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Response Scaling: Night-time Baselines, Resting Baselines, and Initial Value Dependencies

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Abstract

Ideally, response scores that are derived to assess individual differences in responsiveness should be independent of the researcher's subjective preferences for any specific baseline condition, for instance, resting (pre-task) values or night-time baselines. A methodological investigation was designed to evaluate three issues: namely, baseline bias, initial-value dependency bias, and response score bias.

51 hypertensive patients participated in three 24-hour periods of psychophysiological monitoring. The monitoring consisted of measurements taken during rest periods and tasks in the laboratory, as well as measurements during daytime activities and during night-time. The assessment included the cold pressor test, mental load, active relaxation, and stair climbing as a physically demanding task. Blood pressure and heart rate were employed in exploring specific methods of response scaling.

The findings indicated that the assessment of individual differences in responsiveness, i.e. rank ordering of subjects, was biased substantially. (1) Inconsistencies exist between response scores that were derived by relating task level to night-time baselines, rather than to resting baseline in the laboratory. This deviation was obvious for task-baseline differences but less evident for residualized change scores and true scores. (2) Positive initial-value dependency for BP and HR, i.e. association of higher baseline and higher response magnitude, was found when resting baselines were used. However, negative initial-value dependency was found in several instances when night-time baselines were employed. (3) Inconsistencies were also evident among various methods of response scaling, whereby a discordance seems to exist between the simple difference, on the one hand, and residualized change score and true score models, on the other.

A strategy of response scaling is suggested that disregards simple difference scores and employs (1) a residualized change score to represent incremental change and (2) a design-specific true score model that allows for both a test of initial-value dependency and an estimation of true difference. Baseline bias, initial-value dependency bias, and response score bias may be responsible for some of the inconsistencies in outcomes of psychophysiological research.

Descriptors: Baseline, Blood pressure, Heart rate, Law of initial values, Response scaling

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Introduction

The definition of baselines and various methodological aspects of response scaling continue to represent basic concerns in designing psychophysiological research. Many strategies and solutions have been suggested. (For reviews, see Foerster, Schneider & Walschburger, 1983; Kallus, 1992; Schneiderman & McCabe, 1989; Stemmler & Fahrenberg, 1989.) The selection of certain measurements to represent the baseline and, similarly, a preference for a specific change score and the consideration of initial-value dependencies may determine the results of the experiment and, in some instances, may even lead to a reversal of interpretation in comparison to alternative choices. Recent examples of such outcomes in the assessment of cardiovascular reactivity are provided, for example, by Fahrenberg, Foerster, and Wilmers (1995) and Giaconi, Volterrani, Marabotti, Genovesi-Ebert, Palombo, and Ghione (1993).

Response scaling lacks standardization between laboratories. The preference for a specific measurement model may influence the evaluation of change – both in terms of response magnitude and rank ordering of individuals concerning reactivity. These issues, of course, are especially relevant when a replication of essential findings is intended or when metaanalytic studies are conducted. It appears that these issues are less importent in experimental research with randomized assignment of subjects and treatments. In quasi-experimental research which employs non-equivalent groups, for example, patients and control subjects, (borderline hypertensive and normotensive subjects, etc.) response scaling is an essential issue in research methodology.

It is from this perspective that each measurement model is considered as a theoretical stance in its own right and also a bias in the representation of physiological changes. Since an ideal measurement is not available it should be useful to elaborate on three kinds of possible bias in response scaling: *baseline bias*, *initial-value-dependency bias*, and *response score bias*.

The evaluation can be guided by referring to empirical data in order to depict statistically relationships among various response measures and, if discrepancies exist, to assess the approximate size of such effects. The ultimate criterion to evaluate certain measurement models, of course, should come from subsequent evaluation of usefulness either in theory building or in prediction of relevant outcomes.

Baselines

The design of psychophysiological research must include definitions of pre-test, in-between or post-test control periods, often referred to as resting baselines. The selection of a valid control period obviously depends on (1) a relatively steady state, i.e., a stable (stationary) condition without marked trends during the observation interval in particular variables, and (2) an effective, experimental or statistical, control of collative situational variables and of relevant subject characteristics. Pre-test and in-between rest periods may contain, for example, error variance on account of recurrent circadian changes and regular daily events (e.g. food intake), anxious intra-experimental trends due to adaptation to the laboratory, apprehension or increasing fatigue, boredom, or impatience. Furthermore, sequence and carry-over effects may be present.

It is often assumed, however questionable it may seem, that rest periods with especially low values (relative minima) are well suited as baselines because much of the irrelevant variance seems to be excluded. Some investigators have employed extended initial rest periods or even a dry-run session on a previous day (e.g., Fahrenberg, Walschburger, Foerster, Myrtek & Müller, 1983) or a subsequent day (Obrist, 1981) to establish valid "baselines". However, the specific criteria are seldom discussed and the lack of standardization across laboratories is obvious (see Hastrup, 1986; Jennings, Kamarck, Stewart, Eddy & Johnson, 1992; Pickering & Gerin, 1990; Stemmler & Fahrenberg, 1989).

The objection can be raised that a "true" baseline does not exist and, therefore, the traditionally used word "baseline" should be replaced by some alternative such as "control period". The choice of such periods would depend on the experimental question. However, the term "control period", for example, some arbitrary initial resting condition, would be even more ambiguous because it lacks an indication which effects, situational variables or relevant subject characteristics, were controlled. Effects due to differential adaptation concerning the setting and the experimental tasks may be altogether overlooked although such effects may exist in many studies.

Psychophysiological research on anxiety patients provides a good example of how trait and state aspects, anticipatory and stimulus-dependent effects, evaluation of laboratory setting and response to experimental conditions are confounded (e.g., Lader, 1975). This example makes evident that the use of a rather arbitrary pre-task control period would obscure initial-value-dependencies and basic relationships between essential components in the patient's manifest anxiety. The concept of basal values as opposed to initial values or control periods, respectively, is indispensible here. Obviously, a baseline bias can be assumed for any design that employs non-equivalent groups (controls).

Baseline implies, correctly in our opinion, the notion of basal values, i.e. an approximation of the individual's lowest, relatively stable value. We should seek or attempt to establish such basal values.

For most physiological parameters such baselines may be operationally defined as the lowest measure during sleep (or, more precisely, Non-Rem sleep) and, at daytime, as the lowest measure during an extended period of subjective and physical relaxation in reclining position.

The issue of defining adequate baselines has gained renewed interest since ambulatory monitoring systems became available to many laboratories. These systems allow for recordings under naturalistic conditions, e.g., night-time measurements of blood pressure and heart rate. Such measurements are assumed to represent more valid indicators of basal conditions than conventional pre-task resting periods, although the effects of sleep stages and, in some cases, sleep disturbances on concurrent cardiovascular changes must be taken into account.

It would be of interest to know more about the biometric properties of sleep baselines since various indices can be derived, e.g., mean of entire night versus lowest value of the sleep recording. Another relevant question relates to the assessment of cardiovascular reactivity. Do response measures that refer to pre-task baselines accord with response measures that refer to night-time measurements as baselines? Discordant findings would necessitate further evaluation of measurement concepts and, finally, more explicit reference to theoretically derived criteria for assessing validity.

A recent laboratory-field comparison of heart rate and blood pressure measurements revealed that subjects with elevated blood pressure also had an elevated heart rate in the laboratory (baselines and task levels) compared to normotensive subjects. However, these group differences disappeared during a subsequent 24-hour ambulatory monitoring. These findings suggest differential adaptations to the laboratory (Fahrenberg, Foerster & Wilmers, 1993).

Initial-value dependencies

An essential aspect of response scaling relates to initial value dependencies. Conceptual developments are noticeable here, for example, the derivation of a statistical rationale to test for such initial-value dependencies (Foerster, 1995; Myrtek & Foerster, 1986; see also Berntson, Uchino & Cacioppo, 1994). A basic issue here is the distinction between two kinds of initial-value-dependency:

- dependency due to the regression to the mean, i.e., the statistical dependency which can be seen as a methodological artifact, and
- true initial-value dependency that may reflect homeostatic constraints, i.e. the biological dependency according to Wilder.

Both effects, often being opposite in the sign of correlation, may compensate for each other and thus may obscure or neutralize group differences. This distinction of statistical and biological initial-value-dependency is still conceptual. Attempts at empiricial differentiation of both effects require investigations that employ manipulative within-subject designs and adequate statistical models.

Foerster (1995) recently discussed the statistical intricacies and provided a metaanalysis of a number of psychophysiological studies, each of which included many variables and conditions. The empirical finding was that, contrary to Wilder's Law of Initial Values and irrespective of the measurement model used, the direction of the initial-value-dependencies was mostly positive, i.e. higher initial values were associated with higher response measures (accounting for the direction of activation).

Measurement model

Another basic issue in response scaling was dealt with in a number of recent articles. There is growing awareness that researchers should explicitly provide the measurement model to indicate the specific structural relationship model that is assumed (Foerster, 1995; Fahrenberg et al., 1995; Jin, 1992; Stemmler 1987; Stemmler & Fahrenberg, 1989). Theoretical assumptions concerning the error components that are present in baselines and in task values constitute an essential issue here.

Response scaling means assignment of a score to an observed change so that, within-subject and between-subjects, a reliable and valid assessment of response can be obtained. Convential change scores are:

DIF Unweighted (simple) differences between task level and baseline are related to baselines by computation and, eventually, homeostatic constraints, however such effects are confounded.

ALS Residual change scores (traditionally named ALS, i.e., autonomic lability scores) that are derived by substracting the predicted value (via regressing the task level on the baseline) from the observed value. ALS are independent of baselines and, thus, represent incremental variance.

DIF is still widely used although its conceptual adequacy is highly questionable. Residual change scores ALS eliminate statistical as well as biological initial-value-dependency and thus present a biased evaluation of change.

Measurement models should make explicit the specific assumptions of measurement, an essential aspect being here the assumptions which components of variance (error variance) are reflected in the measurement model (cf. Table 1).

Certain components of variance (error variance) can be differentiated conceptually: (1) error of measurement in a strict sense, i.e. random non-periodic variation around true score; and (2) error variance specific for baseline or task level, e.g., increased number of measurement artifacts during performance. Both error components may exist in baseline and task values, however uncorrelated. Correlated sources of variance may be assumed in (1) additive periodic components, e.g., circadian

Table 1: Components of error variance as reflected in measurement models (Case 1 to Case 4a, according to Kendall & Stewart, 1967).

Component of Error Variance	Accounted for in Case 3	Case 1	Case 4	Case 1a	Case 4a
Error in Baseline and Task Level Uncorrelated					
Error of Measurement in Strict Sense	x	x	x	x	x
Error Component Error Variance specific for Baseline or Task Level		x	x		x
Error in Baseline and Task Level Correlated					
Additive Periodic Component in Baseline and in Task Level Effects of Adaptation, Learning etc.				x	x
Individual Differences in Non-linear Trends of Adaptation or Performance					x
Assumptions	**Case 3**	**Case 1**	**Case 4**	**Case 1a**	**Case 4a**
Error Variance of Baseline s_b^2 is Estimated		x	x	x	x
Error Variance of Task Level s_t^2 is Estimated			x		x
Assumption $s_b^2 = s_t^2$	x			x	
Assumption $r_{bt} = 0$	x	x	x		

Note: Model case 3 refers to a single measurement (data period) of baseline and task level (pre-post design), case 1 (1a) and case 4 (4a) assume at least two measurements of baselines and/or task levels for estimation of specific error variances.

regulation, sleep stages, slow blood pressure waves, so that the difference between baseline and task level will depend on the phase relationship of measurement, and in (2) individual differences in non-linear trends of anticipation, adaptation and performance, biometeorological effects, and other external conditions which actually effect both levels – pre-task (baseline) and task – to an unknown extent.

In accordance with such assumptions and estimations, respectively, concerning error variance and correlation of error variance, Kendall and Stewart (1967) have derived distinct structural relationships models. These concepts were adapted to response scaling in psychophysiological research (cf. Foerster, 1995; Stemmler & Fahrenberg, 1989).

TRU True difference scores are calculated according to distinct measurement models: Case 1, Case 1a, Case 3, Case 4, and Case 4a (according to Kendall & Stewart, 1967). It should be noted that these models essentially differ as to which components of total variance are assumed as error variance, and concerning error variance of baseline s_b^2 and task levels s_t^2 and correlation of errors r_{bt} (cf. Table 1 and Foerster, 1995).

An evaluation of three models appears to be especially relevant in the present methodological investigation: (1) Model Case 3 which represents the pre-post design, (2) Model Case 4 for a repeated measurement design which also is applicable in the present investigation assuming independent errors, and, similarly, (3) Model Case 4a assuming correlated errors. Less interesting for the present investigation are Models Case 1 and Case 1a, which deal with repeated measurements for the initial values only while Case 4 a nd Case 4a have repeated measurements for both baseline and task value.

The components of error variance and within-subject variance for baselines and task levels depicted in Table 1 obviously will depend on (1) the duration and the number of measurements (averaging) within the measurement period, (2) the interval between measurements (e.g., 24-hours), and (3) phase relationships within each condition (e.g., time of measurement relative to slow blood pressure variation). Statistical averaging may lead to a reduction of some of the components of error variance. Cases 1, 1a, 4, and 4a estimate the error variances based on at least one replication of measurement.

The selection of a distinct measurement model requires theoretically derived criteria or, at the very least, evidence of the practical advantages relating to, for example, ease of measurement, distribution characteristics, discriminatory efficiency, and coefficients of reliability and stability. This approach was substantiated in a recent investigation of cardiovascular reactivity in subjects with elevated blood pressure as compared to normotensive subjects. This research was guided by the theoretical assumption that borderline hypertensives should exhibit increased responsiveness. There were no significant group differences in task-baseline differences or in residualized change scores. However, a positive initial-value dependency in blood pressure responses was found: elevated blood pressure is associated with a larger increase under task conditions. Response scaling that employed pre-task baselines, reliability estimates, and "true" difference scores indicated higher responsiveness in subjects with elevated blood pressure and, thus were by definition, in accordance with the positive initial-value dependency as compared to task-baseline differences or residualized change scores. It was concluded that some inconsistencies in the literature with respect to blood pressure responsiveness in borderline hypertension may be attributed to the specific method of response scaling.

Research questions

A comprehensive evaluation of baselines and change scores requires a set of physiological variables, a sufficient sample size, recordings that include night-time measurements, measurements during daily activities, i.e., during standardized tasks and rest periods (preferably with the same recording device), and, if possible, replications of such assessments on a second and third day. Such data have become available from a research project on cardiovascular responsiveness and psychophysiological relationships in hypertensive patients (Franck, Herrmann & Fahrenberg, 1996).

Mental load as provided by a multiple reaction task and the cold pressor test were selected as laboratory tasks because of their frequent use in previous work. A multiple baseline design included initial rest periods, in-between rest periods, and a condition of active relaxation. Since active relaxation was a familiar technique to most of the patients, it was supposed that especially low readings might be obtained in this condition. Furthermore, a semi-standardized task, i.e., climbing stairs inside a building, was introduced to provide a physical challenge and a wider range of response magnitudes.

Preceeding contributions have mainly dealt with initial value dependencies and the evaluation of change scores (Fahrenberg et al., 1995; Foerster, 1995). The present article is primarily concerned with a comparison of various baseline measures and, furthermore, with aspects of empirical validity and biometric properties that may serve to attain an optimal strategy in response scaling.

The interesting questions were whether certain choices – such as (1) the choice of baseline, e.g., night-time baseline, initial rest period in the laboratory or a relaxation period and (2) the choice of response measure like simple task-baseline difference, DIF, or residualized change score, ALS, as compared to a true score models, TRUE - would lead to different rank ordering of subjects concerning cardiovascular responsiveness. Further evaluation of such discrepancies would appear to be a relevant issue in standardization across laboratories.

Methods

Subjects

In this study, 51 male hypertensive patients were each monitored three times for 24-hours while they participated in an in-patient rehabilitation program in the Klinik für Rehabilitation Glotterbad, Glottertal, Schwarzwald, that lasted between four to six weeks. They ranged in age from 22 to 60 years, with a mean age of 47.7 (SD = 9.9). According to WHO criteria, the distribution was: 3 patients, WHO I; 21 patients, WHO II; and 27 patients WHO III. In 31 patients who received antihypertensive medication their schedule remained unchanged during this study. Further details on clinical status, medication, and rehabilitation outcome are omitted here because these aspects appear to be less relevant for the present methodological investigation. The obvious questions whether the degree of severity of the hypertensive disease or medication may affect the findings on issues in response scaling is referred to in the Discussion.

Apparatus

The configuration that was employed in ambulatory monitoring consisted of two recorders: a four channel recorder for blood-pressure, heart rate, respiration rate, and activity (Physioport/Tonoport, Par-Natic/Hellige); and a pocket-sized computer (PB 1000 Casio) that was programmed to obtain self-ratings at fixed intervals. This method to obtain blood pressure and other physiological measurements and concurrent self-ratings has proven effective in previous studies (Fahrenberg et al., 1993; Fahrenberg, 1996; Käppler, Becker & Fahrenberg, 1994.)

Procedure and Methods

The first two recordings were obtained, electrodes and transducers not replaced, on two subsequent days (48 hours) about ten days after the patient arrived at the rehabilitation center. The third recording was made about 14 days later. At the beginning of each 24-hour ambulatory monitoring session the patients participated in a standardized assessment that was conducted in the laboratory of the rehabilitation center. The subjects were seated in comfortable chairs. The electrodes and transducers were fastened and blood pressure measurement was checked carefully. On the average the preparation took 30 minutes. The protocol comprised in a fixed order:

Rest period 1 (duration 5 minutes)

Cold pressor test demanding the immersion of the left hand in cold water kept at a steady temperature of 4°C by continuous cooling (duration, 90 seconds).

Rest period 2 (duration 2 minutes)

Relaxation. Patients were instructed to practice active relaxation, a familiar technique in this rehabilitation clinic, for 15 minutes.

Rest period 3 (duration 2 minutes)

Mental load that was provided by a multiple reaction time task (Wiener Determinationsgerät, Zak Company, Simbach); 120 trials at a success rate of 50 per cent, 150 trials at 25 per cent success rate; total duration about 5 minutes).

Rest period 4 (duration 2 minutes)

Stair climbing was conducted in the same building (fast climbing of 48 steps up and down without skipping steps; duration about 1 minute).

After this assessment was concluded the monitoring was continued while the patients followed their course of rehabilitation activities and their daily routines. The duration of the sleep segment was ascertained by referring (1) to the continuously recorded activity and (2) information from the patients, who were thoroughly interviewed after each 24-hour recording period. Thus, a comprehensive 48-hour ambulatory recording and another 24-hour record were obtained that included night-time and daytime averages as well as blood pressure and heart rate response levels during standardized tasks and rest periods.

Blood pressure (SBP, DBP, MBP, mmHg) was recorded intermittently (daytime interval of 30 min and 60 min at night). Automatic blood pressure measurements were also initiated in the last minute of each rest period and immediately after relaxation, after mental load task, and after climbing stairs. The Physioport employs the ECG to define a window for detecting Korotkov sounds that are transmitted by a microphone attached over the brachial artery. Heart rate (HR, bpm) was automatically derived from the continuous ECG recordings from Nehb anterior leads. Heart rate readings for rest periods and tasks were averages for two minutes, i.e., the minute of BP measurement and the preceding minute. However, for night-time and daytime monitoring heart rate measures were obtained as averages across the ten minutes preceeding each BP measurement. Rest and task measures were omitted when daytime means were computed. Recordings of respiration rate were discarded here, as were recordings of physical activity – after assessing the sleep segment.

Self-reports made concurrent to each daytime blood pressure measurement comprised ten seven-step items concerning setting variables and mood, e.g., feeling tense. Furthermore, questionnaire data were available concerning quality of sleep (duration, disturbances) and the patients subjective assessment of the monitoring. The intention was to register contextual variables that might be useful here in evaluating certain aspects of reliability and validity of this methodology.

Baselines

Four baseline measures were derived from sleep recordings of blood pressure and heart rate. The mean of the entire night is the most suggestive index because the number of observations should serve to reduce measurement error. The lowest measures of blood pressure and heart rate may be seen as nearest approximation of true basal conditions. However, technical artifacts may have occurred so that a careful evaluation regarding outliers is mandatory. The mean of the last two hours of sleep, i.e., 2-hour interval before waking up in the morning, represents a transition period between sleep and wakefulness. This period may have special significance in hemodynamic regulation; however, difficulties in segmentation of sleep vs. awake condition and, eventually, trends in distribution of sleep stages and dream activity have to be considered (Baumgart & Rahn, 1990; Tofler & Muller, 1992; Wilson, Ferencz, Dischinger, Brenner & Zeger, 1988). Finally, a baseline was defined for the blood pressure measurement nearest to the minute of minimum heart rate of the entire night (Myrtek, 1990).

Three baseline measures were derived from recordings during standard conditions: initial rest period, i.e., pre-cold pressor test; pre-relaxation; and post-relaxation. Pre-mental load task and pre-climbing stairs were discarded here.

Change Scores

Five change scores were computed for each baseline and task condition: *DIF*, *ALS*, and *TRU* (Case 3, 4, 4a). These measurement models differ concerning their assumptions about which components of error are reflected and how an initial-value-dependency is accounted for (see above).

In the present investigation the measurements from day 2 were used for estimation of error variance for day 1 by ANOVA (cf. Kendall & Stewart, 1967, p. 382); and likewise day 3 for error variances on day 2. Baselines and task levels, here, mostly refer to one measurement of BP and HR, which was obtained as an average for one minute, but night-time and daytime means based on frequent measurements were also available.

Initial-Value Dependency

The tests on initial-value relationships depend on the assumptions that refer to $\lambda = s_t^2/s_b^2$ in each measurement model and, additionally, depend on the correlation r_{bt} in Case 4a. In testing initial-value dependencies only components of error variances that can be assumed for both values, baseline and task level, should be contained in the model. The assumption of equal error variances $s_b^2 = s_t^2$ (Model Case 3) is questionable as soon as obvious differences in the duration of baselines and tasks exist. In such designs the Model Case 4 should be employed if replications of measurements are available. In case 4a, furthermore, such components of variance that are correlated between baseline and task level are included in the error variance, e.g., additive periodic components and non-linear trends of adaptation.

Statistical Analyses

The biometric properties of the four sleep baselines were examined and compared to resting baselines from the standardized assessment. Likewise, the five change scores were explored. These statistical analyses included formal aspects, like distribution parameters and coefficients of stability. The intention was to evaluate various kinds of baselines and response scores and to investigate their concordance or discordance. Such analyses should help in developing optimal strategies for assessing individual differences in responsiveness. The tests on initial-value dependencies were performed by a specifically designed program which also calculated the change scores. Univariate statistics and tests from the SAS package were used in comparing the findings for various baselines and change scores.

Results

Table 2 depicts the basic statistics for blood pressure and heart rate baselines: four night-time baselines and three resting periods, as well as three tasks and daytime mean for the first of three 24-hour recording periods. Day 2 and day 3 were omitted here, but coefficients of stability were included in Table 2. Since all baseline values exhibit only negligible or small deviations from the normal distribution concerning skewness and kurtosis, those statistics are omitted.

Resting values in the laboratory are obviously on a higher level than night-time mean, e.g., for pre-cold pressor test: SPB about 17 mmHg, DBP 16 mmHg, and HR 10 bpm. Subsequently, a decrease, especially in DBP and HR, was observed in pre-relaxation rest and for all three variables during active relaxation. But still a substantial difference exists between such resting baselines and the night-time measures, e.g., night-time mean. Such differences were several times larger than the changes caused by the laboratory tasks.

Increased SBP and HR were measured, as expected, during tasks; the climbing stairs test caused an especially large increase. It is evident from the daytime BP means and variances that some of the patients do not exhibit hypertensive values under rest conditions. Especially low BP and HR measures were obtained in a few subjects. The between-subject variance of sleep baselines, resting levels, and task levels in SBP, DBP and HR, were roughly in the same order.

The correlation coefficients day 1 - day 2 for mean daytime BP and HR ranged between .83 and .90, thus indicating high reliability and stability. The highest coefficients of stability day 1 to day 2 for blood pressure sleep baselines were found for the mean of entire night (for SBP $r = .84$, for DBP $r = .88$), and even higher for heart rate ($r =.91$), which, of course, corresponds to the number of observations involved. The baseline referring to the lowest value during night-time, ranked second, the mean of the last two hours of sleep, ranked third and the blood pressure baseline at heart rate minimum fourth. Averages for data periods, i.e., night-time and daytime means, had higher stability coefficients than single measurements, i.e., pre-task and task levels. Coefficients of stability were lower as soon as measurements from day 3, i.e., with an interval of two weeks, were included in the comparison.

Between days several significant differences in means exist as revealed by t-tests for correlated samples: sleep mean of SBP 121 mmHg for day 1 and 117 mmHg for day 2 ($df = 50$, $p = .002$), and climbing stairs SBP 163 mmHg for day 1 and 156 mmHg for day 2 ($df= 50$, $p = .018$). Furthermore, trends were obvious for resting pre-cold pressor and task levels between day 1 and day 3. Trends

Table 2: Sleep Baselines, Resting Baselines, and Task Levels for Blood Pressure and Heart Rate (Day 1). Correlations and Trends across Days.

Measure		Mean	SD	Minimum	Maximum	Correlation r Day 1-2	Day 2-3	Day 1-3	t-Tests p Day 1-2	Day 1-3
Systolic Blood Pressure										
Sleep	Mean	121.4	17.7	99.0	180.5	.84	.66	.76	.002	-
	Minimum	107.0	15.6	87.0	164.0	.69	.52	.68	-	-
	Mean 2 Hour	121.2	16.3	95.0	166.5	.57	.57	.60	-	-
	Minimum/HR	117.6	17.4	89.0	178.0	.47	.58	.66	-	-
Resting	Pre Cold Pressor	138.2	14.5	109.0	184.0	.52	.52	.47	-	.004
Pre Relaxation		138.3	15.2	111.0	183.0	.48	.44	.54	-	-
	Post Relaxation	133.6	13.6	108.0	169.0	.41	.41	.60	-	-
Task Level	Cold Pressor	147.5	18.1	114.0	193.0	.63	.53	.61	-	.001
	Mental Load	144.9	14.7	120.0	179.0	.53	.56	.58	-	.008
	Stair Climbing	163.8	23.9	118.0	206.0	.69	.61	.62	.018	.000
Daytime	Mean	142.8	13.6	120.0	188.0	.83	.60	.67	-	-
Diastolic Blood Pressure										
Sleep	Mean	76.3	9.4	56.7	99.3	.88	.55	.63	-	-
	Minimum	65.0	11.5	41.0	91.0	.66	.44	.55	-	-
	Mean 2 Hour	77.0	12.6	54.0	109.0	.66	.54	.69	-	-
	Minimum/HR	75.2	11.6	52.0	98.0	.40	.52	.38	-	-
Resting	Pre Cold Pressor	92.1	8.2	69.0	107.0	.54	.71	.49	.006	.000
	Pre Relaxation	85.8	9.3	65.0	107.0	.59	.46	.37	.008	.004
	Post Relaxation	86.1	8.4	66.0	105.0	.64	.60	.50	.000	.000
Task Level	Cold Pressor	94.4	9.1	74.0	113.0	.65	.47	.35	.010	.002
	Mental Load	92.2	9.1	70.0	107.0	.54	.55	.34	-	.005
	Stair Climbing	75.8	10.6	56.0	96.0	.46	.50	.23	.016	.004
Daytime	Mean	88.8	6.9	76.4	102.3	.83	.56	.51	.000	-
Heart Rate										
Sleep[a]	Mean	61.7	8.2	47.9	86.0	.91	.70	.79	-	-
	Minimum	57.3	7.9	40.0	74.4	.81	.46	.69	-	.042
	Mean 2 Hour	60.8	7.6	46.3	81.2	.78	.58	.74	-	-
Resting	Pre Cold Pressor	72.0	9.7	38.0	96.0	.81	.55	.50	-	-
	Pre Relaxation	67.7	10.1	47.0	95.0	.86	.54	.55	-	-
	Post Relaxation	66.4	9.8	38.0	93.0	.83	.64	.61	-	-
Task Level	Cold Pressor	73.2	9.7	37.0	97.0	.81	.58	.49	-	-
	Mental Load	74.7	11.1	42.5	99.5	.85	.67	.49	-	-
	Stair Climbing	93.8	21.5	39.5	138.0	.91	.20	.19	-	-
Day time	Mean	78.3	10.6	49.2	99.9	.90	.42	.45	-	-

Notes: N between 51 and 48 due to missing data.
[a] For heart rate is sleep baseline Minimum/HR identical to Minimum.
Significant findings by t-Tests for correlated samples indicate decrease of BP across days but an increase in HR Sleep Minimum between day 1 and day 3.

appear to be absent in DBP sleep baselines; changes occur in resting and task levels. Significant changes, without exception, indicated a decrease in BP. The average level of heart rate remained rather stable, although the measurements for particular subjects as indicated by the correlation coefficients (Table 2) may vary between days.

It is noteworthy that the within-subject standard deviation showed more changes across days than did the means. Whole day SD for diastolic BP and heart rate increased ($p < .01$) between day 1 and day 2. There was no trend in within-subject SD of night-time measures except a highly significanct decrease ($p < .001$) of heart rate measures (bpm).

The statistical analysis of concurrently assessed self-report data on mood and activity did not reveal reliable trends across days 1, 2 and 3, nor were such trends present in questionnaire data on quality of sleep and subjective evaluation of the monitoring. An over-all trend to further adaptation was thus not evident between day 1, which actually was about ten days after the patient had arrived at the rehabilitation center, and days 2 and 3.

Baseline

In the present set of data, a certain response magnitude, for example, SBP response to cold pressor stimulation can be related to night-time baseline or to pre-cold pressor baseline. Coefficients of correlation, then, may be employed to indicate the amount of concordance/discordance between both response scalings (Table 3). A coefficient $r = .48$ means that both assessments of responsiveness attained a common variance of only 25 per cent. The ranking of subjects concerning BP responsiveness, consequently, would be rather inconsistent.

Although almost all of the correlation coefficients in Table 3 were statistically significant, the magnitude of these coefficients indicate that the rank ordering of subjects actually will depend essentially on which baseline is selected. This baseline bias is more evident for response scores DIF than for residualized change scores ALS or true scores TRU. The concordance within such pairs of response scores was especially low for daytime mean that represents an average of many measures, and was especially high for climbing stairs, which may be due to greater variance in BP and HR.

Initial-Value Dependency

Initial-value dependency for BP and HR were explored concerning three task levels, i.e., cold pressor, mental load, and climbing stairs, and likewise, mean of entire day. Night-time mean, night-time minimum, and pre-cold pressor were employed as baselines. A selection of findings for day 1 is presented in Table 4. The slopes b of the structural relationship models indicate whether significant

Table 3: Correlation between Response Scores Derived from the same Measurement Model but Relating to two Alternative Baselines.

	Response Score				
	DIF	**ALS**	**TRU Case 3**	**TRU Case 4**	**TRU Case 4a**
			Cold Pressor		
SBP	.48	.72	.84	.73	.81
DBP	.49	.65	.76	.70	.79
HR	.42	.52	.51	.53	.52
			Mental Load		
SBP	.30	.63	.61	.52	.64
DBP	.44	.71	.80	.65	.77
HR	.41	.41	.63	.60	.62
			Stair Climbing		
SBP	.74	.85	.97	.95	.96
DBP	.69	.91	.97	.84	.94
HR	.93	.90	.99	.98	.98
			Daytime Mean		
SBP	.08	.58	.33	.49	.48
DBP	.10	.68	.33	.52	.59
HR	.53	.65	.77	.79	.77

Note: Each coefficient represents the concordance/discordance of response measures that relate a certain task level to either night-time mean as baseline or to initial resting as baseline.
$r \geq .24$ $p \leq .05$, $r \geq .33$ $p \leq .01$ (one tailed)

dependencies compared to the hypothesis b = 1, i.e., absence of initial-value dependency, exists. Estimates of the error variance ratio λ and the coefficient of correlation r_{bt} may help in understanding obvious discrepancies between Models Case 3, 4, and 4a concerning tests of initial-value dependency.

The findings depicted in Table 4 appear to be rather inconsistent, but a close-up evaluation revealed certain systematic aspects. Significant ($p < .05$) initial-value dependencies were present in 43 per cent of all tests. The initial-value dependency mostly (30 out of 44 tests) is mainly positive, i.e., larger response magnitudes were found for higher baselines. This finding is in accordance with previous work (cf. Foerster, 1995; Myrtek & Foerster, 1986). But it is evident from Table 4 that the

Table 4: Tests for Initial Value Dependencies in Blood Pressure and Heart Rate Concerning Sleep Baselines and Resting Baselines.

	Case 3 b	Case 4 b	Case 4a b	Ratio λ	Correlation r_{bt}
			Baseline Nighttime Mean		
			Cold Pressor Test		
SBP	1.07	0.67	0.89	2.24	-.07
DBP	0.89	0.32--	0.84	1.13	.07
HR	1.42	0.99	1.17	2.00	.09
			Mental Load		
SBP	0.68	0.49--	0.68--	2.00	-.16
DBP	0.82	0.31--	0.73-	3.59	-.18
HR	1.64++	1.26	1.37++	3.40	-.18
			Stair Climbing		
SBP	4.61++	0.71	1.38+	3.26	-.44
DBP	a	a	0.79	6.08	-.34
HR	6.95++	2.73	2.70++	7.17	-.66
			Daytime Mean		
SBP	0.69-	0.78	0.78-	0.58	-.13
DBP	0.51--	0.57-	0.69--	0.76	-.30
HR	1.55++	1.35	1.35++	1.81	-.27
			Baseline Nighttime Minimum		
			Cold Pressor Test		
SBP	1.44	1.04	1.12	1.63	-.85
DBP	0.41	0.77	0.79	0.65	-.13
HR	1.51	1.28	1.26	1.55	-.29
			Mental Load		
SBP	0.90	0.79	0.84	1.31	-.06
DBP	0.48	0.56	0.69--	0.84	.00
HR	1.74++	1.54+	1.48++	1.65	-.14
			Stair Climbing		
SBP	5.25++	2.17	1.66++	2.19	-.40
DBP	a	a	0.74-	1.36	-.27
HR	6.13++	4.49++	2.93++	3.49	-.51
			Daytime Mean		
SBP	0.81	1.08	0.97	0.39	-.09
DBP	0.31--	0.92	0.65--	0.18	-.23
HR	1.59++	1.62++	1.47++	0.89	-.19
			Baseline Pre Cold Pressor (Initial Rest Laboratory)		
			Cold Pressor Test		
SBP	1.38+	1.33	1.37++	1.19	.12
DBP	1.15	1.16	1.22+	0.96	.25
HR	1.00	1.00	1.00	0.99	.12
			Mental Load		
SBP	1.05	1.06	1.11	0.92	.26
DBP	1.20	1.13	1.13	1.31	.22
HR	1.14	1.14	1.15+	1.03	.07
			Stair Climbing		
SBP	2.34++	2.00++	1.92++	1.68	-.06
DBP	2.02+	1.23	1.27	2.03	.00
HR	3.36++	2.86++	2.33++	2.25	-.36
			Daytime Mean		
SBP	0.90	1.19	1.18	0.30	.01
DBP	0.74	1.04	1.01	0.25	.13
HR	1.13	1.22	1.15	0.59	-.04

Notes: b slope of the structural relationship model. Measurements from day 2 were employed in estimates for day 1.

a Tests not applicable because variance-covariance matrix cannot be factorized (Bartlett-Test, Bartlett, 1950).

Initial value dependencies: (+) positive (-) negative $p < .05$; (++) positive (--) negative $p < .01$.

findings, to some extent, depend on the specific baseline, on the task, and especially on the structural relationship model selected. It should be noted that baseline night-time mean and daytime mean were averages as compared to single measurements in rest and task conditions within the laboratory.

Models. If an averaged baseline (night-time mean) was used for single measure tasks, the task error variances were clearly greater than baseline error variances ($\lambda >> 1$). Therefore, tests of Model Case 3 had to be rejected if error variance estimates were accepted. Case 3 tests differed clearly from Case 4 tests. Accordingly, if single measure baselines (night minimum, initial rest) were employed with daytime mean (averaged), the ratio of error variances was clearly less than unity ($\lambda << 1$), and likewise Case 3 tests were doubtful whenever repeated measurement estimates were accepted. Differences between Case 4 and Case 4a tests were evident for high correlations of errors r_{bt}, e.g., in climbing stairs task. Generally, Case 4a tests were more powerful than Case 4 tests. Accepting the day-to-day repeated measurements for error variance estimates, further evaluation can be restricted to Case 4a tests only.

Baselines. For the b slopes of Model Case 4a common trends for all three baselines were evident. For SBP, b slopes increased from night-time mean over night-time minimum to initial rest for all tasks and daytime means; negative initial-value dependencies disappeared, positive initial-value dependencies were enhanced. DBP and HR b slopes were roughly equal for both night-time baselines, but increased for DBP and decreased for HR when initial rest was used. This was true for all tasks and for daytime mean. Therefore, negative night-time initial-value dependencies of DBP and some of the positive initial-value dependencies of HR were reduced or disappeared.

Tasks. Responses to climbing stairs had positive initial-value dependency even for SBP and regardless of which baselines were employed.

Variables. For blood pressure variables, positive and negative initial-value dependencies were found depending on which baseline was used, whereas HR showed only positive dependencies.

Change Scores

The set of five change scores first had to be compared with respect to distribution characteristics and stability. Computations included three cardiovascular variables, five baselines, four conditions (cold pressor test, mental load, stair climbing, and daytime mean), and three days. These computations revealed only a few instances of significant deviations in skewness and kurtosis compared to normal distribution. Correlations across day 1 - day 2 and day 1 - day 3 indicated that coefficients of stability were roughly in the same order for the response scores. Neither distribution characteristics nor coefficients of stability provide cues for selecting a certain response score.

The correspondance between change scores that were derived from different measurement models is depicted in Table 5. Three of five true difference scores (cf. above) were included along with conventional DIF and ALS scores. Only such pairs of baselines and conditions that compare regarding number of measurements were selected here.

The correlation coefficients were generally in the range of .70 to 1.00, indicating a high degree of concordance. Response measures according to certain structural relationship models were in almost perfect concordance (cf. findings for Case 4a, Table 5) and, likewise, the correlation between such true score estimates and residualized change scores *ALS* was nearly 1.00. This finding is evident for sleep minimum and pre-cold pressor relating to task levels. However, the coefficients were lower when simple task-baseline differences *DIF* and *ALS*, and, likewise, DIF and true scores were compared. Especially for diastolic blood pressure coefficients shrank to .67, indicating essential discrepancies in the assessment of individual differences in responsiveness. This finding was obvious for night-time minimum as the baseline and for the relationship between night-time mean and daytime mean but was not evident when pre-cold pressor was employed as baseline (see Table 5).

Table 5: Concordance between Response Scores derived from different Measurement Models (Day 1).

Response Score	DIF/ ALS	DIF/ Case 3	DIF/ Case 4	DIF/ Case 4a
		Nighttime Minimum - Pre Cold Pressor		
SBP	.85	.87	.91	.90
DBP	.68	.91	.79	.75
HR	.97	.89	.92	.92
		Nighttime Minimum - Cold Pressor		
SBP	.90	.83	.89	.88
DBP	.69	.88	.74	.73
HR	.96	.88	.91	.91
		Nighttime Minimum - Mental Load		
SBP	.84	.87	.91	.89
DBP	.70	.90	.86	.80
HR	1.00	.92	.94	.95
		Nighttime Minimum - Stair Climbing		
SBP	.91	.84	.87	.88
DBP	.67	.80	.67	.67
HR	1.00	.95	.96	.97
		Pre Cold Pressor - Cold Pressor		
SBP	.99	.91	.92	.92
DBP	.98	.94	.94	.92
HR	.98	.98	.98	.98
		Pre Cold Pressor - Mental Load		
SBP	.96	.94	.93	.92
DBP	.97	.92	.93	.94
HR	1.00	.97	.98	.97
		Pre Cold Pressor - Stair Climbing		
SBP	1.00	.91	.93	.93
DBP	.93	.84	.90	.90
HR	.99	.95	.96	.97
		Nighttime Mean - Daytime Mean		
SBP	.77	.95	.90	.90
DBP	.69	.95	.91	.84
HR	1.00	.92	.95	.95

Note: DIF refers to simple task-baseline differences, ALS to residualized change scores, and Case 3 and Case 4a refer to true score models.

Discussion

The methodology of response scaling has not yet attained a satisfactory level of standardization. Researchers obviously differ in their preference for selection and control of rest periods as pre-task baseline and in their choice of response score. Furthermore, the evaluation of experimental results will depend on the recognition and interpretation of initial-value dependencies. Such methodological options may be responsible for an essential part of the many inconsistencies in the vast literature on cardiovascular reactivity. The present investigation was to explore the significance and relative size of such response scaling method effects. The selection of cardiovascular parameters, baseline conditions, tasks, and likewise the inclusion of five response scores may lead to more insight in specific aspects of measuring change.

The conclusions obtained in the present study refer to the assessment of in-patient hypertensives and cannot be generalized without reservations. Some of the subjects received antihypertensive medication. There is some evidence, however, from the literature that the reactivity as compared to level of blood pressure is not decisively determined by antihypertensive medication (Julius, 1988; Mills & Dimsdale, 1991; Schmieder, Rüddel & von Eiff, 1990). In the present study t-tests between groups did not reveal consistent differences in baselines or task levels of heart rate or blood pressure: neither between WHO-groups (24 WHO I + II vs 26 WHO III) nor concerning medication (29 without, 22 on antihypertensive medication). This finding, of course, does not rule out the possibility of such effects.

The main concern here was to obtain reliable recordings of blood pressure and heart rate on a variety of occasions, i.e., baseline measures, pre-task measures, standardized tasks in the laboratory, and during monitoring (daytime, night-time). Special precautions are required for such repeated measurement designs that extend over several days. It appears that a rehabilitation center is especially suited for this investigation. There is no obvious reason to suppose that the methodological conclusions will be valid only for such patients. However, the present study deals with such patients and so do most studies on BP responsiveness.

Baseline Bias

Night-time baselines of BP and HR were expectedly much lower than resting and relaxation baselines in the laboratory. SBP and DBP minimum at night had higher coefficients of stability than resting values that also refer to a single measurement. The 48 hour recording with electrodes and transducers not removed, revealed a high reproducibility of night-time and daytime averages of BP and HR. With the exception of BP at night-time HR minimum all of the sleep baselines, i.e., mean, minimum, and mean of last two hours of sleep, appear to be suited as habitual baselines, whereby night-time mean as an average of a number of measurements attained the highest coefficients of stability. Between rest periods in the laboratory, i.e., pre-cold pressor, pre-relaxation and post-relaxation, relatively small differences exist, but compared to night-time baselines an increase in sympathetic activation was obvious although effects of body position (lying, sitting) and setting variables may also be present. Task effects on blood pressure and heart rate, thus, were superimposed to an already enhanced pre-task level which, certainly, did not represent a "basal" condition.

The assessment of individual differences in cardiovascular responsiveness depends on the selection of baselines. The present findings indicate that the discordance in rank ordering of subjects will be most obvious for simple differences and least obvious for true scores: This baseline bias was smaller for increased response magnitude and variance during tasks like climbing stairs but was a strong bias in the evaluation of cold pressor and mental load tests. It should be noted, again, that the reliability of baselines depends on the data period and the number of measures that were averaged. Repeated measurements in pre-task and task conditions are desirable.

The present study does not allow us to conclude that sleep recordings provide the best 'basal' value from which to score reactions. Such evaluation would require external criteria, e.g., investigating the incremental validity in prediction of certain outcomes. However, such night-time basal values appear to be indispensible if differential adaptation to the laboratory is an essential issue. Findings from research on office hypertension and related phenomena indicated that such effects are ubiquituous and have to be accounted for in research designs.

Initial-value Dependency Bias

Initial-value dependency had to be examined for all available baselines. Findings revealed a relative similarity between response scalings relating to night-time baselines and, likewise, between response scalings relating to resting baselines. Especially suited for testing initial-value dependency in simple pre-post designs were pairs of baseline and task levels which contain an equivalent number of measurements, e.g, either single measurements or averages (which tend to eliminate specific sources of variance).

Negative initial-value dependency, i.e., the association of lower baselines and higher response magnitude, was evident for night-time mean and daytime mean of systolic and diastolic blood pressure and, on the contrary, a positive dependency for heart rate. This finding was only partially confirmed when single measure baselines and task levels were employed. Positive and negative initial-value dependencies, likewise, were found for night-time minimum as baseline. But referring to the initial baseline in the laboratory (pre-cold pressor), which can be seen as a setting-dependent enhanced baseline, only positive relationships prevailed. Higher pre-task level and higher response magnitude were associated, as observed in previous investigations (cf. Fahrenberg et al., 1995; Foerster, 1995).

The findings about initial-value dependency, furthermore, depend on the specific task. In climbing stairs, for example, systolic blood pressure had positive initial-value dependency irrespective of the baseline used. This may be due to the magnitude of the task induced variance.

The Model Case 3 assumption of equal error variances should be rejected whenever initial and final values are averages based on data periods of varying lengths. The robustness of this test can be seen by comparing Case 3 results with Case 4 results. Due to a mathematical dependency the b slope of Case 3 is underestimated or overestimated if the error variance ratio λ is less or greater than unity. From this, comparable initial and final values (here, single measure baselines and standard tasks) that are familiar in psychophysiological experiments showed most robust Case 3 tests. Moreover, it is noteworthy that Case 3 and Case 4 tests never led to contradictory results.

The assumption of uncorrelated errors had only a slight influence on the b slopes (comparing Case 4 with Case 4a), but Case 4a tests appeared to be more powerful. Deviation from the assumption of uncorrelated errors may compensate for a deviation from the assumption of equal error variances. This is obvious in a comparing Case 3 and Case 4a tests, whereby Case 3 tests were more conservative especially for laboratory rest and task values.

Response Score Bias

The obvious discordance of response scores (*DIF*, *ALS* and *TRU*), which is evident at least in some instances of this investigation, underlines the size and practical relevance of the response score bias. For an extended discussion of this issue, refer to a previous article (Fahrenberg et al., 1995).

Suggestions for a Strategy

Any strategy regarding the selection of a certain response score has to account for three kinds of biometric bias, as discussed above. Investigators who prefer *DIF* should keep in mind that this response score contains confoundations of the so-called statistical initial-value dependency, and possibly, a homeostatic initial-value dependency. The baseline bias is most obvious for *DIF*, and a multiple baseline design that includes night-time baselines appears to be mandatory to avoid questionable interpretation in assessing individual differences in responsiveness. *DIF* leads to a rank ordering of subjects that essentially deviates from assessments that employ *ALS* or *TRU* scores. *DIF* scores are conventionally used and seem to have face validity because of their simplicity in describing manifest change without referring to sample statistics but, nevertheless, the use of *DIF* should be strongly discouraged.

ALS indicate the incremental change independent from a specific baseline, although the baseline bias due to selecting, for example, initial resting baseline or night-time baseline is effective (see Table 3). This response score has advantages if the investigator is especially interested in incremental change; however, homeostatic initial-value dependency will remain obscure.

TRU scores that are derived from a structural relationship model are to be preferred since the investigator is to specify (1) the assumptions with respect to components of error variance in a given design, and (2) adequate prodecures of estimation (e.g., averaging, replication, experimental control). The selection of a structural relationship model will depend on the availability of repeated measurements: (1) the length of data periods and averaging, and (2) the replication of such measurements to obtain estimates for the essential components of error variance (see Table 1).

TRU scores are well suited to reflect homeostatic initial-value dependency, while disregarding statistical (spurious) initial-value dependency. In the present context, all models led to highly redundant response scores but this may be different for other designs, variables, tasks, and replications. Case 3 and Case 4a appear to have advantages with respect to theoretical modeling in psychophysiological experimentation. True score Model Case 3 leads to true differences, even if only a pre-post design is available, and Model Case 4a contains reliability estimates based on repeated measurements which may have correlated components of error (see Table 1).

None of the response scoring methods can be recommended unequivocally. The optimal strategy, thus, would include two scores: (1) a response score that contains true score change and, therefore, true initial-value dependency; and (2) a response score that eliminates initial-value dependency and provides a focus on incremental change (i.e., residualized change scores *ALS*).

Furthermore, the present findings suggest that, wherever available, a night-time baseline should be included because such basal values appear to provide an outstanding perspective on initial-value dependency as compared to setting-specific initial resting baselines. Referring to sleep baselines, then, would allow the evaluation of differential adaptations to the laboratory.

In concluding, the present methodological investigation has found empirical evidence for a *baseline bias*, an *initial-value dependency bias*, and a *response score bias* that may operate in psychophysiological assessments of individual differences in cardiovascular responsiveness and that may be present in other domains. The choice of baseline and the choice of response score depend on the experimental question, but a method study may reveal inconsistencies and limitations in the use of conventional response scalings. These methodological issues require further research and, finally, standardization between laboratories.

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Appendix

Appendix A: Sleep Baselines, Resting Baselines, and Task Levels for Blood Pressure and Heart Rate: Valid Number of Subjects, Mean, SD, Minimum, Maximum, Correlations and Trends across Days.

Day 1		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
					Systolic Blood Pressure							
Sleep	Minimum	50	107.0	15.6	87.0	164.0	.69	.52	.68	+.200	-.677	+.331
	Mean	50	121.4	17.7	99.0	180.5	.84	.66	.76	+.002	-.065	+.504
	Mean 2 Hour	50	121.2	16.3	95.0	166.5	.57	.57	.60	+.080	-.104	+.520
	Minimum/HR	50	117.6	17.4	89.0	178.0	.47	.58	.66	+.928	-.832	+.790
Resting	Pre Cold Pressor	51	138.2	14.5	109.0	184.0	.52	.52	.47	+.564	+.014	+.004
	Pre Relaxation	51	138.3	15.2	111.0	183.0	.48	.44	.54	+.432	+.823	+.320
	Post Relaxation	51	133.6	13.6	108.0	169.0	.41	.41	.60	+.240	-.740	+.354
	Pre Mental Load	48	141.6	14.9	119.0	183.0	.49	.56	.60	+.137	+.086	+.001
	Laboratory Mean	51	137.5	12.7	115.0	178.7	.53	.57	.63	+.169	+.143	+.004
Task Level	Cold Pressor	51	147.5	18.1	114.0	193.0	.63	.53	.61	+.162	+.039	+.001
	Mental Load	49	144.9	14.7	120.0	179.0	.53	.56	.58	+.244	+.107	+.008
	Stair Climbing	51	163.8	23.9	118.0	206.0	.69	.61	.62	+.018	+.024	+.001
Daytime	Mean	51	142.8	13.6	120.0	188.0	.83	.60	.67	+.120	-.335	-.918

Day 1		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
					Diastolic Blood Pressure							
Sleep	Minimum	50	65.0	11.5	41.0	91.0	.66	.44	.55	+.524	-.753	+.324
	Mean	50	76.3	9.4	56.7	99.3	.88	.55	.63	+.162	+.749	+.089
	Mean 2 Hour	50	77.0	12.6	54.0	109.0	.66	.54	.69	+.535	-.895	+.335
	Minimum/HR	50	75.2	11.6	52.0	98.0	.40	.52	.38	-.780	-.178	-.323
Resting	Pre Cold Pressor	51	92.1	8.2	69.0	107.0	.54	.71	.49	+.006	+.043	+.001
	Pre Relaxation	51	85.8	9.3	65.0	107.0	.59	.46	.37	+.008	+.509	+.004
	Post Relaxation	51	86.1	8.4	66.0	105.0	.64	.60	.50	+.001	+.046	+.001
	Pre Mental Load	48	91.5	7.9	70.0	108.0	.59	.45	.35	+.083	+.001	+.001
	Laboratory Mean	51	89.8	7.5	71.0	102.7	.67	.66	.50	+.001	+.002	+.001
Task Level	Cold Pressor	51	94.4	9.1	74.0	113.0	.65	.47	.35	+.010	+.163	+.002
	Mental Load	49	92.2	9.1	70.0	107.0	.54	.55	.34	+.142	+.049	+.005
	Stair Climbing	51	75.8	10.6	56.0	96.0	.46	.50	.23	+.016	+.175	+.004
Daytime	Mean	51	88.8	6.9	76.4	102.3	.83	.56	.51	+.001	-.654	+.070

Day 1		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Day 2-3	Day 1-3	Trend Day 1-2	Day 2-3	Day 1-3
						Mean Blood Pressure						
Sleep	Minimum	50	80.1	11.9	62.0	116.0	.66	.46	.60	+.363	-.855	+.177
	Mean	50	91.0	11.0	71.2	124.3	.88	.62	.72	+.008	-.464	+.134
	Mean 2 Hour	50	91.4	12.6	71.0	127.5	.68	.57	.65	+.190	-.390	+.349
	Minimum/HR	50	89.0	11.4	64.0	116.0	.51	.67	.50	-.831	-.243	-.555
Resting	Pre Cold Pressor	51	107.1	9.0	86.0	128.0	.53	.62	.46	+.025	+.009	+.001
	Pre Relaxation	51	102.9	9.9	82.0	126.0	.55	.51	.54	+.042	+.578	+.012
	Post Relaxation	51	101.6	8.7	84.0	121.0	.58	.53	.57	+.004	+.279	+.001
	Pre Mental Load	48	107.8	8.2	88.0	126.0	.55	.49	.47	+.049	+.003	+.001
	Laboratory Mean	51	105.4	7.8	89.3	121.7	.61	.60	.53	+.005	+.008	+.001
Task Level	Cold Pressor	51	111.8	9.7	93.0	134.0	.65	.54	.52	+.012	+.034	+.001
	Mental Load	49	109.5	8.9	91.0	128.0	.49	.59	.41	+.093	+.029	+.002
	Stair Climbing	51	104.8	11.1	78.0	129.0	.49	.56	.42	+.005	+.015	+.001
Daytime	Mean	51	106.5	7.6	92.1	122.1	.81	.57	.60	+.003	-.427	+.262

Day 1		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Day 2-3	Day 1-3	Trend Day 1-2	Day 2-3	Day 1-3
						Heart Rate						
Sleep	Minimum	50	57.3	7.9	40.0	74.4	.81	.46	.69	-.619	-.298	-.042
	Mean	50	61.7	8.2	47.9	86.0	.91	.70	.79	+.931	-.195	-.071
	Mean 2 Hour	50	60.8	7.6	46.3	81.2	.78	.58	.74	+.840	-.221	-.087
Resting	Pre Cold Pressor	51	72.0	9.7	38.0	96.0	.81	.55	.50	-.800	-.586	-.464
	Pre Relaxation	51	67.7	10.1	47.0	95.0	.86	.54	.55	+.738	-.271	-.342
	Post Relaxation	51	66.4	9.8	38.0	93.0	.83	.64	.61	-.486	-.603	-.340
	Pre Mental Load	48	72.1	10.6	34.5	92.5	.82	.55	.47	-.675	-.355	-.237
	Laboratory Mean	51	70.0	9.5	36.8	91.7	.87	.61	.55	-.527	-.522	-.360
Task Level	Cold Pressor	51	73.2	9.7	37.0	97.0	.81	.58	.49	+.489	-.580	-.869
	Mental Load	49	74.7	11.1	42.5	99.5	.85	.67	.49	+.915	-.151	-.269
	Stair Climbing	51	93.8	21.5	39.5	138.0	.91	.20	.19	+.605	-.625	-.617
Daytime	Mean	51	78.3	10.6	49.2	99.9	.90	.42	.45	+.808	+.909	+.855

Day 2		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
						Systolic Blood Pressure						
Sleep	Minimum	51	104.8	12.8	85.0	144.0	.69	.52	.68	+.200	-.677	+.331
	Mean	51	117.0	13.3	96.0	171.1	.84	.66	.76	+.002	-.065	+.504
	Mean 2 Hour	49	118.0	14.7	90.5	166.5	.57	.57	.60	+.080	-.104	+.520
	Minimum/HR	50	117.9	13.6	92.0	169.0	.47	.58	.66	+.928	-.832	+.790
Resting	Pre Cold Pressor	50	137.0	12.7	114.0	167.0	.52	.52	.47	+.564	+.014	+.004
	Pre Relaxation	51	136.6	14.1	108.0	173.0	.48	.44	.54	+.432	+.823	+.320
	Post Relaxation	51	131.1	14.2	107.0	180.0	.41	.41	.60	+.240	-.740	+.354
	Pre Mental Load	49	138.2	16.2	109.0	181.0	.49	.56	.60	+.137	+.086	+.001
	Laboratory Mean	51	135.1	12.9	110.0	167.3	.53	.57	.63	+.169	+.143	+.004
Task Level	Cold Pressor	51	144.5	17.1	116.0	204.0	.63	.53	.61	+.162	+.039	+.001
	Mental Load	49	142.6	14.2	120.0	190.0	.53	.56	.58	+.244	+.107	+.008
	Stair Climbing	50	156.4	25.8	122.0	216.0	.69	.61	.62	+.018	+.024	+.001
Daytime	Mean	51	141.0	14.3	119.1	186.1	.83	.60	.67	+.120	-.335	-.918

Day 2		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
						Diastolic Blood Pressure						
Sleep	Minimum	51	63.8	11.3	40.0	88.0	.66	.44	.55	+.524	-.753	+.324
	Mean	51	75.1	9.2	58.0	95.3	.88	.55	.63	+.162	+.749	+.089
	Mean 2 Hour	49	76.0	9.8	55.5	94.0	.66	.54	.69	+.535	-.895	+.335
	Minimum/HR	50	75.3	11.4	50.0	119.0	.40	.52	.38	-.780	-.178	-.323
Resting	Pre Cold Pressor	50	88.4	10.1	72.0	116.0	.54	.71	.49	+.006	+.043	+.001
	Pre Relaxation	51	82.6	9.4	63.0	104.0	.59	.46	.37	+.008	+.509	+.004
	Post Relaxation	51	82.1	9.7	54.0	101.0	.64	.60	.50	+.001	+.046	+.001
	Pre Mental Load	49	89.6	9.3	70.0	111.0	.59	.45	.35	+.083	+.001	+.001
	Laboratory Mean	51	86.6	8.7	66.3	106.3	.67	.66	.50	+.001	+.002	+.001
Task Level	Cold Pressor	51	91.6	9.0	66.0	115.0	.65	.47	.35	+.010	+.163	+.002
	Mental Load	49	90.3	9.7	69.0	110.0	.54	.55	.34	+.142	+.049	+.005
	Stair Climbing	50	72.2	10.3	52.0	97.0	.46	.50	.23	+.016	+.175	+.004
Daytime	Mean	51	86.5	7.9	67.5	109.0	.83	.56	.51	+.001	-.654	+.070

Day 2		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
						Mean Blood Pressure						
Sleep	Minimum	51	78.6	10.0	62.0	104.0	.66	.46	.60	+.363	-.855	+.177
	Mean	51	88.8	9.5	73.2	118.6	.88	.62	.72	+.008	-.464	+.134
	Mean 2 Hour	49	89.7	10.2	70.0	111.5	.68	.57	.65	+.190	-.390	+.349
	Minimum/HR	50	89.2	10.8	66.0	135.0	.51	.67	.50	-.831	-.243	-.555
Resting	Pre Cold Pressor	50	104.2	9.0	87.0	126.0	.53	.62	.46	+.025	+.009	+.001
	Pre Relaxation	51	100.3	9.4	78.0	119.0	.55	.51	.54	+.042	+.578	+.012
	Post Relaxation	51	98.1	9.4	81.0	117.0	.58	.53	.57	+.004	+.279	+.001
	Pre Mental Load	49	105.5	9.6	87.0	132.0	.55	.49	.47	+.049	+.003	+.001
	Laboratory Mean	51	102.4	8.4	87.7	120.7	.61	.60	.53	+.005	+.008	+.001
Task Level	Cold Pressor	51	108.9	9.3	93.0	135.0	.65	.54	.52	+.012	+.034	+.001
	Mental Load	49	107.3	9.2	93.0	136.0	.49	.59	.41	+.093	+.029	+.002
	Stair Climbing	50	100.0	11.4	82.0	129.0	.49	.56	.42	+.005	+.015	+.001
Daytime	Mean	51	104.3	8.2	89.9	124.9	.81	.57	.60	+.003	-.427	+.262

Day 2		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
						Heart Rate						
Sleep	Minimum	50	57.9	8.6	33.6	77.6	.81	.46	.69	-.619	-.298	-.042
	Mean	50	62.0	8.3	44.4	86.1	.91	.70	.79	+.931	-.195	-.071
	Mean 2 Hour	48	60.6	8.5	44.0	91.1	.78	.58	.74	+.840	-.221	-.087
Resting	Pre Cold Pressor	50	72.2	10.7	49.0	97.0	.81	.55	.50	-.800	-.586	-.464
	Pre Relaxation	51	67.5	10.5	50.5	92.5	.86	.54	.55	+.738	-.271	-.342
	Post Relaxation	51	67.0	9.5	48.5	96.0	.83	.64	.61	-.486	-.603	-.340
	Pre Mental Load	49	72.7	9.8	52.0	93.0	.82	.55	.47	-.675	-.355	-.237
	Laboratory Mean	51	70.5	9.5	50.3	94.2	.87	.61	.55	-.527	-.522	-.360
Task Level	Cold Pressor	51	72.6	9.8	54.5	101.5	.81	.58	.49	+.489	-.580	-.869
	Mental Load	49	74.7	10.9	54.0	106.5	.85	.67	.49	+.915	-.151	-.269
	Stair Climbing	50	93.7	22.3	46.0	145.0	.91	.20	.19	+.605	-.625	-.617
Daytime	Mean	51	78.1	11.5	49.6	105.2	.90	.42	.45	+.808	+.909	+.855

Day 3		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
					Systolic Blood Pressure							
Sleep	Minimum	50	105.8	18.0	75.0	158.0	.69	.52	.68	+.200	-.677	+.331
	Mean	50	120.8	18.7	84.8	177.5	.84	.66	.76	+.002	-.065	+.504
	Mean 2 Hour	44	121.1	19.2	82.5	174.5	.57	.57	.60	+.080	-.104	+.520
	Minimum/HR	50	117.5	20.3	78.0	184.0	.47	.58	.66	+.928	-.832	+.790
Resting	Pre Cold Pressor	51	131.6	15.9	111.0	188.0	.52	.52	.47	+.564	+.014	+.004
	Pre Relaxation	51	136.1	16.4	106.0	184.0	.48	.44	.54	+.432	+.823	+.320
	Post Relaxation	51	131.9	15.8	101.0	180.0	.41	.41	.60	+.240	-.740	+.354
	Pre Mental Load	51	133.8	16.8	109.0	188.0	.49	.56	.60	+.137	+.086	+.001
	Laboratory Mean	51	132.4	14.8	110.0	185.3	.53	.57	.63	+.169	+.143	+.004
Task Level	Cold Pressor	51	139.7	17.2	107.0	191.0	.63	.53	.61	+.162	+.039	+.001
	Mental Load	51	138.6	17.6	107.0	189.0	.53	.56	.58	+.244	+.107	+.008
	Stair Climbing	51	150.4	21.9	109.0	194.0	.69	.61	.62	+.018	+.024	+.001
Daytime	Mean	51	142.8	15.5	108.8	184.8	.83	.60	.67	+.120	-.335	-.918

Day 3		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
					Diastolic Blood Pressure							
Sleep	Minimum	50	64.2	9.0	44.0	81.0	.66	.44	.55	+.524	-.753	+.324
	Mean	50	74.8	9.0	56.3	93.0	.88	.55	.63	+.162	+.749	+.089
	Mean 2 Hour	44	75.7	9.9	57.5	101.5	.66	.54	.69	+.535	-.895	+.335
	Minimum/HR	50	77.5	11.0	53.0	102.0	.40	.52	.38	-.780	-.178	-.323
Resting	Pre Cold Pressor	51	86.2	8.4	70.0	112.0	.54	.71	.49	+.006	+.043	+.001
	Pre Relaxation	51	81.7	8.2	67.0	99.0	.59	.46	.37	+.008	+.509	+.004
	Post Relaxation	51	79.6	9.9	56.0	100.0	.64	.60	.50	+.001	+.046	+.001
	Pre Mental Load	51	84.7	8.4	69.0	108.0	.59	.45	.35	+.083	+.001	+.001
	Laboratory Mean	51	83.5	8.0	70.7	103.7	.67	.66	.50	+.001	+.002	+.001
Task Level	Cold Pressor	51	89.8	9.3	73.0	119.0	.65	.47	.35	+.010	+.163	+.002
	Mental Load	51	87.7	9.1	71.0	107.0	.54	.55	.34	+.142	+.049	+.005
	Stair Climbing	51	70.1	11.4	39.0	96.0	.46	.50	.23	+.016	+.175	+.004
Daytime	Mean	51	87.0	7.6	72.4	102.7	.83	.56	.51	+.001	-.654	+.070

Day 3		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
						Mean Blood Pressure						
Sleep	Minimum	50	78.8	10.3	55.0	103.0	.66	.46	.60	+.363	-.855	+.177
	Mean	50	89.8	10.7	70.8	120.0	.88	.62	.72	+.008	-.464	+.134
	Mean 2 Hour	44	90.5	11.5	69.0	125.5	.68	.57	.65	+.190	-.390	+.349
	Minimum/HR	50	90.5	12.7	69.0	129.0	.51	.67	.50	-.831	-.243	-.555
Resting	Pre Cold Pressor	51	101.0	9.4	84.0	129.0	.53	.62	.46	+.025	+.009	+.001
	Pre Relaxation	51	99.6	9.7	83.0	122.0	.55	.51	.54	+.042	+.578	+.012
	Post Relaxation	51	96.7	10.5	76.0	120.0	.58	.53	.57	+.004	+.279	+.001
	Pre Mental Load	51	100.7	9.6	86.0	130.0	.55	.49	.47	+.049	+.003	+.001
	Laboratory Mean	51	99.5	9.0	87.0	124.0	.61	.60	.53	+.005	+.008	+.001
Task Level	Cold Pressor	51	106.1	10.2	89.0	137.0	.65	.54	.52	+.012	+.034	+.001
	Mental Load	51	104.3	10.4	87.0	132.0	.49	.59	.41	+.093	+.029	+.002
	Stair Climbing	51	96.5	11.2	71.0	123.0	.49	.56	.42	+.005	+.015	+.001
Daytime	Mean	51	105.2	9.1	87.2	129.8	.81	.57	.60	+.003	-.427	+.262

Day 3		N	Mean	SD	Minimum	Maximum	Correlation Day 1-2	Correlation Day 2-3	Correlation Day 1-3	Trend Day 1-2	Trend Day 2-3	Trend Day 1-3
						Heart Rate						
Sleep	Minimum	50	59.7	9.7	40.1	85.9	.81	.46	.69	-.619	-.298	-.042
	Mean	50	63.5	10.0	45.0	89.4	.91	.70	.79	+.931	-.195	-.071
	Mean 2 Hour	44	62.6	9.7	43.0	89.3	.78	.58	.74	+.840	-.221	-.087
Resting	Pre Cold Pressor	49	73.0	12.5	45.5	100.5	.81	.55	.50	-.800	-.586	-.464
	Pre Relaxation	51	69.0	10.9	49.5	96.5	.86	.54	.55	+.738	-.271	-.342
	Post Relaxation	51	67.6	9.8	49.5	90.5	.83	.64	.61	-.486	-.603	-.340
	Pre Mental Load	51	73.4	11.1	41.5	96.5	.82	.55	.47	-.675	-.355	-.237
	Laboratory Mean	51	71.3	10.6	45.5	94.7	.87	.61	.55	-.527	-.522	-.360
Task Level	Cold Pressor	51	73.4	11.5	47.5	102.0	.81	.58	.49	+.489	-.580	-.869
	Mental Load	51	76.1	12.0	46.0	102.0	.85	.67	.49	+.915	-.151	-.269
	Stair Climbing	51	95.9	24.0	45.5	134.0	.91	.20	.19	+.605	-.625	-.617
Daytime	Mean	51	78.0	12.8	51.9	108.4	.90	.42	.45	+.808	+.909	+.855

Note: P-values of trend are positive if the first mean is greater than the second, and negative if the first mean is smaller than the second, respectively.

Appendix B: Tests for Initial Value Dependencies and Weights of the True Differences in Blood Pressure and Heart Rate Concerning Sleep Baselines and Resting Baselines

	Model case 3		Model case 1		Model case 4		Model case 1a		Model case 4a	
	b	g	b	g	b	g	b	g	b	g
					Total Mean Entire Night					
					Cold Pressor Test					
SBP	1.07	0.43	0.55 –	0.84	0.67	0.69	1.04	0.45	0.89	0.52
DBP	0.89	0.25	0.25 ––	0.88	0.32 ––	0.69	0.97	0.23	0.84	0.27
HR	1.42	0.52	0.81	0.91	0.99	0.75	1.25 +	0.59	1.17	0.63
					Mental Concentration Task					
SBP	0.68	0.53	0.43 ––	0.83	0.49 ––	0.73	0.81	0.44	0.68 ––	0.53
DBP	0.82	0.29	0.27 ––	0.88	0.31 ––	0.77	0.94	0.25	0.73 –	0.33
HR	1.64 ++	0.60	1.07	0.91	1.26	0.77	1.45 ++	0.67	1.37 ++	0.72
					Climbing Stairs					
SBP	4.61 ++	0.06	0.35 –	0.78	0.71	0.38	1.59 ++	0.17	1.38 +	0.20
DBP	8.00	0.00	0.04 ––	0.88	0.04 ––	0.79	1.13	0.03	0.79	0.04
HR	6.95 ++	0.13	1.01	0.91	2.73	0.34	2.81 ++	0.33	2.70 ++	0.34
					Mean of Entire Day					
SBP	0.69 –	0.75	0.61 ––	0.84	0.78	0.66	0.72 ––	0.71	0.78 –	0.66
DBP	0.51 ––	0.67	0.38 ––	0.88	0.57 –	0.59	0.66 ––	0.51	0.69 ––	0.49
HR	1.55 ++	0.59	1.01	0.91	1.35	0.68	1.38 ++	0.66	1.35 ++	0.68
					Sleep Minimum					
					Cold Pressor Test					
SBP	1.44	0.34	0.71	0.69	1.04	0.47	1.24	0.39	1.12	0.44
DBP	0.41	0.44	0.27 ––	0.66	0.77	0.24	0.67 ––	0.27	0.79	0.23
HR	1.51	0.46	0.86	0.81	1.28	0.55	1.31 +	0.53	1.26	0.55
					Mental Concentration Task					
SBP	0.90	0.51	0.68	0.67	0.79	0.58	0.93	0.50	0.84	0.54
DBP	0.48	0.52	0.39 ––	0.65	0.56	0.45	0.62 ––	0.41	0.69 ––	0.37
HR	1.74 ++	0.54	1.16	0.81	1.54 +	0.61	1.53 ++	0.61	1.48 ++	0.64
					Climbing Stairs					
SBP	5.25 ++	0.06	0.48	0.63	2.17	0.14	1.86 ++	0.16	1.66 ++	0.18
DBP	-0.04 ––	0.18	-0.01 ––	0.66	80.37	0.00	0.86	-0.01	0.74 –	-0.01
HR	6.13 ++	0.18	1.37	0.81	4.49 ++	0.25	3.03 ++	0.37	2.93 ++	0.38
					Mean of Entire Day					
SBP	0.81	0.66	0.77	0.69	1.08	0.49	0.82	0.65	0.97	0.54
DBP	0.31 ––	0.73	0.34 ––	0.66	0.92	0.24	1.00	0.22	0.65 ––	0.34
HR	1.59 ++	0.60	1.17	0.81	1.62 ++	0.59	1.46 ++	0.65	1.47 ++	0.65
					Sleep Mean of Last Two Hours					
					Cold Pressor Test					
SBP	1.25	0.38	0.82	0.58	1.23	0.39	1.17	0.41	1.16	0.41
DBP	0.41 –	0.56	0.35 ––	0.67	0.69	0.34	0.55 ––	0.42	0.72 –	0.32
HR	1.61 +	0.50	1.02	0.79	1.41	0.57	1.42 ++	0.57	1.37 ++	0.59
					Mental Concentration Task					
SBP	0.76	0.45	0.59	0.57	0.82	0.41	0.82	0.41	0.86	0.40
DBP	0.40 –	0.61	0.37 ––	0.66	0.50	0.49	0.48 ––	0.51	0.61 ––	0.40
HR	1.87 ++	0.55	1.34	0.78	1.70 ++	0.61	1.67 ++	0.62	1.62 ++	0.64
					Climbing Stairs					
SBP	3.58 +	0.09	0.60	0.53	2.48	0.13	1.72 ++	0.18	1.60 ++	0.20
DBP	0.17	0.36	0.09 ––	0.68	0.14	0.43	0.70 –	0.09	0.65 ––	0.09
HR	8.34 ++	0.11	1.17	0.78	6.01 ++	0.15	3.25 ++	0.28	3.14 ++	0.29
					Mean of Entire Day					
SBP	0.69	0.63	0.75	0.58	1.21	0.36	0.66 ––	0.66	1.00	0.44
DBP	0.32 ––	0.82	0.39 ––	0.67	0.69	0.38	1.00	0.26	0.57 ––	0.46
HR	1.73 ++	0.57	1.25	0.79	1.77 ++	0.56	1.56 ++	0.63	1.57 ++	0.62

	Model case 3 b	Model case 3 g	Model case 1 b	Model case 1 g	Model case 4 b	Model case 4 g	Model case 1a b	Model case 1a g	Model case 4a b	Model case 4a g
Minute of Minimum Heart Rate										
Cold Pressor Test										
SBP	1.16	0.41	1.02	0.47	1.32	0.36	1.14	0.42	1.24	0.39
DBP	0.36	0.43	0.39	0.40	1.86	0.08	0.28 --	0.56	1.01	0.16
Mental Concentration Task										
SBP	0.66	0.45	0.57	0.52	0.86	0.35	0.71 --	0.42	0.86	0.35
DBP	0.37	0.44	0.43	0.38	1.18	0.14	0.11 --	1.45	0.91	0.18
Climbing Stairs										
SBP	4.82 +	0.05	0.67	0.34	4.73 +	0.05	2.02 ++	0.11	2.01 ++	0.11
DBP	-0.56 --	0.27	-0.26 --	0.58	2.34	-0.06	0.83	-0.18	0.79	-0.19
Mean of Entire Day										
SBP	0.69 -	0.71	1.04	0.47	1.07	0.46	0.45 --	1.09	1.06	0.46
DBP	0.35 --	0.76	0.66	0.40	0.98	0.27	1.00	0.26	0.82	0.32
Initial Rest Laboratory (Before Cold Pressor)										
Cold Pressor Test										
SBP	1.38 +	0.61	1.60 ++	0.53	1.33	0.63	1.44 ++	0.59	1.37 ++	0.61
DBP	1.15	0.75	1.44 ++	0.60	1.16	0.75	1.20 +	0.72	1.22 +	0.71
HR	1.00	0.92	1.09	0.85	1.00	0.92	1.00	0.92	1.00	0.92
Mental Concentration Task										
SBP	1.05	0.76	1.34 ++	0.59	1.06	0.75	1.07	0.75	1.11	0.72
DBP	1.20	0.66	1.43 +	0.55	1.13	0.70	1.24 +	0.64	1.13	0.70
HR	1.14	0.89	1.23 ++	0.82	1.14	0.89	1.15 +	0.88	1.15 +	0.88
Climbing Stairs										
SBP	2.34 ++	0.38	1.74 +	0.51	2.00 ++	0.45	2.08 ++	0.43	1.92 ++	0.47
DBP	2.02 +	0.26	1.01	0.53	1.23	0.43	1.59 ++	0.33	1.27	0.42
HR	3.36 ++	0.37	1.53 +	0.81	2.86 ++	0.44	2.39 ++	0.52	2.33 ++	0.54
Mean of Entire Day										
SBP	0.90	0.67	1.15	0.53	1.19	0.51	0.87	0.70	1.18	0.52
DBP	0.74	0.72	0.97	0.55	1.04	0.51	0.64 --	0.83	1.01	0.53
HR	1.13	0.73	1.01	0.81	1.22	0.67	1.11	0.74	1.15	0.71
Relaxation										
Cold Pressor Test										
SBP	1.54 +	0.55	2.02 ++	0.42	1.50 +	0.56	1.68 ++	0.50	1.63 ++	0.52
DBP	1.12	0.70	1.22	0.65	1.09	0.72	1.14	0.70	1.10	0.72
HR	1.00	0.84	1.00	0.84	0.98	0.85	1.00	0.84	0.98	0.85
Mental Concentration Task										
SBP	1.15	0.59	1.76 ++	0.38	1.18	0.57	1.22	0.55	1.28 +	0.53
DBP	1.10	0.68	1.16	0.65	1.01	0.74	1.11	0.68	0.98	0.77
HR	1.14	0.84	1.13	0.85	1.12	0.86	1.14	0.84	1.12	0.86
Climbing Stairs										
SBP	3.79 ++	0.15	1.58	0.37	3.17 ++	0.19	2.56 ++	0.23	2.40 ++	0.24
DBP	1.83	0.27	0.74	0.67	0.90	0.55	1.40 ++	0.35	1.07	0.46
HR	3.53 ++	0.33	1.38	0.84	2.81 ++	0.41	2.34 ++	0.49	2.27 ++	1.51
Mean of Entire Day										
SBP	0.99	0.50	1.20	0.42	1.60 +	0.31	0.99	0.51	1.41 ++	0.35
DBP	0.74	0.72	0.83	0.65	0.99	0.54	0.70 --	0.76	0.93	0.57
HR	1.12	0.70	0.94	0.84	1.21	0.65	1.10	0.71	1.13	0.69

Remarks: Abbreviations see Table 1.
Session 1 with session 2 as replication.
– negative IVD p<.05; –– negative IVD p<.01; + positive IVD p<.05; ++ positive IVD p<.01.
b slope of the structural relationship model; w weight of the true difference derived from the model.

Appendix C: Redundancies Between Nine Baselines from Sleep and Laboratory: Differences in Means and Standard Deviations and Correlation Coefficients.

Baseline 1		Baseline 2		N	Means (1)	Means (2)	p	Stand.Dev. (1)	Stand.Dev. (2)	p	Correl. r	Correl. p
						Systolic Blood Pressure						
Sleep	Minimum	Sleep	Mean	50	107	121	.000	15	17	.026	92	.000
			Mean 2 Hour	50	107	121	.000	15	16	.639	80	.000
			Minimum/HR	50	107	117	.000	15	17	.190	81	.000
		Resting	Pre Cold Pressor	50	107	138	.000	15	14	.616	49	.000
			Pre Relaxation	50	107	138	.000	15	15	.848	61	.000
			Post Relaxation	50	107	133	.000	15	13	.280	58	.000
			Pre Mental Load	47	107	141	.000	15	15	.731	52	.000
			Laboratory Mean	50	107	137	.000	15	12	.081	61	.000
	Mean	Sleep	Mean 2 Hour	50	121	121	.856	17	16	.301	82	.000
			Minimum/HR	50	121	117	.014	17	17	.829	81	.000
		Resting	Pre Cold Pressor	50	121	138	.000	17	14	.138	45	.001
			Pre Relaxation	50	121	138	.000	17	15	.220	58	.000
			Post Relaxation	50	121	133	.000	17	13	.042	50	.000
			Pre Mental Load	47	122	141	.000	17	15	.228	45	.001
			Laboratory Mean	50	121	137	.000	17	12	.008	55	.000
	Mean 2 Hour	Sleep	Minimum/HR	50	121	117	.035	16	17	.478	75	.000
		Resting	Pre Cold Pressor	50	121	138	.000	16	14	.436	38	.005
			Pre Relaxation	50	121	138	.000	16	15	.632	54	.000
			Post Relaxation	50	121	133	.000	16	13	.182	48	.000
			Pre Mental Load	47	122	141	.000	16	15	.576	37	.009
			Laboratory Mean	50	121	137	.000	16	12	.057	48	.000
	Minimum/HR	Resting	Pre Cold Pressor	50	117	138	.000	17	14	.180	43	.001
			Pre Relaxation	50	117	138	.000	17	15	.296	53	.000
			Post Relaxation	50	117	133	.000	17	13	.063	46	.001
			Pre Mental Load	47	118	141	.000	17	15	.308	45	.001
			Laboratory Mean	50	117	137	.000	17	12	.013	52	.000
Resting	Pre Cold Pressor	Resting	Pre Relaxation	51	138	138	.918	14	15	.621	77	.000
			Post Relaxation	51	138	133	.008	14	13	.590	64	.000
			Pre Mental Load	48	138	141	.114	14	14	.695	66	.000
			Laboratory Mean	51	138	137	.457	14	12	.041	88	.000
	Pre Relaxation	Resting	Post Relaxation	51	138	133	.000	15	13	.201	81	.000
			Pre Mental Load	48	138	141	.101	15	14	.769	70	.000
			Laboratory Mean	51	138	137	.466	15	12	.010	87	.000
	Post Relaxation	Resting	Pre Mental Load	48	134	141	.000	13	14	.452	60	.000
			Laboratory Mean	51	133	137	.000	13	12	.317	85	.000
	Pre Mental Load	Resting	Laboratory Mean	48	141	138	.002	14	12	.012	87	.000

Baseline 1		Baseline 2		N	Means (1)	Means (2)	p	Stand.Dev. (1)	Stand.Dev. (2)	p	Correl. r	Correl. p
						Diastolic Blood Pressure						
Sleep	Minimum	Sleep	Mean	50	65	76	.000	11	9	.018	82	.000
			Mean 2 Hour	50	65	77	.000	11	12	.308	78	.000
			Minimum/HR	50	65	75	.000	11	11	.881	68	.000
		Resting	Pre Cold Pressor	50	65	92	.000	11	8	.020	28	.041
			Pre Relaxation	50	65	86	.000	11	9	.115	30	.030
			Post Relaxation	50	65	86	.000	11	8	.027	25	.065
			Pre Mental Load	47	65	91	.000	11	8	.016	35	.014
			Laboratory Mean	50	65	89	.000	11	7	.002	33	.015
	Mean	Sleep	Mean 2 Hour	50	76	77	.413	9	12	.000	90	.000
			Minimum/HR	50	76	75	.388	9	11	.051	66	.000
		Resting	Pre Cold Pressor	50	76	92	.000	9	8	.358	36	.009
			Pre Relaxation	50	76	86	.000	9	9	.863	39	.004
			Post Relaxation	50	76	86	.000	9	8	.417	36	.008
			Pre Mental Load	47	76	91	.000	9	8	.276	37	.009
			Laboratory Mean	50	76	89	.000	9	7	.090	41	.002
	Mean 2 Hour	Sleep	Minimum/HR	50	77	75	.238	12	11	.473	63	.000
		Resting	Pre Cold Pressor	50	77	92	.000	12	8	.002	35	.011
			Pre Relaxation	50	77	86	.000	12	9	.021	38	.005
			Post Relaxation	50	77	86	.000	12	8	.003	40	.003
			Pre Mental Load	47	77	91	.000	12	8	.000	44	.001
			Laboratory Mean	50	77	89	.000	12	7	.000	44	.001
	Minimum/HR	Resting	Pre Cold Pressor	50	75	92	.000	11	8	.016	27	.053
			Pre Relaxation	50	75	86	.000	11	9	.096	32	.021
			Post Relaxation	50	75	86	.000	11	8	.020	30	.031
			Pre Mental Load	47	75	91	.000	11	8	.014	34	.016
			Laboratory Mean	50	75	89	.000	11	7	.002	34	.013
Resting	Pre Cold Pressor	Resting	Pre Relaxation	51	92	85	.000	8	9	.245	70	.000
			Post Relaxation	51	92	86	.000	8	8	.836	75	.000
			Pre Mental Load	48	92	91	.306	8	7	.878	75	.000
			Laboratory Mean	51	92	89	.000	8	7	.080	92	.000
	Pre Relaxation	Resting	Post Relaxation	51	85	86	.746	9	8	.205	82	.000
			Pre Mental Load	48	86	91	.000	9	7	.248	63	.000
			Laboratory Mean	51	85	89	.000	9	7	.012	80	.000
	Post Relaxation	Resting	Pre Mental Load	48	86	91	.000	8	7	.514	71	.000
			Laboratory Mean	51	86	89	.000	8	7	.065	90	.000
	Pre Mental Load	Resting	Laboratory Mean	48	91	89	.004	7	7	.296	90	.000

Baseline 1		Baseline 2		N	Means (1)	Means (2)	Means p	Stand.Dev. (1)	Stand.Dev. (2)	Stand.Dev. p	Correl. r	Correl. p
					Mean Blood Pressure							
Sleep	Minimum	Sleep	Mean	50	80	91	.000	11	11	.257	88	.000
			Mean 2 Hour	50	80	91	.000	11	12	.444	83	.000
			Minimum/HR	50	80	89	.000	11	11	.688	74	.000
		Resting	Pre Cold Pressor	50	80	107	.000	11	9	.046	33	.015
			Pre Relaxation	50	80	103	.000	11	9	.176	42	.002
			Post Relaxation	50	80	101	.000	11	8	.020	40	.004
			Pre Mental Load	47	80	107	.000	11	8	.009	47	.001
			Laboratory Mean	50	80	105	.000	11	7	.002	45	.001
	Mean	Sleep	Mean 2 Hour	50	91	91	.656	11	12	.042	88	.000
			Minimum/HR	50	91	89	.090	11	11	.716	72	.000
		Resting	Pre Cold Pressor	50	91	107	.000	11	9	.150	33	.016
			Pre Relaxation	50	91	103	.000	11	9	.437	45	.001
			Post Relaxation	50	91	101	.000	11	8	.076	41	.003
			Pre Mental Load	47	91	107	.000	10	8	.043	41	.004
			Laboratory Mean	50	91	105	.000	11	7	.011	44	.001
	Mean 2 Hour	Sleep	Minimum/HR	50	91	89	.075	12	11	.334	70	.000
		Resting	Pre Cold Pressor	50	91	107	.000	12	9	.014	35	.011
			Pre Relaxation	50	91	103	.000	12	9	.061	46	.000
			Post Relaxation	50	91	101	.000	12	8	.004	48	.000
			Pre Mental Load	47	91	107	.000	12	8	.001	46	.001
			Laboratory Mean	50	91	105	.000	12	7	.000	49	.000
	Minimum/HR	Resting	Pre Cold Pressor	50	89	107	.000	11	9	.098	22	.108
			Pre Relaxation	50	89	103	.000	11	9	.306	37	.006
			Post Relaxation	50	89	101	.000	11	8	.046	35	.010
			Pre Mental Load	47	89	107	.000	11	8	.034	38	.007
			Laboratory Mean	50	89	105	.000	11	7	.007	37	.007
Resting	Pre Cold Pressor	Resting	Pre Relaxation	51	107	102	.000	8	9	.319	73	.000
			Post Relaxation	51	107	101	.000	8	8	.739	71	.000
			Pre Mental Load	48	107	107	.693	8	8	.617	73	.000
			Laboratory Mean	51	107	105	.001	8	7	.021	91	.000
	Pre Relaxation	Resting	Post Relaxation	51	102	101	.080	9	8	.096	83	.000
			Pre Mental Load	48	103	107	.000	9	8	.107	68	.000
			Laboratory Mean	51	102	105	.002	9	7	.003	84	.000
	Post Relaxation	Resting	Pre Mental Load	48	101	107	.000	8	8	.601	66	.000
			Laboratory Mean	51	101	105	.000	8	7	.128	88	.000
	Pre Mental Load	Resting	Laboratory Mean	48	107	105	.000	8	7	.291	88	.000

Baseline 1		Baseline 2		N	Means (1)	Means (2)	Means p	Stand.Dev. (1)	Stand.Dev. (2)	Stand.Dev. p	Correl. r	Correl. p
						Heart Rate						
Sleep	Minimum	Sleep	Mean	50	57	61	.000	7	8	.590	92	.000
			Mean 2 Hour	50	57	60	.000	7	7	.528	92	.000
		Resting	Pre Cold Pressor	50	57	71	.000	7	9	.074	59	.000
			Pre Relaxation	50	57	67	.000	7	10	.032	60	.000
			Post Relaxation	50	57	66	.000	7	9	.058	62	.000
			Pre Mental Load	47	57	72	.000	7	10	.009	65	.000
			Laboratory Mean	50	57	70	.000	7	9	.085	65	.000
	Mean	Sleep	Mean 2 Hour	50	61	60	.017	8	7	.139	95	.000
		Resting	Pre Cold Pressor	50	61	71	.000	8	9	.100	67	.000
			Pre Relaxation	50	61	67	.000	8	10	.043	67	.000
			Post Relaxation	50	61	66	.000	8	9	.079	68	.000
			Pre Mental Load	47	62	72	.000	8	10	.017	67	.000
			Laboratory Mean	50	61	70	.000	8	9	.123	70	.000
	Mean 2 Hour	Resting	Pre Cold Pressor	50	60	71	.000	7	9	.027	65	.000
			Pre Relaxation	50	60	67	.000	7	10	.011	64	.000
			Post Relaxation	50	60	66	.000	7	9	.021	66	.000
			Pre Mental Load	47	61	72	.000	7	10	.002	68	.000
			Laboratory Mean	50	60	70	.000	7	9	.031	70	.000
Resting	Pre Cold Pressor	Resting	Pre Relaxation	51	71	67	.000	9	10	.642	83	.000
			Post Relaxation	51	71	66	.000	9	9	.885	88	.000
			Pre Mental Load	48	72	72	.999	9	10	.400	87	.000
			Laboratory Mean	51	71	70	.000	9	9	.547	96	.000
	Pre Relaxation	Resting	Post Relaxation	51	67	66	.024	10	9	.592	91	.000
			Pre Mental Load	48	68	72	.000	10	10	.605	77	.000
			Laboratory Mean	51	67	70	.001	10	9	.372	88	.000
	Post Relaxation	Resting	Pre Mental Load	48	66	72	.000	9	10	.486	82	.000
			Laboratory Mean	51	66	70	.000	9	9	.527	94	.000
	Pre Mental Load	Resting	Laboratory Mean	48	72	70	.000	10	9	.064	94	.000

Note: Rounding of numbers may lead to slight deviations across tables.

Appendix D1: Questionnaire of Health, Condition, Sleep, and Habit of Living (Administered Before Day 1 and 3): Number of Valid Subjects, Mean, Standard Deviation, Minimum, Maximum, Trend of Means and Standard Deviations between Days (p-Level), Stabilities between Days (Correlation Coefficient r and p-Level).

Day 1	N	Mean	SD	Minimum	Maximum	Trend Means Day13	Trend SDs Day13	Stability Day13	
Variable						p	p	r	p
Tired in the morning	51	2.92	1.64	1.00	5.00	.676	.256	.41	.002
Low fitness	51	3.16	1.60	1.00	5.00	.000	.076	.51	.000
Easily exhausted	50	3.14	1.62	1.00	5.00	.017	.444	.72	.000
Dizziness in the morning	51	2.14	1.30	1.00	5.00	.051	.533	.53	.000
Dazed feeling	51	1.98	1.38	1.00	5.00	.647	.800	.38	.004
Headaches	51	1.69	1.10	1.00	5.00	.622	.775	.70	.000
Loss of appetite	51	1.41	0.98	1.00	5.00	.656	.876	.56	.000
Susceptible to the weather	51	2.45	1.50	1.00	5.00	.874	.794	.68	.000
Arrhythmias	50	2.06	1.53	1.00	5.00	.149	.038	.44	.001
Intermittent heartbeats	51	1.45	1.12	1.00	5.00	.323	.012	.78	.000
Congestions	51	2.20	1.51	1.00	5.00	.010	.220	.69	.000
Tension in the chest	51	1.82	1.31	1.00	5.00	.370	.280	.62	.000
Pains in the chest	50	1.96	1.37	1.00	5.00	.005	.000	.84	.000
Palpitations Climbing Stairs	51	3.08	1.67	1.00	5.00	.006	.754	.65	.000
Breathlessness Climbing Stairs	51	2.65	1.81	1.00	5.00	.071	.506	.48	.000
Narrowness in breast	51	1.73	1.28	1.00	5.00	.043	.220	.73	.000
State of health	46	2.72	0.58	2.00	4.00	.059	.024	.21	.163
Health concern	51	3.43	0.90	1.00	5.00	.352	.704	.29	.031
Job strain	51	2.31	1.35	1.00	5.00	.583	.538	.71	.000
Stressful activities	51	2.35	1.29	1.00	5.00	.871	.681	.58	.000
Content with job	51	3.82	1.13	1.00	5.00	.656	.439	.63	.000
Well-being	51	3.51	0.97	2.00	5.00	.204	.387	.43	.001
Nervous	51	2.08	1.13	1.00	5.00	.002	.000	.43	.001
Significant events	51	1.86	0.35	1.00	2.00	.709	.669	.45	.001
Number of sign. events	51	0.10	0.30	0.00	1.00	.302	.000	.20	.150
Smoking	51	1.86	0.35	1.00	2.00	.323	.256	.91	.000
Number of cigarettes	51	0.82	2.52	0.00	13.00	.583	.772	.92	.000
Coffee	51	1.22	0.42	1.00	2.00	.425	.502	.63	.000
Cups of coffee	51	1.82	1.44	0.00	6.00	.386	.527	.58	.000
Hours of sleep (last night)	51	6.65	1.88	0.00	12.00	.369	.000	.46	.000
Hours of sleep (usually)	51	7.08	1.44	4.00	10.00	.860	.854	.75	.000
Interruptions of sleep (last night)	51	2.08	2.34	0.00	15.00	.266	.000	.72	.000
Interruptions of sleep (usually)	51	1.96	1.93	0.00	10.00	.379	.362	.77	.000
FBL-Scale General Condition	51	18.86	7.38	8.00	35.00	.022	.701	.71	.000
FBL-Scale Cardiovascular Condition	50	16.96	8.21	8.00	38.00	.004	.388	.75	.000
Duration of sleep (difference)	51	-0.43	1.64	-8.00	4.00	.362	.000	.06	.660
Interruptions of sleep (difference)	51	0.12	1.62	-7.00	5.00	.100	.000	.12	.386

Day 3 Variable	N	Mean	SD	Mini- mum	Maxi- mum	Trend Means Day13 p	Trend SDs Day13 p	Stability Day13 r	 p
Tired in the morning	51	2.82	1.41	1.00	5.00	.676	.256	.41	.002
Low fitness	51	2.33	1.29	1.00	5.00	.000	.076	.51	.000
Easily exhausted	51	2.71	1.50	1.00	5.00	.017	.444	.72	.000
Dizziness in the morning	51	1.80	1.20	1.00	5.00	.051	.533	.53	.000
Dazed feeling	51	1.88	1.34	1.00	5.00	.647	.800	.38	.004
Headaches	51	1.75	1.07	1.00	5.00	.622	.775	.70	.000
Loss of appetite	51	1.35	1.00	1.00	5.00	.656	.876	.56	.000
Susceptible to the weather	51	2.43	1.54	1.00	5.00	.874	.794	.68	.000
Arrhythmias	51	1.75	1.16	1.00	5.00	.149	.038	.44	.001
Intermittent Heartbeats	51	1.35	0.89	1.00	5.00	.323	.012	.78	.000
Congestions	51	1.78	1.33	1.00	5.00	.010	.220	.69	.000
Tension in the chest	51	1.69	1.16	1.00	5.00	.370	.280	.62	.000
Pains in the chest	50	1.68	0.96	1.00	4.00	.005	.000	.84	.000
Palpitations Climbing Stairs	51	2.53	1.62	1.00	5.00	.006	.754	.65	.000
Breathlessness Climbing Stairs	51	2.20	1.66	1.00	5.00	.071	.506	.48	.000
Narrowness in breast	51	1.47	1.14	1.00	5.00	.043	.220	.73	.000
State of health	48	2.94	0.76	1.00	5.00	.059	.024	.21	.163
Health concern	51	3.57	0.85	1.00	5.00	.352	.704	.29	.031
Job strain	51	2.39	1.27	1.00	5.00	.583	.538	.71	.000
Stressful activities	51	2.37	1.23	1.00	5.00	.871	.681	.58	.000
Content with job	51	3.88	1.03	1.00	5.00	.656	.439	.63	.000
Well-being	51	3.71	1.08	1.00	5.00	.204	.387	.43	.001
Nervous	50	1.62	0.70	1.00	5.00	.002	.000	.43	.001
Significant events	51	1.84	0.37	1.00	2.00	.709	.669	.45	.001
Number of sign. events	51	0.20	0.66	0.00	4.00	.302	.000	.20	.150
Smoking	51	1.88	0.33	1.00	2.00	.323	.256	.91	.000
Number of cigarettes	51	0.75	2.48	0.00	15.00	.583	.772	.92	.000
Coffee	51	1.18	0.39	1.00	2.00	.425	.502	.63	.000
Cups of coffee	51	1.98	1.33	0.00	5.00	.386	.527	.58	.000
Hours of sleep (last night)	51	6.86	1.17	3.00	9.00	.369	.000	.46	.000
Hours of sleep (usually)	51	7.06	1.42	2.00	10.00	.860	.854	.75	.000
Interruptions of sleep (last night)	51	1.82	1.55	0.00	9.00	.266	.000	.72	.000
Interruptions of sleep (usually)	51	2.12	1.77	0.00	10.00	.379	.362	.77	.000
FBL-Scale General Condition	51	17.08	7.10	8.00	33.00	.022	.701	.71	.000
FBL-Scale Cardiovascular Condition	51	14.49	7.50	8.00	37.00	.004	.388	.75	.000
Hours of sleep (difference)	51	-0.20	0.89	-3.00	2.00	.362	.000	.06	.660
Interruptions of sleep (difference)	51	-0.29	0.97	-3.00	3.00	.100	.000	.12	.386

Note: FBL=Freiburger Beschwerde Liste

Variables for Appendix D1

Tired in the morning	Nach dem Aufstehen müde?
Low fitness	Körperliches Leistungsvermögen verringert?
Easily exhausted	Ermüden Sie schnell?
Dizziness in the morning	Schwindlig beim Aufstehen?
Dazed feeling	Fühlen Sie sich benommen?
Headaches	Haben Sie Kopfschmerzen?
Loss of appetite	Haben Sie Appetitmangel?
Susceptible to the weather	Reagiert Ihr Körper auf Wetterveränderungen?
Arrhythmias	Schlägt Ihr Herz unregelmäßig?
Intermittent Heartbeats	Haben Sie das Gefühl, Ihr Herz setzt aus?
Congestions	Haben Sie Blutandrang zum Kopf?
Tension in the chest	Schwere in der Herzgegend?
Pains in the chest	Haben Sie Herzschmerzen?
Palpitations Climbing Stairs	Herzklopfen beim Treppensteigen?
Breathlessness Climbing Stairs	Atemnot beim Treppensteigen?
Narrowness in breast	Gefühl erstickender Enge in der Brust?
State of health	Wie ist Ihr Gesundheitszustand?
Health concern	Sind Sie optimistisch Ihre Gesundheit betreffend?
Job strain	Ist Ihr Beruf belastend für Sie?
Stressful activities	Belastung durch andere Tätigkeiten?
Content with job	Sind Sie zufrieden mit Ihrem Beruf?
Well-being	Fühlen Sie sich heute wohl?
Nervous	Sind Sie nervös?
Significant events	Gab es besondere Ereignisse?
Number of sign. events	Anzahl besonderer Ereignisse
Smoking	Haben Sie heute schon geraucht?
Number of cigarettes	Anzahl der Zigaretten
Coffee	Haben Sie heute schon Kaffee getrunken?
Cups of coffee	Anzahl Tassen Kaffee
Hours of sleep (last night)	Stunden Schlaf letzte Nacht
Hours of sleep (usually)	Stunden Schlaf gewöhnlich
Interruptions of sleep (last night)	Anzahl Aufwachen letzte Nacht
Interruptions of sleep (usually)	Anzahl Aufwachen gewöhnlich
FBL-Scale General Condition	FBL-Skala Allgemeinbefinden
FBL-Scale Cardiovascular Condition	FBL-Skala Herz-Kreislauf
Hours of sleep (difference)	Stunden Schlaf zu wenig oder viel
Interruptions of sleep (difference)	Anzahl Aufwachen zu wenig oder viel

Appendix D2: Questionnaire of Health, Condition, Sleep, and Habit of Living (Administered After Day 1, 2, and 3): Number of Valid Subjects, Mean, Standard Deviation, Minimum, Maximum, Trend of Means and Standard Deviations between Days (p-Level), Stabilities between Days (Correlation Coefficient r and p-Level).

Day 1 Variable	N	Mean	SD	Mini-mum	Maxi-mum	Trend Means Day12 p	Trend SDs Day12 p	Stability Day12 r	 p
Interesting Experiment	50	3.36	0.92	2.00	5.00	.013	.762	.46	.001
Unpleasant Experiment	51	1.82	0.77	1.00	3.00	.544	.936	.61	.000
Unpleasant Blood Pressure	50	2.40	0.90	1.00	5.00	.444	.326	.71	.000
Unpleasant Self-Ratings	51	1.63	0.77	1.00	4.00	.589	.729	.53	.000
Too Much Measures (Day)	51	2.00	1.02	1.00	5.00	.113	.729	.75	.000
Too Much Measures (Night)	51	1.73	1.02	1.00	5.00	.136	.267	.62	.000
Slept Well Last Night	51	2.82	1.34	1.00	5.00	.015	.266	.25	.072
Troubled Sleep by Experiment	51	2.31	1.09	1.00	5.00	.010	.001	.18	.189
Feeling Well	51	3.82	1.01	2.00	5.00	.091	.445	.71	.000
Smoked	51	1.86	0.35	1.00	2.00	.999	.999	.83	.000
Number of Cigarets	51	0.47	1.57	0.00	9.00	.098	.000	.85	.000
Coffee	51	1.20	0.40	1.00	2.00	.999	.999	.87	.000
Number of Cups of Coffee	51	1.92	1.23	0.00	4.00	.011	.000	.85	.000
Hours of Sleep Last Night	51	5.37	2.37	0.00	9.00	.000	.000	.36	.008
Hours of Sleep Usually	51	7.06	1.65	0.00	10.00	.218	.007	.83	.000
Sleep Interrupts Last Night	51	3.63	2.76	0.00	16.00	.006	.000	.63	.000
Sleep Interrupts Usually	51	1.71	1.75	0.00	10.00	.005	.828	.91	.000
Hours of Sleep (Difference)	51	-1.69	1.98	-7.00	1.00	.001	.002	.27	.045
Sleep Interrupts (Difference)	51	1.92	2.07	-2.00	8.00	.000	.009	.24	.080

Day 2 Variable	N	Mean	SD	Mini-mum	Maxi-mum	Trend Means Day23 p	Trend SDs Day23 p	Stability Day23 r	 p
Interesting Experiment	51	3.73	0.90	2.00	5.00	.744	.439	.48	.000
Unpleasant Experiment	50	1.88	0.77	1.00	4.00	.013	.016	.43	.001
Unpleasant Blood Pressure	51	2.31	0.99	1.00	5.00	.999	.104	.52	.000
Unpleasant Self-Ratings	51	1.57	0.81	1.00	4.00	.560	.408	.58	.000
Too Much Measures (Day)	51	1.84	0.99	1.00	5.00	.198	.404	.46	.000
Too Much Measures (Night)	51	1.55	0.90	1.00	5.00	.732	.521	.55	.000
Slept Well Last Night	51	3.35	1.15	1.00	5.00	.017	.048	.37	.006
Troubled Sleep by Experiment	51	1.88	0.68	1.00	5.00	.226	.005	.30	.030
Feeling Well	51	4.00	0.94	2.00	5.00	.019	.079	.51	.000
Habituation on Experiment	49	3.39	1.11	1.00	5.00	.075	.682	.45	.001
Smoked	51	1.86	0.35	1.00	2.00	.662	.080	.67	.000
Number of Cigarets	51	0.84	2.72	0.00	15.00	.226	.000	.93	.000
Coffee	51	1.20	0.40	1.00	2.00	.575	.669	.82	.000
Number of Cups of Coffee	51	2.24	1.63	0.00	6.00	.117	.108	.61	.000
Hours of Sleep Last Night	51	6.55	1.40	3.00	9.00	.002	.008	.59	.000
Hours of Sleep Usually	51	7.22	1.33	4.00	10.00	.055	.842	.90	.000
Sleep Interrupts Last Night	51	2.78	1.78	0.00	10.00	.119	.005	.57	.000
Sleep Interrupts Usually	51	2.00	1.77	0.00	10.00	.558	.711	.85	.000
Hours of Sleep (Difference)	51	-0.67	1.29	-6.00	2.00	.022	.036	.38	.005
Sleep Interrupts (Difference)	51	0.78	1.43	-2.00	4.00	.069	.000	.51	.000

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