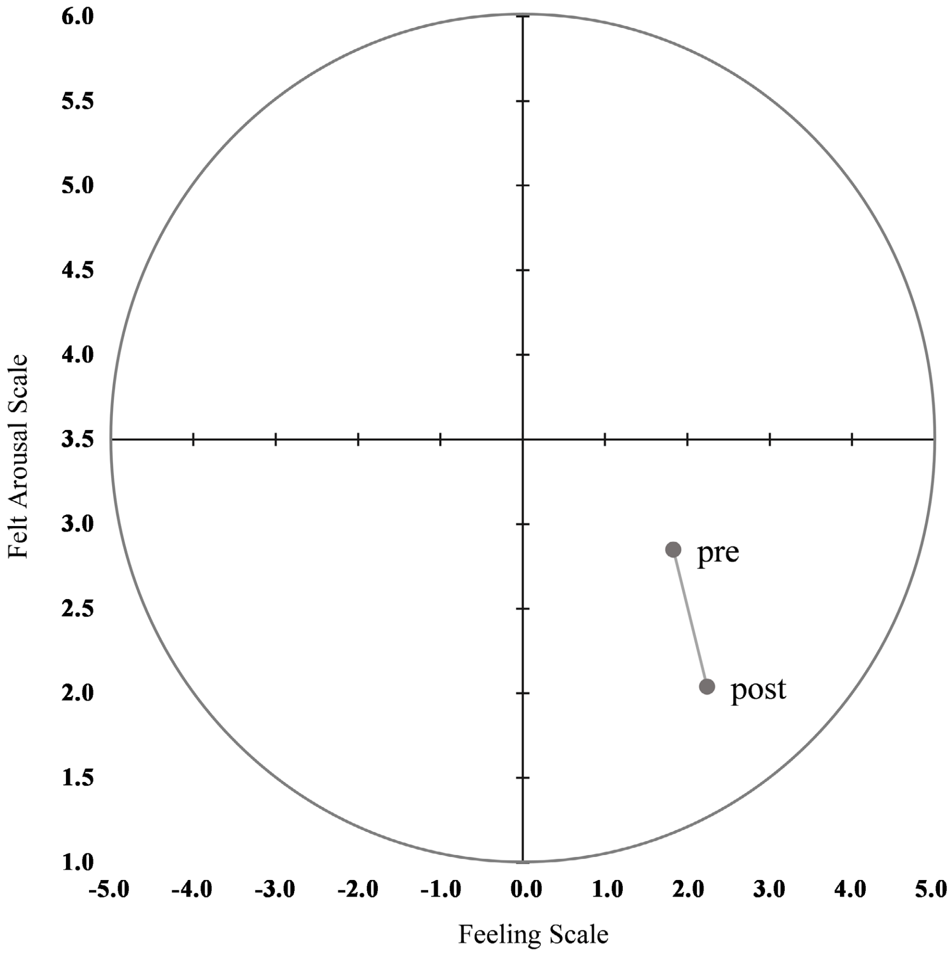

Figure 1. Affective response before (pre) and after (post) the autogenic training (AT) exercise in accordance with the two-dimensional model by Ekkekakis and Petruzzello (2002).

fact, the AT exercise in the present study was based exclusively on autosuggestion and thus, was performed in the complete absence of physical load, preventing large changes in the arousal level to occur. Obviously, this was different in the study of Maibach et al. (2020), where the physical load was increased stepwise up to the level of subjective exhaustion, being accompanied with intensive physiological responses and large changes of arousal (e.g., Niven et al., 2018; Oliveira et al., 2013; Stork et al., 2018). This difference in the exercise procedures was further reflected in the larger number of participants showing zero variations. These were 66 (29.5%) for the FS and 59 (26.3%) for the FAS in the present study, compared to the 8 (9.7%) and 3 (3.6%) in the study by Maibach et al. (2020). This observation confirms Hypothesis 7.

When viewing the present results together, a clear picture emerges, from which the use of the German translations of the FS and the FAS (by Maibach et al., 2020) for the AT exercise, resembling an exercise addressing the lower end of physical activation, can be recommended. As was expected, the execution of the passive relaxation technique led to a systematic (physiological) relaxation response, which was accompanied by pleasant feelings. This was reflected in the decrease of arousal (as measured with the FAS) and the increase of affective valence (as measured with the FS). However, comparing the results of the present study with previous findings on AT exercises is difficult because previous research has mainly focused on the state of anxiety (cf. Stetter & Kupper, 2002). This limited view on affective states was already criticized by Ekkekakis et al. (2000). Further, for the self-other comparison, the correlations within and between the different dimensions followed a systematic pattern. That is, pairs of the same construct were positively correlated, whereas pairs of different constructs were either not correlated or showed a negative correlation. The correlation coefficients were larger for same pairs (i.e., convergent validity) and smaller for different pairs (i.e., discriminant validity). Therefore, the criteria for construct validity were fully satisfied.

Based on these results, the application of the two-dimensional circumplex model (Russell, 1980) and the use of the two single-item scales FS and FAS can be recommended for the research field of relaxation techniques (e.g., autogenic training or progressive muscle relaxation), especially since the effect of the relaxation response can be nicely classified within the quadrant "unactivated-pleasant affect" in the circumplex model (Ekkekakis et al., 2000; Hall et al., 2002). The perception of interoceptive cues related to temperature sensation, muscular sensitivity, and cardiovascular perception are crucial for the relaxation response (Vaitl, 2020). This supports the assumption from the DMM (Ekkekakis, 2003), that the dominant processing of interoceptive cues leads to a pleasant affect during low-intensity exercises (cf. Brand & Kanning, 2021).

5. Conclusion

The present study confirms the validity for the German translations of the two single-item questionnaires FS and FAS for a low-intensity AT exercise. Hence, there is now evidence that the translated scales can be used to measure the affective responses for exercises across a variety of different intensity levels, from low-intensity (present study), over moderate-intensity (Thorenz et al., under review), to high-intensity (Maibach et al., 2020) level exercises. Future studies should test the application of the German versions of the FS and the FAS in different clinical populations for which AT is used in therapy, or for a younger population (adolescents) in a school setting. Furthermore, the validity of the FS and the FAS for other systematic relaxation techniques, such as the active relaxation technique progressive muscle relaxation, should also be tested. The questionnaires validated here could also be used to achieve the WHO goal of having inactive people engage in repeated and adherence physical activity.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Bok, D., Rakovac, M., & Foster, C. (2022). An Examination and Critique of Subjective Methods to Determine Exercise Intensity: The Talk Test, Feeling Scale, and Rating of Perceived Exertion. *Sports Medicine (Auckland, N.Z.), 52,* 2085-2109. https://doi.org/10.1007/s40279-022-01690-3

Bradley, M. M., & Lang, P. J. (1994). Measuring Emotion: The Self-Assessment Manikin and the Semantic Differential. *Journal of Behavior Therapy and Experimental Psychiatry, 25,* 49-59. https://doi.org/10.1016/0005-7916(94)90063-9

Brand, R., & Kanning, M. (2021). Sport Tut Gut?! Bewegung und Wohlbefinden. In M. Krüger, A. Güllich, & C. Pierdzioch (Eds.), *Sport in Kultur und Gesellschaft: Handbuch Sport und Sportwissenschaft* (pp. 379-391). Springer Spektrum. https://doi.org/10.1007/978-3-662-53407-6_36

Campbell, D. T., & Fiske, D. W. (1959). Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix. *Psychological Bulletin, 56,* 81-105. https://doi.org/10.1037/h0046016

Chan, J. S., Liu, G., Liang, D., Deng, K., Wu, J., & Yan, J. H. (2019). Special Issue-Therapeutic Benefits of Physical Activity for Mood: A Systematic Review on the Effects of Exercise Intensity, Duration, and Modality. *The Journal of Psychology, 153,* 102-125. https://doi.org/10.1080/00223980.2018.1470487

Charter, R. A., & Larsen, B. S. (1983). Fisher's Z to R. *Educational and Psychological Measurement, 43,* 41-42. https://doi.org/10.1177/001316448304300106

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Routledge.

Ebert, D. D., & Kowalsky, J. (2012). Entspannungsverfahren. In M. Berking, & W. Rief (Eds.), *Springer-Lehrbuch: Vol. 5024. Klinische Psychologie und Psychotherapie für Bachelor: Band II: Therapieverfahren Lesen, Hören, Lernen im Web* (pp. 107-116). Springer. https://doi.org/10.1007/978-3-642-25523-6_10

Ekkekakis, P. (2003). Pleasure and Displeasure from the Body: Perspectives from Exercise. *Cognition & Emotion, 17,* 213-239. https://doi.org/10.1080/02699930302292

Ekkekakis, P., & Petruzzello, S. J. (2002). Analysis of the Affect Measurement Conundrum in Exercise Psychology: IV. A Conceptual Case for the Affect Circumplex. *Psychology of Sport and Exercise, 3,* 35-63. https://doi.org/10.1016/S1469-0292(01)00028-0

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005). Variation and Homogeneity in Affective Responses to Physical Activity of Varying Intensities: An Alternative Perspective on Dose-Response Based on Evolutionary Considerations. *Journal of Sports Sciences, 23,* 477-500. https://doi.org/10.1080/02640410400021492

Ekkekakis, P., Hall, E. E., Van Landuyt, L. M., & Petruzzello, S. J. (2000). Walking in (Affective) Circles: Can Short Walks Enhance Affect? *Journal of Behavioral Medicine, 23,* 245-275. https://doi.org/10.1023/A:1005558025163

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The Pleasure and Displeasure People Feel When They Exercise at Different Intensities: Decennial Update and Progress towards a Tripartite Rationale for Exercise Intensity Prescription. *Sports Medicine* (*Auckland, N.Z.), 41,* 641-671. https://doi.org/10.2165/11590680-000000000-00000

Flake, J. K., Pek, J., & Hehman, E. (2017). Construct Validation in Social and Personality Research. *Social Psychological and Personality Science, 8,* 370-378. https://doi.org/10.1177/1948550617693063

Grasberger, D. (2014). *Autogenes Training: Inklusive CD mit 70 Minuten* (8. Aufl.).

Gräfe und Unzer.

Hall, E. E., Ekkekakis, P., & Petruzzello, S. J. (2002). The Affective Beneficence of Vigorous Exercise Revisited. *British Journal of Health Psychology, 7,* 47-66. https://doi.org/10.1348/135910702169358

Hardy, C. J., & Rejeski, W. J. (1989). Not What, but How One Feels: Measurement of Affect during Exercise. *Journal of Sport & Exercise Psychology, 11,* 304-317. https://doi.org/10.1123/jsep.11.3.304

Irnich, C. (2013). Relaxation Techniques. In D. Irnich (Ed.), *Myofascial Trigger Points: Comprehensive Diagnosis and Treatment* (pp. 245-252). Churchill Livingstone. https://doi.org/10.1016/B978-0-7020-4312-3.00024-6

Kanji, N. (1997). Autogenic Training. *Complementary Therapies in Medicine, 5,* 162-167. https://doi.org/10.1016/S0965-2299(97)80060-X

Kanji, N., White, A., & Ernst, E. (2006). Autogenic Training to Reduce Anxiety in Nursing Students: Randomized Controlled Trial. *Journal of Advanced Nursing, 53,* 729-735. https://doi.org/10.1111/j.1365-2648.2006.03779.x

Kellmann, M., & Beckmann, J. (2020). Sport und Bewegung. In F. Petermann (Ed.), *Entspannungsverfahren: Das Praxishandbuch: mit E-Book inside* (6th ed., pp. 346-356). Beltz.

Maibach, M., Niedermeier, M., Sudeck, G., & Kopp, M. (2020). Erfassung Unmittelbarer Affektiver Reaktionen auf Körperliche Aktivität. *Zeitschrift für Sportpsychologie, 27,* 4-12. https://doi.org/10.1026/1612-5010/a000291

Mikicin, M., & Kowalczyk, M. (2015). Audio-Visual and Autogenic Relaxation Alter Amplitude of Alpha EEG Band, Causing Improvements in Mental Work Performance in Athletes. *Applied Psychophysiology and Biofeedback, 40,* 219-227. https://doi.org/10.1007/s10484-015-9290-0

Niven, A., Laird, Y., Saunders, D. H., & and Phillips, S. M. (2020). A Systematic Review and Meta-Analysis of Affective Responses to Acute High Intensity Interval Exercise Compared with Continuous Moderate- and High-Intensity Exercise. *Health Psychology Review, 15,* 540-573. https://doi.org/10.1080/17437199.2020.1728564

Niven, A., Thow, J., Holroyd, J., Turner, A. P., & Phillips, S. M. (2018). Comparison of Affective Responses during and after Low Volume High-Intensity Interval Exercise, Continuous Moderate- and Continuous High-Intensity Exercise in Active, Untrained, Healthy Males. *Journal of Sports Sciences, 36,* 1993-2001. https://doi.org/10.1080/02640414.2018.1430984

Oliveira, B. R. R., Slama, F. A., Deslandes, A. C., Furtado, E. S., & Santos, T. M. (2013). Continuous and High-Intensity Interval Training: Which Promotes Higher Pleasure? *PLOS ONE, 8,* e79965. https://doi.org/10.1371/journal.pone.0079965

Oweis, P., & Spinks, W. (2001). Biopsychological, Affective and Cognitive Responses to Acute Physical Activity. *Journal of Sports Medicine and Physical Fitness, 41,* 528-538. https://www.proquest.com/scholarly-journals/biopsychological-affective-cognitive-responses/docview/202682225/se-2

Rose, E. A., & Parfitt, G. (2008). Can the Feeling Scale Be Used to Regulate Exercise Intensity? *Medicine and Science in Sports and Exercise, 40,* 1852-1860. https://doi.org/10.1249/MSS.0b013e31817a8aea

Russell, J. A. (1980). A Circumplex Model of Affect. *Journal of Personality and Social Psychology, 39,* 1161-1178. https://doi.org/10.1037/h0077714

Schermelleh-Engel, K., Geiser, C., & Burns, G. L. (2020). Multitrait-Multimethod-Analysen (MTMM-Analysen). In H. Moosbrugger, & A. Kelava (Eds.), *Testtheorie und Fragebogen-*

konstruktion (pp. 661-686). Springer. https://doi.org/10.1007/978-3-662-61532-4_25

Schönbrodt, F. D., & Perugini, M. (2013). At What Sample Size Do Correlations Stabilize? *Journal of Research in Personality, 47,* 609-612. https://doi.org/10.1016/j.jrp.2013.05.009

Schultz, J. H. (1932). *Das Autogene Training. Konzentrative Selbstentspannung. Versuch einer klinisch-praktischen Darstellung.* Thieme.

Seo, E., & Kim, S. (2019). Effect of Autogenic Training for Stress Response: A Systematic Review and Meta-Analysis. *Journal of Korean Academy of Nursing, 49,* 361-374. https://doi.org/10.4040/jkan.2019.49.4.361

Spielberger, C. D. (1983). *State-Trait Anxiety Inventory for Adults*. APA PsycTests. https://doi.org/10.1037/t06496-000

Stetter, F., & Kupper, S. (2002). Autogenic Training: A Meta-Analysis of Clinical Outcome Studies. *Applied Psychophysiology and Biofeedback, 27,* 45-98. https://doi.org/10.1023/A:1014576505223

Stork, M. J., Gibala, M. J., & Martin Ginis, K. A. (2018). Psychological and Behavioral Responses to Interval and Continuous Exercise. *Medicine and Science in Sports and Exercise, 50,* 2110-2121. https://doi.org/10.1249/MSS.0000000000001671

Svebak, S., & Murgatroyd, S. (1985). Metamotivational Dominance: A Multimethod Validation of Reversal Theory Constructs. *Journal of Personality and Social Psychology, 48,* 107-116. https://doi.org/10.1037/0022-3514.48.1.107

Thorenz, K., Sudeck, G., Berwinkel, A., & Weigelt, M. (under review). *The Affective Response to Moderate Physical Activity: A Further Validation Study for the German Version of the Feeling Scale and the Felt Arousal Scale*.

Vaitl, D. (2020). Autogenes Training. In F. Petermann (Ed.), *Entspannungsverfahren: Das Praxishandbuch: mit E-Book inside* (6th ed., pp. 65-82). Beltz.

Van Landuyt, L. M., Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2000). Throwing the Mountains into the Lakes: On the Perils of Nomothetic Conceptions of the Exercise-Affect Relationship. *Journal of Sport and Exercise Psychology, 22,* 208-234. https://doi.org/10.1123/jsep.22.3.208

Welch A.S., Hulley, A., Ferguson, C., & Beauchamp, M. R. (2007). Affective Responses of Inactive Women to a Maximal Incremental Exercise Test: A Test of the Dual-Mode Model. *Psychology of Sport and Exercise, 8,* 401-423. https://doi.org/10.1016/j.psychsport.2006.09.002

World Health Organization (2018). *Global Action Plan on Physical Activity 2018-2030: More Active People for a Healthier World*. https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf?sequence=1&isAllowed=y

World Health Organization (2020). *WHO Guidelines on Physical Activity and Sedentary Behaviour: At a Glance*. https://apps.who.int/iris/bitstream/handle/10665/337001/9789240014886-eng.pdf