

Confidential

1 **Creating a Measure to Operationalize Engaged Well-Being at Work**

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12 **Abstract**

13 **Background:**

14 Mental well-being and work engagement are both desirable, positive ~~psychological~~ states of  
15 mind that help employees to better function in the workplace. While occupational  
16 researchers have argued in favor of considering both states concurrently, it is less clear how  
17 this might be translated to provide an instrument characterizing the workforce accordingly.  
18 The present study describes empirical efforts to operationalize a construct called engaged  
19 well-being.

20 **Methods:**

21 We used employee-level data (n = 13,538) from three waves of the German linked personnel  
22 panel (LPP; 2012-2017). Exploratory factor analysis and a combination of hierarchical and  
23 non-hierarchical cluster analyses linked with within-sum-of-squares statistics were used to  
24 identify distinct profiles describing mental well-being and work engagement concurrently.  
25 These profiles were then used as the basis to identify cut-offs to create replicable categories  
26 of engaged well-being. Using the longitudinal data from a subgroup providing data across  
27 more than one wave, we observed whether the newly constructed indicator changed over  
28 time.

29 **Results:**

30 The exploratory factor analysis suggested that both states were two distinct factors. Cluster  
31 analysis linked with within-sum-of-squares statistics suggested a four-cluster solution:  
32 engaged well-being (46.9%), disengaged well-being (27.5%), engaged strain (8.8%), and  
33 disengaged strain (16.8%). One cut-off for each state was identified to replicate the cluster  
34 solution. Across observation periods, we could observe changes in engaged well-being.

35 **Conclusions:**

36 Our measure of engaged well-being can be used to simultaneously characterize a  
37 workforce's mental well-being and work engagement. Changes in this measure over time  
38 suggest its potential utility in organizational interventions. Future studies are needed to  
39 further explore both the antecedents, correlates, and potential effects of engaged well-  
40 being.

41 **Keywords:**

42 mental well-being; work engagement; employees; cluster analysis; operationalization

## 43 **Background**

44

45 Occupational research has traditionally focused on reducing factors that cause stress and  
46 might lead to disease and infirmity, but an increasing emphasis on positive organizational  
47 behavior has shifted attention to individuals' strengths and healthy functioning and the  
48 workplace conditions that facilitate them (1-3). Mental well-being and work engagement are  
49 two desirable, positive ~~psychological~~ states of mind that help individuals to better function in  
50 the workplace (4).

51

52 Both mental well-being and work engagement have individually received much attention.  
53 Based on a definition from the World Health Organization (WHO), an individual in a state of  
54 mental well-being "realizes his or her own potential, can cope with the normal stresses of  
55 life, can work productively and fruitfully, and is able to make a contribution to her or his  
56 community" (5). Mental well-being is widely considered to have both hedonic (i.e., feeling  
57 good) and eudaimonic components (i.e., functioning well) (6, 7). Employees with low mental  
58 well-being, for example, are more likely to be less productive and have more days of sick  
59 leave (8). Moreover, in Germany mental disorders have been identified as one of the most  
60 common reasons for days of sick leave (16.6 %) (9) and the most common health-related  
61 reason for early retirement (43%) (10). Work engagement, on the other hand, is commonly  
62 defined as a work-related state of mind that is positive and fulfilling and not focused on a  
63 single object, event, or person (11). It encompasses vigor (e.g., having high levels of energy,  
64 mental resilience, persistence), dedication (e.g., having a sense of significance, enthusiasm,  
65 inspiration, pride, challenge), and absorption (e.g., being fully concentrated and deeply  
66 engrossed, feeling time ~~fly~~ flies by, having difficulty to detach from work) (11). Work  
67 engagement is associated with greater life satisfaction (12, 13), happiness (14), and better  
68 health outcomes (13, 15). Other studies identify associations between work engagement and  
69 greater job satisfaction, better in-role and extra-role job performance, and lower  
70 absenteeism (13, 16-19). Additionally, a meta-analysis has found that work engagement is  
71 related to better business outcomes such as customer satisfaction, productivity, profit,  
72 employee turnover, and accidents (20).

73

74 Occupational researchers have argued in favor of considering both states concurrently (1,  
75 21, 22). **Even though the research listed above indicates that both states are relevant for**  
76 **both employees and employers,** ~~While~~ mental well-being is a state that focuses on life as a  
77 whole and is therefore thought to be particularly important for employees ~~themselves,~~ **while**  
78 the ~~motivational and~~ work-related nature of work engagement makes it especially relevant  
79 to employers (21). Combining the employee perspective on well-being and health with the  
80 employer perspective on productivity has the potential to offer mutual benefit (1). For  
81 example, conceptual work suggests that an indicator characterizing both mental well-being  
82 and work engagement might be a better predictor for the success of organizational  
83 interventions (e.g., coaching) than monetary outcomes such as return of investments (22).  
84 Grant (2012) (22) reasons that when both states are considered simultaneously, they offer a  
85 more direct and holistic view of what most interventions intend to address – that is,  
86 improvements in the behaviour or state of employees that should in the long run lead to  
87 several organizational benefits. Other work suggests that a narrow focus on only one of  
88 these factors in organizational interventions as an intermediate outcome measure will limit  
89 the more distal organizational benefits of said interventions (4). Indeed, their cross-sectional  
90 study indicates that mental well-being and work engagement are related states that  
91 simultaneously better explain variations in a common outcome of interest in organizational  
92 research: employee productivity (4). In general, previous literature and established models  
93 such as the job-demands resources model suggest that in the workplace both health-related  
94 and motivational processes operate to influence not only employees but also organizational  
95 performance indicators (23-25).

96

97 Mental well-being and work engagement are positively associated with one another (26, 27),  
98 however, studies that address both states empirically are relatively sparse (28). Even fewer  
99 studies have argued, how a concurrent consideration can be transformed to provide a single  
100 indicator that characterizes the workforce based on their mental well-being and their work  
101 engagement. Robertson and colleagues, for example, call for the addition of mental well-  
102 being to work engagement to obtain “full engagement” (4, 21, 29). They argue that while  
103 many engagement scales already include items describing well-being, they are not  
104 comprehensive enough to sufficiently capture mental well-being and therefore require a  
105 separate indicator of mental well-being. Full engagement is therefore a combination of being

106 engaged and experiencing high mental well-being (21). However, while the authors establish  
107 that both states are moderately correlated, they do not demonstrate that they are distinct,  
108 even though both show independent associations with productivity (4). Previous work such  
109 as the “well-being and engagement framework”, conceptualizes the presence of a conjoint  
110 construct but, to our knowledge, has resulted in no empirically defined measurements for  
111 the proposed categories (22). This framework, for example, suggests that mental well-being  
112 and work engagement form a two-dimensional space in which the employees can be divided  
113 into four meaningful subgroups (flourishing, acquiescent, distressed but functional,  
114 distressed and disengaged). These subgroups characterize a workforce based on what  
115 combinations of high or low levels of mental health and work engagement employees are  
116 reporting (22, 30, 31). To the best of our knowledge, the extent to which this two-  
117 dimensional room can be separated into four or, indeed, any finite number of categories has  
118 not yet been demonstrated using empirical data. A further knowledge gap is the absence of  
119 evidence that any operational measure for this construct demonstrates change over time:  
120 such evidence would be needed to justify its use as an intermediate outcome in  
121 interventions studies.

122

123 The present study describes empirical efforts to operationalize a construct characterizing a  
124 workforce’s mental well-being and work engagement, which we will refer to as “engaged  
125 well-being”. These efforts will address three aims. First, based on previous research (4), we  
126 quantify the extent to which mental well-being and work engagement are correlated and  
127 confirm that they are distinct states that can be used as two separate factors for further  
128 analysis. Second, assuming that these states are distinct, we test whether they can be  
129 divided into meaningful subgroups with distinct profiles. Although previous conceptual work  
130 hints at four subgroups, we will develop a categorization scheme that best fits data from a  
131 large database of employees. For this we use multiple statistical techniques and  
132 corresponding validation procedures to develop a robust taxonomy that identifies subgroups  
133 within a large sample that vary in potentially important ways with respect to the construct.  
134 Finally, we will use longitudinal data to test whether the newly constructed indicator can  
135 change over time.

136 **Methods**

137

138 **Data**

139

140 This study used the three waves of the Linked Personnel Panel (LPP; wave 1213, 1415, and  
141 1617, DOI: 10.5164/IAB.LPP1617.de.en.v1), a longitudinal panel initiated by the German  
142 Federal Ministry of Labor and Social Affairs (BMAS) and administered at the Institute for  
143 Employment Research (IAB) (32-35). The LPP links information on both the employer (e.g.,  
144 human resources culture, management instruments) and employee (e.g., work  
145 characteristics, health status, sociodemographic characteristics). It is considered  
146 representative of private, moderate- to large-sized (> 50 employees) German companies in  
147 the manufacturing and service sectors (34). **The LPP was sampled from the Institute for  
148 Employment Research Establishment Panel, which is an annual representative survey of  
149 16,000 German companies representing all industries and sizes nationwide (36, 37).  
150 Companies from the business sectors of agriculture, forestry and fishery, as well as civil  
151 service and charity organizations or with less than 50 employees and were excluded. The  
152 sample was stratified according to region, sector, and size (34, 36).** Data access to the LPP  
153 was provided via on-site use at the Research Data Centre (FDZ) of the German Federal  
154 Employment Agency (BA) at the IAB and subsequent remote data access.

155

156 Overall, the LPP contains data from 7,508 employees and 1,219 companies in the first wave  
157 (2012/2013), 7,282 employees and 771 companies in the second wave (2014/2015), and  
158 6,779 employees and 846 companies in the third wave (2016/2017). Inclusion criteria for the  
159 present study were no missing values on the two indicators for mental well-being and work  
160 engagement, and working in a company with 50 or more employees (13,538 employees with  
161 20,170 observations; 96.7% of all respondents). The analytic sample was limited to the first  
162 observation for each employee (n = 13,538), ensuring an equal weight for each individual  
163 both for the first and second aim. For the third aim, we needed longitudinal data and  
164 therefore we used the subgroup of individuals that were observed in at least two successive  
165 waves (n = 2,891 between 2012 and 2014; n = 3,528 between 2014 and 2016). Participants  
166 provided informed consent and the Ethics Committee of the Medical Faculty of the

167 University of Heidelberg approved the use of the LPP for secondary data analysis (2018-  
168 514N-MA).

169

## 170 **Measures**

171

### 172 *Mental Well-Being*

173

174 Mental well-being was measured using the WHO-5 Well-Being Questionnaire (version 1998),  
175 a commonly used and validated instrument (38, 39). This instrument consists of five items  
176 with responses rated on a 6-point Likert scale (0 'at no time'; 5 'all of the time'). Items  
177 assessed whether during the last two weeks employees felt 'cheerful and in good spirits',  
178 'calm and relaxed', 'active and vigorous', 'fresh and rested', and whether their daily life was  
179 filled with things that interested them. In addition to using responses to individual items in  
180 our factor analysis (see below), we calculated an overall mental well-being index as the sum  
181 of the five items multiplied by four (range 0-100) for the remaining analyses. Higher values  
182 indicate a better assessment of one`s well-being with a value of  $\geq 51.0$  considered indicative  
183 of good mental well-being (39).

184

### 185 *Work Engagement*

186

187 Work engagement was measured using a validated short-version of the nine-item Utrecht  
188 Work Engagement Scale (UWES-9) (11, 40, 41). The UWES-9 measures responses on a Likert  
189 scale from 1 'never' to 5 'daily' to the following: 'At my work, I feel bursting with energy', 'At  
190 my job, I feel strong and vigorous', 'When I get up in the morning, I feel like going to work', 'I  
191 am enthusiastic about my job', 'My job inspires me', 'I am proud of the work that I do', 'I am  
192 immersed in my work', 'I feel happy when I am working intensely', and 'I get carried away  
193 when I`m working'. In addition to using responses to individual items in our factor analysis  
194 (see below), a mean score (range 1-5) across all nine items was calculated, a higher score  
195 indicating greater work engagement. **It must be noted, that the original UWES ranges on a  
196 scale from 0 to 6, however, other research indicates that the overall and all three sub-indices  
197 using the shortened scale show a similar internal consistency as the original work (34).** In line



198 with the mental well-being scale, responses to individual items were used for the  
199 exploratory factor analysis and the overall score was used for all remaining analyses.

200

### 201 *Descriptive Sample Characteristics*

202

203 Individual characteristics used to describe the analytical sample were gender (male; female),  
204 age (in years), white-collar/blue-collar status (self-report), and full-time/part-time work.

205

### 206 ***Analyses***

207

208 Sample description was presented as the absolute (n) and relative (%) distribution of  
209 categorical variables, as well as mean values and standard deviations (S.D.) of all metric  
210 measures. We conducted our analyses using the statistical software package STATA, version  
211 14 (42).

212

#### 213 *Aim 1: Distinctiveness and correlation*

214

215 Before operationalizing an indicator characterizing both mental well-being and work  
216 engagement, we first performed an exploratory factor analysis using a maximum likelihood  
217 estimation method with varimax rotation to assess whether items intended to reflect mental  
218 well-being and work engagement resulted in separate factors indicating two distinct states.  
219 We defined the number of factors using the Kaiser criterion (Eigenvalue of  $\geq 1.0$ ) and a  
220 factor loading of  $\geq .3$  was considered sufficient for assigning an item to a factor. We used  
221 Cronbach's alpha to evaluate the internal reliability of the scales and Pearson's correlation  
222 coefficients to assess the extent to which the overall scores of mental well-being and work  
223 engagement were correlated with each other.

224

#### 225 *Aim 2: Defining meaningful subgroups*

226

227 We used cluster analysis to assess the optimal number of categories and the respective cut-  
228 offs for engaged well-being in our dataset. A cluster analysis groups the analytical sample  
229 into several distinct clusters that include observations with similar profiles (i.e., similar

230 combinations of levels of mental well-being and work engagement). An established  
231 clustering procedure was applied (43, 44). The overall scores for mental well-being and work  
232 engagement were used as the two dimensions to define the profiles generated by cluster  
233 analysis. Because cluster analysis requires all indicators to have equal scales, both indicators  
234 were transformed to z-scores. As we made no assumptions on the number of categories *a*  
235 *priori*, we examined the possibility of multiple cluster solutions ( $k = 2, 3, \dots, 9$ ). To guide  
236 identification of the cluster solution best fitting our data, we followed several steps. First,  
237 Ward's hierarchical clustering was applied and these results were then used as the cluster  
238 centers for non-hierarchical k-means clustering. This two-step procedure is recommended  
239 because hierarchical models can lead to nonoptimal solutions (43). That is, hierarchical  
240 models start with  $n$  clusters including one observation each. The two clusters with the  
241 smallest Euclidean distance are then combined in a stepwise procedure, thus reducing the  
242 number of clusters to  $n-1, n-2, \dots, n-(n-1)$  and increasing their size. However, once fused,  
243 individual observations or smaller clusters are not reassigned even if in later steps other  
244 cluster centers would present a better fit. The non-hierarchical procedure thus improves the  
245 clustering by (re-)assigning every observation to the cluster center that is most similar to the  
246 individual observation. Similarity was defined by the smallest Euclidean distance between  
247 individual values and the cluster centers provided by the Ward's hierarchical clustering  
248 procedure. New cluster centers were then computed. Appendix A describes further analyses  
249 to test the agreement between the two clustering steps (Cohen's  $\kappa$ ) as well as an established  
250 double-cross validation procedure, that aimed to test the replicability (stability) of our  $k$   
251 cluster solutions and to identify the best solution (44).

252

253 We applied a previously reported procedure to define the optimal k-means cluster solution  
254 (for more details see (45)). For each cluster solution, we calculated the within-sum-of-  
255 squares ( $WSS_k$ ), its natural logarithm [ $\log(WSS_k)$ ], the eta-squared ( $\eta^2_k = 1 - WSS_k/TSS$ )  
256 coefficient, and the proportional reduction of error coefficient [ $PRE_k = (WSS_{k-1} - WSS_k)/WSS_{k-1}$ ].  
257 The  $\eta^2$ -coefficient is an indicator for the proportional reduction of the WSS for a specific  
258 cluster solution compared to the total sum of squares (TSS), while the PRE-coefficient  
259 measures the proportional reduction of the WSS for a specific  $k$ -cluster solution compared  
260 with the next smaller cluster solution ( $k-1$ ). These statistics indicate how the variance

261 explained increases with the number of clusters. If the improvement of variance explained  
262 after a specific cluster solution levels off, larger cluster solutions should not be chosen (45).

263

264 To assure the reproducibility of our measurement for engaged well-being with the objective  
265 to address the third aim and for the sake of its utility in future studies, we used the results of  
266 the cluster analysis to define general cut-offs for the metric scores of the mental well-being  
267 and work engagement dimensions. These cut-offs are needed to divide the two-dimensional  
268 space created by the dimensions of mental well-being and work engagement into subgroups  
269 that reflect the results of the cluster analysis as closely as possible. Depending on the cluster  
270 solution (see below), we explored a series of different cut-offs. Our choices for cut-offs were  
271 primarily guided by A) the use of established cut-offs that can assign meaningful content to  
272 the clusters and B) the use of deciles to identify cut-offs with an approach that balances the  
273 precision of the cut-offs and the complexity and extent of the analysis. We create several  
274 indicators comprising the categories (i.e., subgroups) based on these cut-offs and test them  
275 against the cluster solution. Cohen's  $\kappa$  as well as the proportion of agreement between each  
276 newly generated indicator and the cluster solution were used to identify the indicator with  
277 the highest agreement in comparison with the cluster solution. To compare the categories of  
278 the indicator of engaged well-being with the results of the cluster solution, we provided a  
279 description of their profiles (means of mental well-being and work engagement), cross-  
280 tabulation and chi<sup>2</sup>-testing, as well as Cohen's  $\kappa$ . This indicator was chosen for further  
281 subgroup analysis (see below).

282

283 *Aim 3: Changes over time*

284

285 Using the newly defined indicator for engaged well-being and its cut-offs, we assigned the  
286 categories of engaged well-being for the 2<sup>nd</sup> and 3<sup>rd</sup> observations of the subgroup of  
287 employees that participated in at least two successive waves. Using this longitudinal  
288 information (wide format) ~~and cross-tabulation~~, we described whether and how employees  
289 changed categories across time. Changes are presented as the migration between categories  
290 ~~across from one~~ observation points ~~to the next~~ (~~n~~ and %).

291 **Results**

292

293 *Description of analytical sample*

294

295 Table 1 provides descriptive statistics of the analytical sample. Mental well-being was on  
296 average rated as good (62.25,  $\pm$ 20.83) and the average reported work engagement is located  
297 in the upper third of the total scale (3.73,  $\pm$ 0.81). The sample had a mean age of 45.96 years  
298 ( $\pm$ 10.87), was primarily male (71.28%), consisted predominantly of white-collar workers  
299 (62.53%) and of employees working in full-time positions (86.74%).

300

301 ---- Table 1 ----

302

303 *Aim 1: Distinctiveness and correlation*

304

305 The EFA using all items for mental well-being and work engagement provided a two-factor  
306 solution showing that they were distinguishable constructs with all items of the WHO-5 scale  
307 having a higher loading ( $\geq$  .3) on one factor and all items of the UWES-9 having a higher  
308 loading ( $\geq$  .3) on the other factor. No cross-loadings were present and therefore each item  
309 can be attributed to one single factor. Cronbach`s alpha for mental well-being and work  
310 engagement were .851 and .909, respectively, indicating very good internal consistencies.  
311 Both constructs correlated moderately (Pearson`s  $r = .398$ ;  $P < 0.000$ ).

312

313 ---- Table 2 ----

314

315 *Aim 2: Defining meaningful subgroups*

316

317 Table 2 presents the results of the within-sum-of-squares statistics. The larger the number of  
318 clusters, the smaller the WSS and therefore the greater the variance explained. The  
319 decreases in WSS are, however, much weaker after the four-cluster solution. Additionally,  
320 the PRE-coefficients indicate that the percentage improvement in WSS indicators is much  
321 lower after the four-cluster solution (15% improvement between the four- and five-cluster  
322 solution compared to 25% improvement between the three- and four-cluster solution) and

323 levels off afterwards. A similar drop in improvement can be found after the 2-cluster  
324 solution, however, here the reduction of the WSS with an  $\eta^2$ -coefficient of 46% is  
325 comparatively small. The double-cross validation presented in Appendix A indicates that the  
326 2- and 4-cluster solutions were most replicable (stable).

327

328 We therefore defined cut-offs for categories comprising engaged well-being using the four-  
329 cluster solution. Figure 1a presents the description of the cluster profiles using values of  
330 mental well-being and work engagement that were transformed to z-scores. The first cluster  
331 exhibits on average both higher mental well-being and work engagement. The last cluster,  
332 on the other hand, has both lower well-being and work engagement. The other clusters  
333 exhibit either high mental well-being and low work engagement or low mental well-being  
334 but high work engagement. Each cluster thus occupies one corner of the two-dimensional  
335 space that mental well-being and work engagement form. Based on this distribution, we  
336 identified one cut-off for each dimension to create categories that closely matched the  
337 cluster solution. Because mental well-being measured by the WHO-5 already has an  
338 established cut-off indicating good mental well-being ( $\geq 51.0$ ), we test this cut-off for the  
339 first dimension. As for the second dimension – work engagement – no cut-offs exist, so we  
340 chose to use values corresponding to each of the nine deciles. We then generated nine  
341 different indicators of engaged well-being, each including four categories based on the  
342 established cut-off for mental well-being and one of the nine cut-offs for work engagement.  
343 Appendix B Table 1 presents the agreement between several indicators of engaged well-  
344 being, based on different cut-offs, and the four-cluster solution. With an overlap of 80.74%  
345 and a Cohen's  $\kappa$  of .728 the indicator using the 4<sup>th</sup> decile of the work engagement  
346 distribution and the established cut-off for mental well-being provided numerical values that  
347 most closely corresponded to the solution identified by cluster analysis.

348

349 ---- *Figure 1* ----

350

351 Figures 1b provides a description of the indicator of engaged well-being that had the highest  
352 agreement with the cluster solution. We labelled the first category 'engaged well-being' as it  
353 exhibits on average both higher mental well-being and work engagement. The last category,  
354 with both lower well-being and work engagement was labelled 'disengaged strain'. The

355 remaining clusters were labelled 'disengaged well-being' (high mental well-being and low  
356 work engagement) and 'engaged strain' (low mental well-being but high work engagement).

357

358 ---- *Table 3* ----

359

360 Further comparison of the distribution of both engaged well-being and the results of the  
361 cluster analysis also revealed a good fit (Table 3). Clusters 1, 2, and 4 are largely assigned to  
362 a single category of engaged well-being: engaged well-being (96.88%), disengaged well-being  
363 (92.90%), disengaged strain (86.78%), respectively. Cluster 3, best resembles the category  
364 engaged strain (40.18%). The comparison shows a highly significant association ( $P < 0.001$ )  
365 between the cluster solution and the engaged well-being categories. Table 4 illustrates the  
366 categories of engaged well-being.

367

368 ---- *Table 4* ----

369

370 *Aim 3: Changes over time*

371

372 **Table Figure 25a** and b present individual changes in engaged well-being over time (2012 to  
373 2014; 2014 to 2016) when applying the cut-offs to the 2<sup>nd</sup> and 3<sup>rd</sup> observations of the  
374 longitudinal data. Both tables show similar changes. Most employees in the category  
375 engaged well-being also reported this category in the next year (70.82% / 69.88%).  
376 Employees that reported to be disengaged strained in the first year, mostly reported the  
377 same in the second year (45.93% / 47.74%) or reported a change into the category  
378 "disengaged well-being (36.70% / 33.09%). On the other hand, employees that reported to  
379 be engaged but strained in the first year, most often reported engaged well-being in the  
380 second year (46.22% / 47.30%). **About half of the employees that belong to the category**  
381 **disengaged well-being in one observation, also report this category in the next observation**  
382 **(54.07% / 50.19%). However, most of the employees that changed between two**  
383 **observation, changed either to disengaged strain (18.77% / 23.34%) or engaged well-being**  
384 **(23.88% / 22.49%).**

385

386 ---- *Table Figure 25a and b* ----

387 **Discussion**

388

389 Previous literature has proposed a simultaneous consideration of both mental well-being  
390 and work engagement and various studies indicate that both states separately are  
391 associated with desirable outcomes for employees and employers. Using a large sample of  
392 employees, the present study added to previous research and considerations in three ways.  
393 First, additional support was provided that mental well-being and work engagement are  
394 moderately correlated. We have added to these correlations by providing evidence that both  
395 states are distinct. Second, it was tested whether these states can be divided into distinct  
396 subgroups by identifying profiles varying with respect to their average mental well-being and  
397 work engagement. The resulting subgroups can be described as 1) high mental well-being  
398 and high work engagement (engaged well-being), 2) high mental well-being and low work  
399 engagement (disengaged well-being), 3) low mental well-being and high work engagement  
400 (engaged distress), and 4) low mental well-being and low work engagement (disengaged  
401 distress). Replicability of the subgroups (or categories) was ensured by identifying and  
402 testing empirical cut-offs. The final construct is referred to as engaged well-being. Finally, we  
403 used longitudinal data to show that engaged well-being can change over time, indicating its  
404 potential use for intervention.

405

406 Our analyses mirror several conceptual considerations and previous empirical observations.  
407 First, in line with previous literature, we found that both mental well-being and work  
408 engagement are moderately and positively correlated (4, 46). The positive correlation  
409 between both constructs was to be expected as a) the work engagement scale includes  
410 items that describe well-being at work, such as “I feel happy when I`m working” and that b)  
411 previous studies have found significant positive associations both cross-sectionally and  
412 longitudinally (26, 27). Additionally, we have shown that both states are distinct, which  
413 supports a previous analysis showing that mental well-being and work engagement have  
414 distinct associations with productivity (4).

415

416 Our findings additionally correspond with ideas formulated in the ‘engagement and well-  
417 being framework’, arguing that the dimensions mental well-being and work engagement can  
418 be comprised into four different categories occupying every corner of this two-dimensional

419 space (22, 31). However, we did not predefine the number of categories for engaged well-  
420 being and instead chose established, data-driven approaches testing multiple cluster  
421 solutions. Still, the best solution provided in our analysis was the four-cluster solution. In line  
422 with the 'engagement and well-being framework', the resulting clusters or categories  
423 combine either higher or lower levels of mental well-being and work engagement. A notable  
424 distinction to the framework is that it defines the mental well-being dimension as a  
425 combination of mental well-being and mental illness (22). Our study uses the WHO-5, a  
426 generic scale with only positively formulated items that reflect mental well-being and not  
427 mental illness (39). The established cut-off is often used for screening in clinical depression  
428 trials, however, the WHO-5 itself has no diagnostic specificity (39). In line with ideas from  
429 the positive psychology approach, which argues that the good is more than the absence of  
430 the bad (3), and based on previous literature that has shown that mental health and mental  
431 illness (47), as well as positive and negative affect (48) cannot be measured on a single  
432 dimension, we decided against a combination of both positive and negative health-related  
433 states in the mental-well-being dimension. Measuring mental illness separately or possibly  
434 as another dimension in engaged well-being could be valuable, especially because positive  
435 organizational psychology studies indicate that positive and negative phenomena explain  
436 unique variance of organizational outcomes (1). We do believe that engaged well-being  
437 could be an instrument used within the mental well-being and engagement framework.

438

439 Engaged well-being combines interests of employees (~~mental well-being~~) and employers  
440 (~~work engagement~~) (1). While the motivational ~~indicators~~ processes associated with such as  
441 work engagement are often the main focus for employers, taking employee health into  
442 account is not only part of the corporate social responsibility but also of business interests,  
443 as healthy employees are more productive and the image of an organization that takes care  
444 of its employees is likely to increase (49). One study proposes that, due to the positive  
445 association with productivity, organizations need to apply more holistic and multipronged  
446 approaches to improve work engagement and physical health by creating motivational work  
447 environments and providing health and wellness programs (17). Positive psychology  
448 interventions seem to be promising for enhancing both employee well-being and  
449 performance (50). While the present study is the first step in corroborating a simultaneous  
450 consideration of mental well-being and work engagement in the form of engaged well-being,



451 we are aware that more work is needed to strengthen the construct and to establish it in  
452 organizational settings, especially in interventions. In the following section, we therefore  
453 discuss the application and further testing of engaged well-being.

454

#### 455 *Future Research and application in organizational settings*

456

457 Our operationalization of engaged well-being is easily replicable and can change over time,  
458 giving it potential to be applicable in workplace interventions. The approach we have  
459 described in measuring engaged well-being could be used in organizations to observe the  
460 distribution of employees across the different categories as well as the changes of this  
461 distribution over time. However, we still need to test, what antecedents lead to these  
462 changes. As proposed in the job-demands resources model, there are two pathways through  
463 which job characteristics influence employees – the health-impairment and the motivational  
464 pathway (23). The model assumes, that while job resources are thought to be predominantly  
465 positively associated with work engagement through the motivational process, job demands  
466 are mainly negatively associated with mental well-being through the health-impairment  
467 process. Several empirical studies have found support for the assumptions of this model (for  
468 reviews see (23, 25, 51)). Based on these pathways, we assume different needs for changes  
469 between different engaged well-being categories. For example, employees in the category  
470 engaged strain might be more likely to change into the category engaged well-being if job  
471 demands (e.g., physical demands, time pressure, mobbing) are reduced, as this should  
472 increase their mental well-being (health-impairment process). Employees in the category  
473 disengaged well-being, on the other hand, might be more likely to change into the category  
474 engaged well-being if job resources (e.g., supportive leadership, organizational justice,  
475 decision-making autonomy) are increased, as this should increase their work engagement  
476 (motivational process). These assumptions also imply that not all employees within an  
477 organization would need the same type of support, depending on their engaged well-being,  
478 therefore implying multi-component interventions. However, while the direct associations  
479 described above have been shown in previous research, multiple studies using the job-  
480 demands resources model have also shown interaction effects between demands and  
481 resources (23, 25, 49). It is assumed that job resources do not only affect work engagement  
482 through the motivational process, but that employees with increased job resources are

483 additionally better able to cope with the strain caused by job demands, therefore reducing  
484 their negative impact on health (23, 25). A more distinctive analysis of such interactions  
485 regarding engaged well-being is important to better understand the antecedents and  
486 processes that influence this new construct.

487

488 Workplace interventions can be used to test whether and how changes in job demands or  
489 resources can influence engaged well-being. By improving work conditions (e.g., increasing  
490 supervisory support or decreasing time-pressure), employers should be able to observe a  
491 shift away from disengaged strain towards engaged well-being. It is, however, important to  
492 note, that while the overall conceptual thoughts of the 'engagement and well-being  
493 framework' might be translated to both the employee and the organizational level (22, 30),  
494 the use of engaged well-being within workplace interventions should be limited to observing  
495 changes within the overall workforce of an organization than within an employee, as the  
496 engaged well-being categories are rather broad and therefore not able to provide detailed  
497 information on changes within individuals.

498

499 Within such workplace interventions, a deeper understanding of the two categories of  
500 engaged strain and disengaged well-being needs to be developed. Why do people report  
501 being engaged while they are strained? One conclusion might be that these employees could  
502 be addicted to their work and thus risking their own mental well-being. However, work  
503 engagement has been defined as a positive state of mind and studies indicate that work  
504 engagement and workaholism are two different constructs (13, 52). Additionally, our results  
505 indicate that only every fifth employee that had been engaged strained in one observation  
506 reported the same in the next, and every second reported an improved change to engaged  
507 well-being, indicating that it might not be the higher levels of work engagement that result  
508 in strain. In contrast, the category disengaged well-being was more stable. Are these  
509 employees that do not care for their work and search for validation outside of the work  
510 environment? How can changes to engaged well-being still be encouraged (e.g., through  
511 better supervision)?

512

513 Additionally, a better understanding of the consequences of engaged well-being makes the  
514 indicator more attractive for use in praxis. As argued by Grant (2012) (22), indicators that

515 capture employee level engagement and well-being might be better indicators of  
516 organizational success than monetary business outcomes. In the short run monetary  
517 outcomes could be quickly improved by worsening working conditions (e.g., high pressure  
518 work environments). In the long run, engaged well-being should lead to more organizational  
519 success, as employees should have better resources to reach organizational goals and are  
520 less likely to 'burn out'. Previous studies have found positive and distinct associations of  
521 mental well-being and engagement with productivity cross-sectionally (4) or longitudinally  
522 using a physical instead of a mental health indicator (17). Future studies should test this  
523 assumption by analysing the long-term effects of engaged well-being on productivity and  
524 other indicators of organizational success.

525

526 We furthermore need to discuss the interpretation of the categories of engaged well-being  
527 in relation to one another. It can be assumed that it is the least desirable to have many  
528 employees in the category disengaged strain that has on average the lowest ratings of  
529 mental well-being or work engagement, while engaged well-being should be the most  
530 desirable category. Whether the category disengaged well-being or engaged strain is  
531 "preferable" cannot be clearly defined. An ordinal or metric interpretation is therefore not  
532 possible. However, because we assume that changes in different antecedents (i.e., work  
533 characteristics) have different consequences depending on the category of engaged well-  
534 being employees find themselves in, this distinction between disengaged well-being and  
535 engaged strain is necessary for employers to make informed decisions.

536

### 537 *Strengths and Limitations*

538

539 A strength of the present study is its use of established and validated indicators of mental  
540 well-being and work engagement (39, 41). However, the generalization of our work using the  
541 UWES-9 for work engagement is somewhat limited due to the data including a shortened  
542 scale compared to that of the original work. Future work needs to test, whether similar  
543 findings can be found using the original scaling. The use of established clustering procedures  
544 that are accompanied by several sensitivity analyses (e.g., double-cross validation, within-  
545 sum-of-squares statistics) is another strength. Because our complete case analysis was based  
546 on only two indices, we were able to include 96.7% of all respondents in our cross-sectional

547 analyses and we can assume that the selection bias due to missing data is rather small (53).  
548 The bias might be larger for the longitudinal analysis, as we face sample attrition (e.g., due to  
549 a healthy worker bias (53)). Additionally, while on the employer level the LPP is  
550 representative for private, moderate- to large-sized German companies in the  
551 manufacturing and service sectors and employees from a wide variety of sectors and  
552 business sizes are included, the employee sample itself is primarily male, older, and working  
553 full-time, and results should therefore be interpreted carefully as they might not be  
554 representative for certain working populations. Future studies should therefore test our cut-  
555 offs using study populations with different sociodemographic characteristics. A bias due to  
556 common method variance cannot be excluded, as all items were measured subjectively and  
557 based on self-reports (54). Therefore, we propose to further test engaged well-being against  
558 objective indicators, such as biomarkers that are associated with stress or objective  
559 indicators for productivity.

560

#### 561 *Conclusion*

562

563 Our measure of engaged well-being can be used to simultaneously characterize a  
564 workforce's mental well-being and work engagement. Change in this measure over time  
565 suggests its potential utility in organizational interventions. Future studies are needed to  
566 further explore both the antecedents, correlates and potential effects of engaged well-  
567 being.

568

569 **Declarations**

570

571 **Ethics approval and consent to participate:**

572 Participants provided informed consent and the Ethics Committee of the Medical Faculty of  
573 the University of Heidelberg approved the use of the LPP for secondary data analysis (2018-  
574 514N-MA).

575

576 **Consent for publication:**

577 Not applicable.

578

579 **Availability of data and materials:**

580 The data that support the findings of this study are available from the Research Data Centre  
581 (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment  
582 Research (IAB) but restrictions apply to the availability of these data, which were used under  
583 license for the current study, and so are not publicly available. Data access can be requested  
584 from the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the  
585 Institute for Employment Research (IAB).

586

587 **Competing interests:**

588 J.E.F. has received royalties for lectures regarding occupational health from various  
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590

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595

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597 CB wrote the manuscript under the guidance of RMH. CB performed data preparation and  
598 analysis. CB and RMH interpreted the results. JEF contributed to the conception and design  
599 of this study. JEF led and supervised the study. All authors revised the final draft of the

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610 **Literature**

- 611 1. Bakker AB, Schaufeli WB. Positive organizational behavior: Engaged employees in  
612 flourishing organizations. *Journal of Organizational Behavior: The International Journal of*  
613 *Industrial, Occupational and Organizational Psychology and Behavior*. 2008;29(2):147-54.
- 614 2. Bakker AB, van Woerkom M. Strengths use in organizations: A positive approach of  
615 occupational health. *Canadian Psychology/psychologie canadienne*. 2018;59(1):38.
- 616 3. Seligman ME, Csikszentmihalyi M. Positive psychology: An introduction. *American*  
617 *Psychologist*. 2000;55(1):5-14.
- 618 4. Robertson IT, Jansen Birch A, Cooper CL. Job and work attitudes, engagement and  
619 employee performance: Where does psychological well-being fit in? *Leadership &*  
620 *Organization Development Journal*. 2012;33(3):224-32.
- 621 5. WHO. World Health Organisation: Mental health: a state of well-being 2014  
622 [Available from: [http://origin.who.int/features/factfiles/mental\\_health/en/](http://origin.who.int/features/factfiles/mental_health/en/)].
- 623 6. Huppert FA. Psychological well-being: Evidence regarding its causes and  
624 consequences. *Applied Psychology: Health and Well-Being*. 2009;1(2):137-64.
- 625 7. Keyes CL. The mental health continuum: From languishing to flourishing in life.  
626 *Journal of health and social behavior*. 2002:207-22.
- 627 8. Bubonya M, Cobb-Clark DA, Wooden M. Mental health and productivity at work:  
628 Does what you do matter? *Labour Economics*. 2017;46:150-65.
- 629 9. Rennert D, Kliner K, Richter M. Arbeitsunfähigkeit. In: Knieps F, Pfaff H, editors.  
630 BKK Gesundheitsreport 2018 Arbeit und Gesundheit Generation 50+2018.
- 631 10. Aerzteblatt. Zehntausende gehen wegen psychischer Probleme in Frührente [Tens of  
632 thousands retire early due to mental health problems]  
633 <https://www.aerzteblatt.de/nachrichten/105820/Zehntausende-gehen-wegen-psychischer->  
634 [Probleme-in-Fruerente2019](https://www.aerzteblatt.de/nachrichten/105820/Zehntausende-gehen-wegen-psychischer-) [updated 9.9.2019].
- 635 11. Schaufeli WB, Salanova M, González-Romá V, Bakker AB. The measurement of  
636 engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of*  
637 *Happiness studies*. 2002;3(1):71-92.
- 638 12. Hakanen JJ, Schaufeli WB. Do burnout and work engagement predict depressive  
639 symptoms and life satisfaction? A three-wave seven-year prospective study. *Journal of*  
640 *affective disorders*. 2012;141(2-3):415-24.
- 641 13. Shimazu A, Schaufeli WB, Kamiyama K, Kawakami N. Workaholism vs. work  
642 engagement: The two different predictors of future well-being and performance. *International*  
643 *journal of behavioral medicine*. 2015;22(1):18-23.
- 644 14. Schaufeli WB, Taris TW, Bakker AB. Dr. Jekyll or Mr. Hyde: On the differences  
645 between work engagement and workaholism. *Research companion to working time and work*  
646 *addiction*. 2006:193-217.
- 647 15. Innstrand ST, Langballe EM, Falkum E. A longitudinal study of the relationship  
648 between work engagement and symptoms of anxiety and depression. *Stress and health*.  
649 2012;28(1):1-10.
- 650 16. Christian MS, Garza AS, Slaughter JE. Work engagement: A quantitative review and  
651 test of its relations with task and contextual performance. *Personnel psychology*.  
652 2011;64(1):89-136.
- 653 17. Merrill RM, Aldana SG, Pope JE, Anderson DR, Coberley CR, Grossmeier JJ, et al.  
654 Self-rated job performance and absenteeism according to employee engagement, health  
655 behaviors, and physical health. *Journal of occupational and environmental medicine*.  
656 2013;55(1):10-8.
- 657 18. Schaufeli WB, Bakker AB, Van Rhenen W. How changes in job demands and  
658 resources predict burnout, work engagement, and sickness absenteeism. *Journal of*

- 659 Organizational Behavior: The International Journal of Industrial, Occupational and  
660 Organizational Psychology and Behavior. 2009;30(7):893-917.
- 661 19. Simbula S, Guglielmi D. I am engaged, I feel good, and I go the extra-mile:  
662 Reciprocal relationships between work engagement and consequences. *Revista de Psicología  
663 del Trabajo y de las Organizaciones*. 2013;29(3):117-25.
- 664 20. Harter JK, Schmidt FL, Hayes TL. Business-unit-level relationship between employee  
665 satisfaction, employee engagement, and business outcomes: a meta-analysis. *Journal of  
666 applied psychology*. 2002;87(2):268.
- 667 21. Robertson IT, Cooper CL. Full engagement: The integration of employee engagement  
668 and psychological well-being. *Leadership & Organization Development Journal*.  
669 2010;31(4):324-36.
- 670 22. Grant AM. ROI is a poor measure of coaching success: towards a more holistic  
671 approach using a well-being and engagement framework. *Coaching: An International Journal  
672 of Theory, Research and Practice*. 2012;5(2):74-85.
- 673 23. Bakker AB, Demerouti E. Job demands–resources theory: Taking stock and looking  
674 forward. *Journal of Occupational Health Psychology*. 2017;22(3):273.
- 675 24. Magee C, Gordon R, Robinson L, Caputi P, Oades L. Workplace bullying and  
676 absenteeism: The mediating roles of poor health and work engagement. *Human Resource  
677 Management Journal*. 2017;27(3):319-34.
- 678 25. Schaufeli WB, Taris TW. A critical review of the Job Demands-Resources Model:  
679 Implications for improving work and health. *Bridging occupational, organizational and  
680 public health*: Springer; 2014. p. 43-68.
- 681 26. Leijten FR, van den Heuvel SG, van der Beek AJ, Ybema JF, Robroek SJ, Burdorf A.  
682 Associations of work-related factors and work engagement with mental and physical health: a  
683 1-year follow-up study among older workers. *Journal of occupational rehabilitation*.  
684 2015;25(1):86-95.
- 685 27. Matthews RA, Mills MJ, Trout RC, English L. Family-supportive supervisor  
686 behaviors, work engagement, and subjective well-being: A contextually dependent mediated  
687 process. *Journal of occupational health psychology*. 2014;19(2):168.
- 688 28. Fairlie P. Work engagement and employee well-being. *Research Handbook on Work  
689 and Well-Being*: Edward Elgar Publishing; 2017.
- 690 29. Johnson S, Robertson I, Cooper CL. Well-Being and Employee Engagement. *WELL-  
691 BEING*: Springer; 2018. p. 31-42.
- 692 30. Grant AM. The third ‘generation’ of workplace coaching: creating a culture of quality  
693 conversations. *Coaching: An International Journal of Theory, Research and Practice*.  
694 2017;10(1):37-53.
- 695 31. Grant AM, Spence GB. Using coaching and positive psychology to promote a  
696 flourishing workforce: A model of goal-striving and mental health. 2010.
- 697 32. Broszeit S, Grunau P, Wolter S. LPP-Linked Personnel Panel 1415: quality of work  
698 and economic success: longitudinal study in German establishments (data collection on the  
699 second wave). 2016.
- 700 33. Broszeit S, Philipp G, Wolter S. LPP-Linked Personnel Panel: quality of work and  
701 economic success: longitudinal study in German establishments (data documentation on the  
702 first wave). 2015.
- 703 34. Kampkötter P, Mohrenweiser J, Sliwka D, Steffes S, Wolter S, editors. Measuring the  
704 use of human resources practices and employee attitudes: the linked personnel panel.  
705 Evidence-based HRM: a Global Forum for Empirical Scholarship; 2016: Emerald Group  
706 Publishing Limited.
- 707 35. Mackeben J, Ruf K, Grunau P, Wolter S. LPP-Linked Personnel Panel 1617:  
708 Arbeitsqualität und wirtschaftlicher Erfolg: Längsschnittstudie in deutschen Betrieben



- 709 (Datendokumentation der dritten Welle). Institut für Arbeitsmarkt-und Berufsforschung  
710 (IAB), Nürnberg [Institute for Employment Research, Nuremberg, Germany]; 2018.
- 711 36. Bellmann L, Bender S, Bossler M, Broszeit S, Dickmann C, Gensicke M, et al. LPP–  
712 Linked Personnel Panel. Quality of Work and Economic Success: Longitudinal Study in  
713 German Establishments (Data Collection on the First Wave) FDZ method reports.  
714 2015;5:2015.
- 715 37. Fischer G, Janik F, Müller D, Schmucker A. The IAB Establishment Panel-things  
716 users should know. *Journal of Contextual Economics*. 2009;129(1):133.
- 717 38. Bech P, Olsen LR, Kjoller M, Rasmussen NK. Measuring well-being rather than the  
718 absence of distress symptoms: a comparison of the SF-36 Mental Health subscale and the  
719 WHO-Five well-being scale. *International journal of methods in psychiatric research*.  
720 2003;12(2):85-91.
- 721 39. Topp CW, Østergaard SD, Søndergaard S, Bech P. The WHO-5 Well-Being Index: a  
722 systematic review of the literature. *Psychotherapy and psychosomatics*. 2015;84(3):167-76.
- 723 40. Schaufeli WB, Bakker AB. Job demands, job resources, and their relationship with  
724 burnout and engagement: A multi-sample study. *Journal of Organizational Behavior: The  
725 International Journal of Industrial, Occupational and Organizational Psychology and  
726 Behavior*. 2004;25(3):293-315.
- 727 41. Schaufeli WB, Bakker AB, Salanova M. The measurement of work engagement with a  
728 short questionnaire: A cross-national study. *Educational and psychological measurement*.  
729 2006;66(4):701-16.
- 730 42. StataCorp, inventorStata Statistical Software: Release 14. College Station, TX:  
731 StataCorp LP2015.
- 732 43. Asendorpf JB, Borkenau P, Ostendorf F, Van Aken MA. Carving personality  
733 description at its joints: Confirmation of three replicable personality prototypes for both  
734 children and adults. *European Journal of Personality*. 2001;15(3):169-98.
- 735 44. Sârbescu P, Boncu A. The resilient, the restraint and the restless: Personality types  
736 based on the Alternative Five-Factor Model. *Personality and Individual Differences*.  
737 2018;134:81-7.
- 738 45. Makles A. Stata tip 110: How to get the optimal k-means cluster solution. *The Stata  
739 Journal*. 2012;12(2):347-51.
- 740 46. Bakker AB, Schaufeli WB, Leiter MP, Taris TW. Work engagement: An emerging  
741 concept in occupational health psychology. *Work & stress*. 2008;22(3):187-200.
- 742 47. Keyes CL. Mental illness and/or mental health? Investigating axioms of the complete  
743 state model of health. *Journal of consulting and clinical psychology*. 2005;73(3):539.
- 744 48. Russell JA, Carroll JM. On the bipolarity of positive and negative affect.  
745 *Psychological bulletin*. 1999;125(1):3.
- 746 49. Zwetsloot G, Pot F. The business value of health management. *Journal of Business  
747 Ethics*. 2004;55(2):115-24.
- 748 50. Meyers MC, van Woerkom M, Bakker AB. The added value of the positive: A  
749 literature review of positive psychology interventions in organizations. *European Journal of  
750 Work and Organizational Psychology*. 2013;22(5):618-32.
- 751 51. Demerouti E, Nachreiner F. Zum Arbeitsanforderungen-Arbeitsressourcen-Modell von  
752 Burnout und Arbeitsengagement–Stand der Forschung. *Zeitschrift für Arbeitswissenschaft*.  
753 2018:1-12.
- 754 52. Schaufeli WB, Taris TW, Van Rhenen W. Workaholism, burnout, and work  
755 engagement: three of a kind or three different kinds of employee well-being? *Applied  
756 psychology*. 2008;57(2):173-203.
- 757 53. Hernán MA, Hernández-Díaz S, Robins JM. A structural approach to selection bias.  
758 *Epidemiology*. 2004;15(5):615-25.

759 54. Podsakoff PM, MacKenzie SB, Lee J-Y, Podsakoff NP. Common method biases in  
760 behavioral research: A critical review of the literature and recommended remedies. Journal of  
761 applied psychology. 2003;88(5):879.  
762

763 **Tables and Figures**

764

765 **Table 1:** Descriptive statistics of the analytical sample (13,538 employees)

	mean / %	S.D. / n
mental well-being (range 0-100)	62.25	20.83
work engagement (range 1-5)	3.73	0.81
age (years)	45.96	10.87
male	71.28	9650
female	28.72	3888
white-collar	62.53	8461
blue-collar	37.47	5071
full-time	86.74	11731
part-time	13.26	1793

766

767 **Table 2:** Within-sum-of-squares statistics by number of clusters (n = 13,538)

cluster solution n (k)	WSS <sub>k</sub>	log(WSS <sub>k</sub> )	$\eta^2_k$	PRE <sub>k</sub>
1	27680.66	10.23	.00	
2	14959.98	9.61	.46	.46
3	11250.22	9.33	.59	.25
4	8394.58	9.04	.70	.25
5	7102.47	8.87	.74	.15
6	6071.34	8.71	.78	.15
7	5091.35	8.54	.82	.16
8	4560.92	8.43	.84	.10
9	4168.98	8.34	.85	.09

768 Note: The statistics are calculated as proposed by Makles (2012) (45); WSS<sub>k</sub> = within-sum-of-  
769 squares; log(WSS<sub>k</sub>) = the natural logarithm of WSS<sub>k</sub>;  $\eta^2_k = 1 - WSS_k / WSS_1$  [eta-squared]; PRE<sub>k</sub> =  
770  $(WSS_{k-1} - WSS_k) / WSS_{k-1}$  [the proportional reduction of error].

771 **Table 3:** Agreement between the four-cluster solution and the indicator for engaged well-  
 772 being (% of employees, n = 13,538)

		<b>results of cluster analysis</b>			
		cluster 1	cluster 2	cluster 3	cluster 4
<b>engaged well- being</b>	engaged well-being	<b>96.88</b>	4.04	30.45	0.00
	disengaged well-being	3.12	<b>92.90</b>	6.57	13.22
	engaged strain	0.00	0.00	<b>40.18</b>	0.00
	disengaged strain	0.00	3.06	22.80	<b>86.78</b>
	total	100	100	100	100

773

774 **Table 4:** Description of the categories of engaged well-being

	<i>mental well-being</i>		<i>work engagement</i>		
	defined as	cut-off at	defined as	cut-off at	
<b><i>engaged well-being</i></b>	+	good to very good	a value of $\geq 51.0$	+	good to very good top 60% (a value of $\geq 3.7$ )
<b><i>disengaged well-being</i></b>	+	good to very good	a value of $\geq 51.0$	-	reduced lowest 40% (a value of $\geq 3.7$ )
<b><i>engaged strain</i></b>	-	reduced	a value of $< 51.0$	+	good to very good top 60% (a value of $< 3.7$ )
<b><i>disengaged strain</i></b>	-	reduced	a value of $< 51.0$	-	reduced lowest 40% (a value of $< 3.7$ )

775 ~~Table 5a: Individual changes in engaged well-being between the observations in 2012 and~~  
 776 ~~2014~~

		<b>year 2014</b>				
		dis- engaged- strain	engaged- strain	dis- engaged- well-being	engaged- well-being	
<b>year</b> <b>2012</b>	disengaged- strain	n	209	29	167	50
		%	45.93	6.37	36.70	10.99
	engaged-strain	n	37	39	52	110
		%	15.55	16.39	21.85	46.22
	disengaged- well-being	n	143	25	412	182
		%	18.77	3.28	54.07	23.88
	engaged-well- being	n	81	98	240	1,017
		%	5.64	6.82	16.71	70.82
	total	n	470	191	871	1,359
		%	16.26	6.61	30.13	47.01

777 ~~Note: employees with at least one missing observation in one year were excluded~~

778

779 ~~Table 5b: Individual changes in engaged well-being between the observations in 2014 and~~  
 780 ~~2016~~

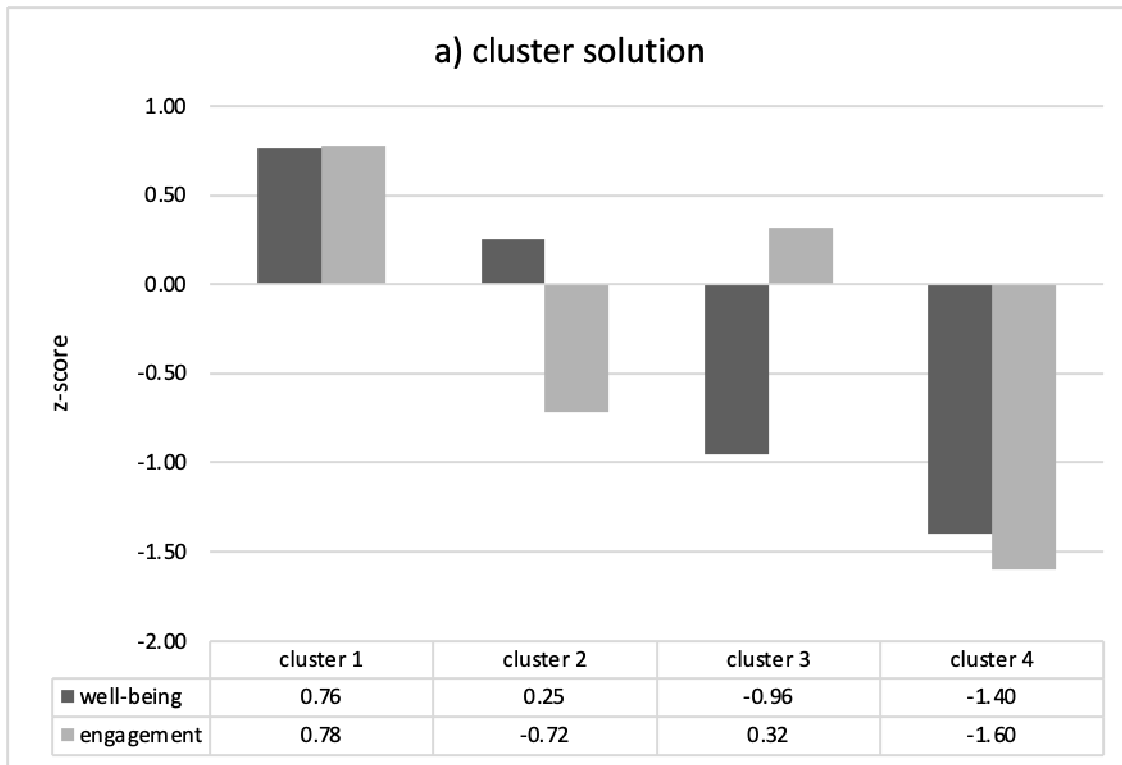
		<b>year 2016</b>				
		dis- engaged- strain	engaged- strain	dis- engaged- well-being	engaged- well-being	
<b>year</b> <b>2014</b>	disengaged- strain	n	264	34	183	72
		%	47.74	6.15	33.09	13.02
	engaged-strain	n	36	48	43	114
		%	14.94	19.92	17.84	47.30
	disengaged- well-being	n	246	42	529	237
		%	23.34	3.98	50.19	22.49
	engaged-well- being	n	86	138	282	1,174
		%	5.12	8.21	16.79	69.88
	total	n	632	262	1,037	1,597
		%	17.91	7.43	29.39	45.27

781 ~~Note: employees with at least one missing observation in one year were excluded~~

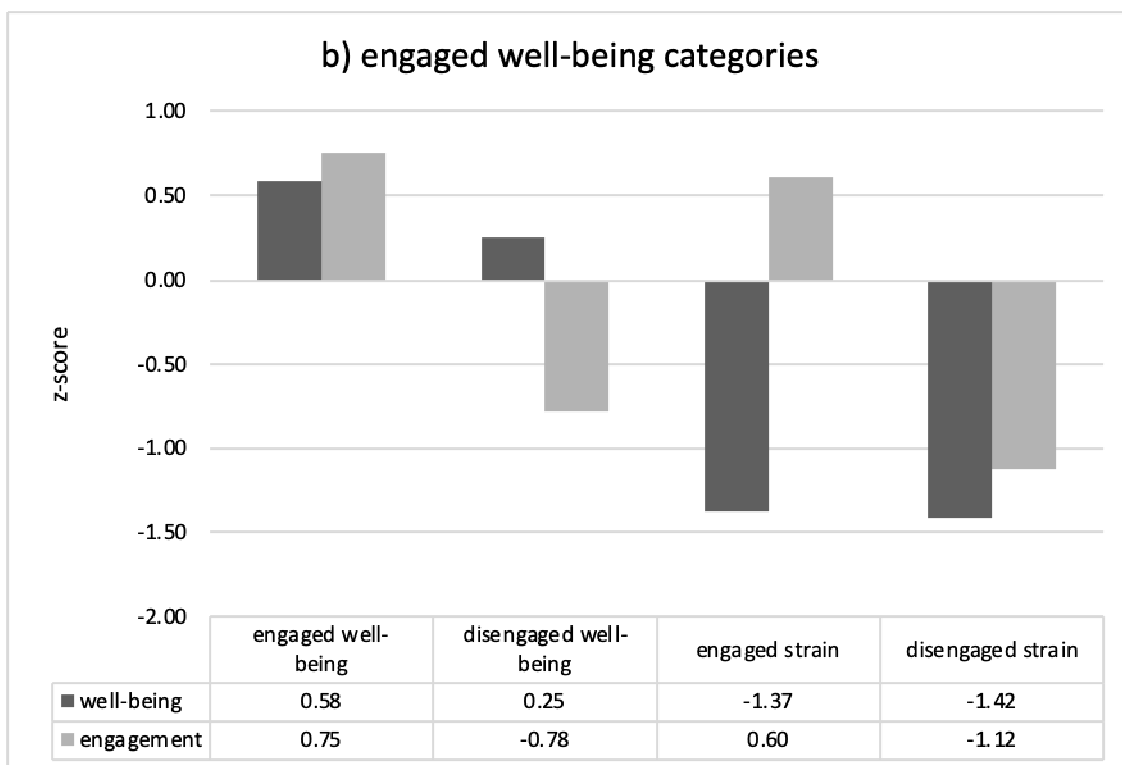
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784 **Figure 1:** Profiles of a) the cluster solutions and b) the engaged well-being categories (values  
 785 transformed to z-scores, n = 13,538)



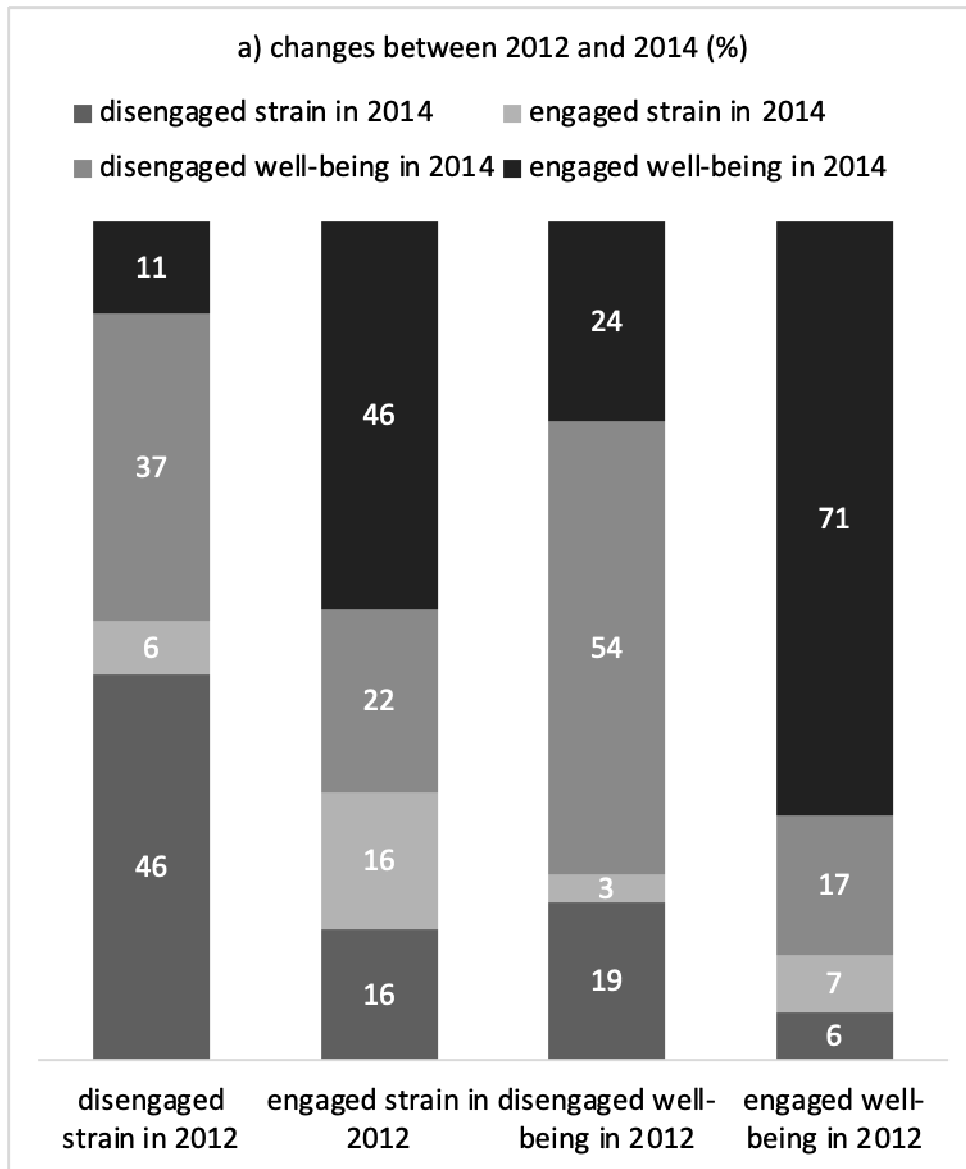
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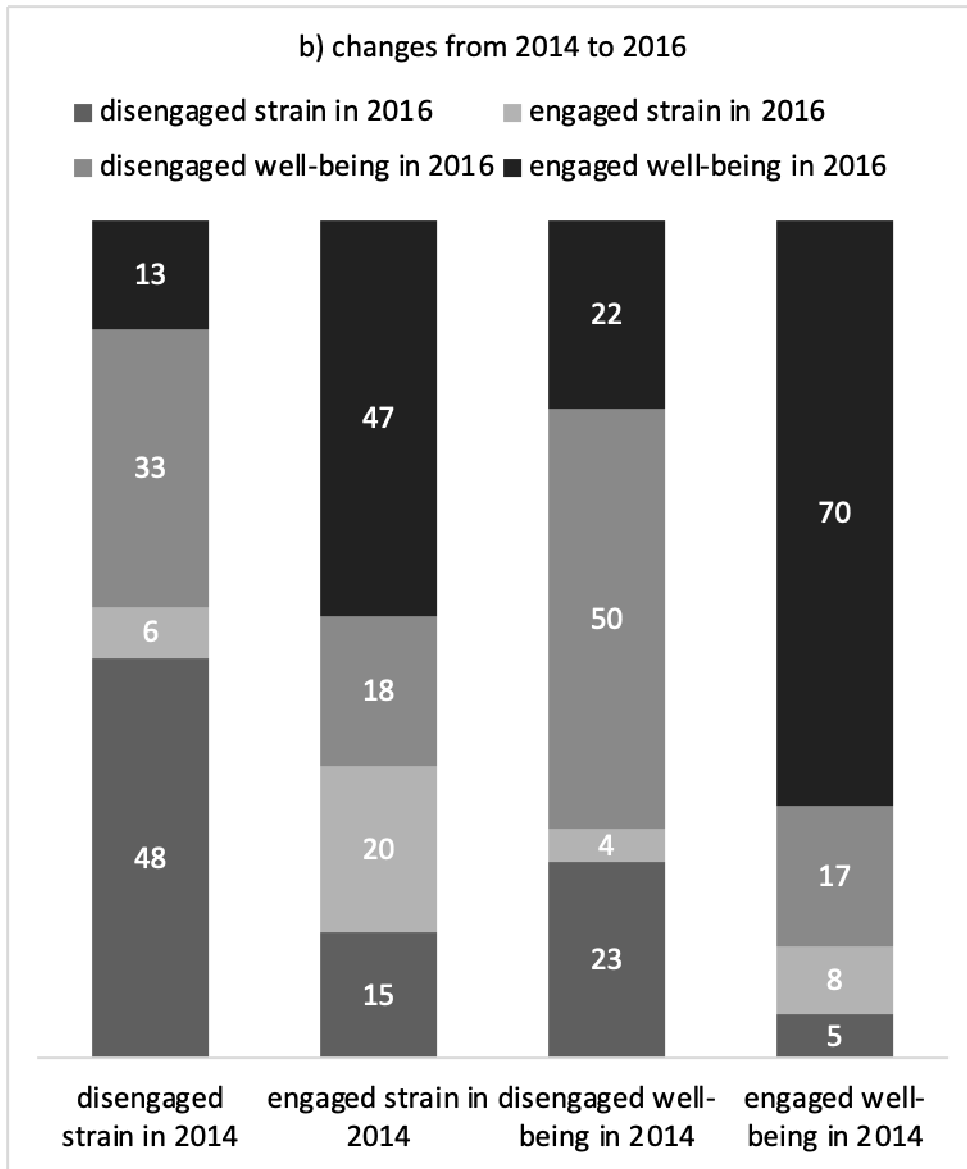


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788 **Figure 2:** Individual changes in engaged well-being between the observations 2012/2014 and  
 789 2014/2016 (in %)





791

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Note: employees with at least one missing observation in one year were excluded