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► **To cite this version:**

Silvio Maltagliati, Attilio Carraro, Géraldine Escriva-Boulley, Maurizio Bertollo, Damien Tessier, et al.. Predicting Changes in Physical Education Teachers' Behaviors Promoting Physical Activity During the COVID-19 Pandemic Using an Integrated Motivational Model. *Journal of Teaching in Physical Education*, 2021, 42 (1), pp.23-33. 10.1123/jtpe.2021-0116 . hal-03821850

HAL Id: hal-03821850

<https://hal.science/hal-03821850v1>

Submitted on 19 Oct 2022

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Predicting Changes in Physical Education Teachers' Behaviors Promoting Physical Activity During the COVID-19 Pandemic Using an Integrated Motivational Model

RUNNING HEAD: PHYSICAL EDUCATION TEACHERS AND COVID-19

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31 Words: 5883

32 Figures: 1

33 Tables: 2

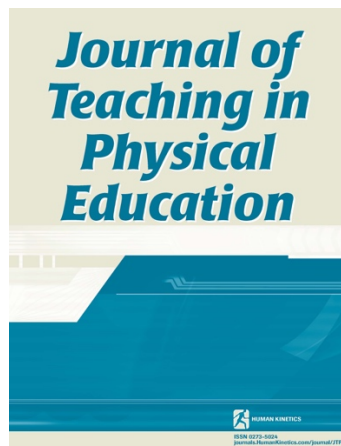
34 Supplementary material: 4 Tables.

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36 **Accepted for publication in the Journal of Teaching in Physical Education (November**
37 **2021)**

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Abstract

Purpose. To identify motivational determinants explaining Physical Education (PE) teachers' behaviors promoting students' physical activity (PA), amidst the COVID-19 pandemic.

Method. 931 Italian and French teachers completed a questionnaire assessing motivational determinants (self-determined motivation, self-efficacy, perceived ease and usefulness toward digital technologies, engagement at work), their intention and behaviors promoting PA, in reference to before and during the pandemic. Path analyses tested associations of changes in motivational determinants with changes in intention and behaviors.

Results. Increases in autonomous, controlled motivation, self-efficacy, perceived usefulness toward digital technologies, and a decrease in amotivation were associated with an increase in the intention to promote PA. In turn, an increase in intention, but also in self-efficacy, autonomous motivation, perceived usefulness toward digital technologies, were paired with an increase in behaviors promoting PA.

Conclusion. Implications regarding the commitment of PE teachers to challenging pedagogical situations, such as promoting PA amidst the COVID-19 pandemic, are discussed.

Keywords: Intention; Self-Efficacy; Self-determined Motivation; Digital Technologies; Cross-Cultural.

58 **Predicting Changes in Physical Education Teachers' Behaviors Promoting Physical**
59 **Activity During the COVID-19 Pandemic Using an Integrated Motivational Model**

60

61 During the Spring 2020, in most countries around the world, lockdown measures were
62 adopted to hinder the spread of the COVID-19 pandemic. One of the most striking influences
63 of restrictive measures was the closure of schools, affecting 1.2 billion students worldwide
64 (UNESCO, 2020). To maintain a pedagogical connection with their students, teachers from all
65 fields had to adapt their pedagogical practices (Crawford et al., 2020). In particular, Physical
66 Education (PE) teachers were among those who experienced the greatest challenge, when
67 deprived from their students' physical presence (Varea & González-Calvo, 2020).

68 **Promoting students' PA during the COVID-19 pandemic**

69 Although it represents a recurrent objective in PE, the promotion of students' physical
70 activity (PA) appeared as one key priority for teachers during the COVID-19 pandemic. Indeed,
71 as observed in the general population (Cheval et al., 2020), youth's level of PA decreased during
72 this period (Dunton et al., 2020), which may have negatively affected both their physical and
73 mental health. To reduce such detrimental consequences, the promotion of students' PA
74 attracted special attention in PE (Whalen et al., 2021). In particular, one study showed that in
75 Italy and in France, PE teachers reported, from before to during lockdown, an increase of
76 behaviors supporting students' PA (Gobbi et al., 2020). For instance, a higher frequency of
77 behaviors encouraging students to be active, to set goals or to monitor their PA levels was
78 observed, suggesting a shift in teachers' behaviors toward the promotion of students' PA.

79 Although informative, these findings disregard the fact that this shift in PE teachers'
80 behaviors was not straightforward and asked them to invest a massive effort of adaptation
81 (O'Brien et al., 2020). Indeed, PE teachers experienced many challenges during this period,
82 related, for example, to the physical absence of their students or to the need to use digital

83 technologies (Centeio et al., 2021; Mercier et al., 2021). In this perspective, examining the
84 motivational determinants underlying teachers' behaviors promoting PA during the COVID-19
85 pandemic remains needed. Ultimately, shedding light on these factors may help to better
86 support teachers in coping with such disruptive educational settings.

87 The present work provides a complementary analysis of Gobbi et al.' (2020) dataset.
88 This study was launched in France and in Italy because these two countries adopted similar and
89 synchronic educational responses to the COVID-19 pandemic (e.g., closure of schools, online
90 teaching) (see Gobbi et al., for an overview). Moreover, authors of this work were already
91 collaborating within a European-wide project about PE and youth' PA
92 (<https://www.impactpe.eu/site/index.php/en/>), which has favored the implementation of the
93 study in two countries. The latter aims at explaining changes in PE teachers' behaviors
94 promoting students' physical activity by testing an integrated model that encompasses several
95 motivational determinants (Hagger, 2009). Below, we describe the motivational determinants
96 in the aforementioned model (i.e., intention, self-determined motivation, self-efficacy,
97 perceived ease and usefulness toward digital technologies, and engagement at work) and
98 present the hypothesized associations (Figure 1A). These variables were selected because of
99 their purported connection with the educational context catalyzed by the COVID-19 pandemic
100 and because previous research had established their importance in explaining teachers'
101 investment in challenging teaching situations. Of note, the massive context change brought by
102 the COVID-19 pandemic and the closure of schools may have affected not only PE teachers'
103 behaviors promoting students' PA, but also the motivational determinants underlying such
104 behaviors. Hence, by measuring variables in reference to both before and during the COVID-
105 19 pandemic, our work focuses on the associations between changes in motivational variables
106 and changes in PE teachers' behaviors promoting students' PA.

107 **Intention to promote PA**

108 In most of the socio-cognitive models, intention is assumed to directly orient actions
109 toward or away from specific behaviors. In particular, according to the Theory of Planned
110 Behavior (Ajzen, 1985), intention, defined as one's willingness to perform a certain behavior,
111 is the most proximal determinant of behavior. Crucially, within the COVID-19 pandemic
112 context, this variable reflects a well-elaborated decision on which teachers' behaviors may be
113 modelled, to counteract the disruption of their habitual pedagogical practices. In educational
114 settings, empirical studies have used, for instance, intention as an indicator of teachers'
115 readiness to promote physically active classes (Martin & Kulinna, 2004), to implement the
116 Greek curriculum (Gorozidis & Papaioannou, 2011), or to participate in educational
117 innovations training (Gorozidis & Papaioannou, 2014; 2016). In this perspective, changes in
118 PE teachers' intention to promote PA, from before to during lockdown, were used as the main
119 determinant of changes in their behaviors.

120 **Self-determined toward promoting PA**

121 Key constructs of the Self-Determination Theory (e.g., Ryan & Deci, 2017) can be used
122 to directly explain changes in teachers' behaviors to promote PA. Moreover, self-determined
123 motivation can also be associated with behaviors through intention. Indeed, type of motivation
124 represents a distal factor which influences the decision-making process of engaging or not in a
125 certain behavior (see Hagger & Chatzisarantis, 2016 for a conceptual discussion). The Self-
126 Determination Theory distinguishes autonomous, controlled motivation and amotivation,
127 arranged within a continuum of motivation (Ryan & Deci, 2017). Autonomous motivation
128 refers to intrinsic (e.g., doing something because it is interesting and enjoyable) and identified
129 (e.g., because it is personally important and valuable) regulations. By contrast, controlled
130 motivation encapsulates introjected (e.g., to avoid feelings of guilt and shame) and external
131 (e.g., to comply to official authorities) regulations. Amotivation corresponds to the lack of
132 intention of doing the activity, or when people enact passively. In educational settings,

133 autonomous motivation has been associated with optimal professional functioning and is
134 assumed to energize teachers' willingness to engage in challenging teaching situations (Ryan
135 & Weinstein, 2009). Conversely, controlled motivation or amotivation may hinder persistence
136 and creativity (Ryan & Weinstein, 2009). For example, autonomous motivation, but not
137 controlled motivation, was associated with greater intention (Gorozidis & Papaioannou, 2014;
138 2016) and persistence (Lam et al., 2010) in implementing educational innovations. As stated by
139 the Self-Determination theory, individuals' self-determined motivation is affected by the
140 environment in which individuals evolve (Ryan & Deci, 2017). Because the educational
141 changes brought by the COVID-19 pandemic had drastically affected teachers' working
142 environments, changes in self-determined motivation were therefore expected to play an
143 important role in teachers' adaptation in promoting PA. In this perspective, we examined
144 whether changes in teachers' self-determined motivation toward the promotion of PA, from
145 before to during lockdown, were associated with changes in teachers' behaviors and intention
146 to promote PA.

147 **Self-efficacy toward promoting PA**

148 Regarding the disruption of traditional educational settings during lockdown, self-
149 efficacy also appeared as a good candidate in explaining both changes in teachers' behaviors
150 and intention to promote PA. Derived from the social-cognitive theory (Bandura, 1986), self-
151 efficacy, defined as beliefs about one's own capabilities to plan and execute a specific behavior,
152 was associated with adaptive outcomes in educational settings (e.g., greater willingness to adapt
153 one's pedagogical behaviors, even in challenging situations) (see Zee & Koomen, 2016 for a
154 review). In PE, this adaptive influence of self-efficacy was also evidenced (Gorozidis &
155 Papaioannou, 2011; Martin & Kulinna, 2004; Pan et al., 2013). For instance, higher self-
156 efficacy was associated with greater intention to promote health among students (Pan et al.,

157 2013). In this line, the association of changes in PE teachers' self-efficacy with changes in their
158 behaviors and intention to promote PA was examined.

159 **Perceived usefulness and ease toward digital technologies**

160 During lockdown, traditional face-to-face pedagogical interactions became impossible
161 and teachers could only provide their pedagogical contents using digital technologies (e.g., live
162 visio-conferences or video tutorials) (Gobbi et al., 2020). Teachers' familiarity with digital
163 technologies was therefore assumed to play a pivotal role in their ability to cope with this
164 situation. In this line, the Technology Acceptance Model (Davis, 1989) posits that perceived
165 usefulness and perceived ease toward digital technologies are related to teachers' behaviors and
166 intention to use such tools in education (Teo, 2012). Thus, changes in perceived usefulness and
167 ease toward digital technologies, from before to during lockdown, were thought to explain
168 changes in PE teachers' intention to promote PA.

169 **Engagement at work**

170 Because professional routines were greatly disrupted during lockdown, engagement at
171 work was also expected to explain teachers' involvement in the challenge of promoting PA.
172 Defined as "a positive fulfilling work-related state of mind characterized by vigor, dedication,
173 and absorption" (Schaufeli & Bakker, 2004, p.74), engagement at work is conceptualized as a
174 relatively persistent affective-cognitive state, which reflects how workers generally feel in
175 relation to their work, over long periods of time and across tasks (Schaufeli et al., 2002). In this
176 perspective, when considered as an enduring construct, engagement at work can be captured
177 through a single measurement (Bakker, 2014). In teaching settings, engagement at work was
178 paired with an increased effort in challenging situations, such as engaging in pedagogical
179 innovations (Karavasilis & Georgios, 2019). The association of engagement at work with
180 changes in behaviors and in the intention to promote PA, from before to during lockdown, was
181 therefore investigated.

182 **The current study**

208 French teachers (Table 1). To allow research teams to work together, the questionnaire was
209 originally developed in English, and subsequently translated in Italian and in French (see Table
210 S1). To estimate internal consistency, we computed Cronbach's alphas coefficients (with values
211 $> .70$ being considered as acceptable). However, because Cronbach's alphas are sensitive to the
212 number of items composing the scale (Eisinga et al., 2013), it is recommended, in the case of
213 two-item scales, to analyze other metrics, such as inter-item correlations. Hence, we
214 additionally computed inter-item correlations for two-item scales (i.e., autonomous and
215 controlled motivation) (with values $> .20$ and $< .40$ being considered as acceptable) (Piedmont,
216 2014).

217 **Measures**

218 With the exception of engagement at work, all motivational determinants and self-
219 reported behaviors promoting PA were captured in reference of both before and during
220 lockdown. To reduce risk of comparison bias, in a first part of the questionnaire, the participants
221 were asked to retrospectively provide information about the variables of interest before
222 lockdown. In a subsequent second part of the questionnaire, the participants provided
223 information about the variables of interest during lockdown. Engagement at work was assessed
224 at the end of the questionnaire.

225 ***Behaviors promoting PA***

226 Behaviors promoting PA were captured using three items (e.g., *Before/during lockdown,*
227 *how often did/do you guide your students to participate in outside-school?*). In the absence of
228 well-validated tools, these items were created because they were assumed to reflect key
229 teachers' behaviors in supporting students' PA (Gobbi et al., 2020). Answers were given on a
230 scale ranging from 1 (*Never*) to 5 (*Always*). Scores were averaged to compute a mean score (α
231 $= .82$ and $.79$ for before and during lockdown, respectively).

232 ***Intention to promote PA***

233 Intention to promote PA was measured using a two-item scale (Ajzen, 1985) (e.g.,
234 *Before/during the lockdown period, I plan/ed to promote outside-school PA of my students*).
235 Answers were given of a seven-point scale, ranging from 1 (*Totally disagree*) to 7 (*Totally*
236 *agree*). Scores were averaged to compute a mean score ($\alpha = .86$ and $.87$ for before and during
237 lockdown, respectively).

238 ***Self-determined motivation toward promoting PA***

239 Motivation to promote PA was captured using a five-item scale based on the Work
240 Tasks Motivation Scale for Teachers (Fernet et al., 2008). Participants reported the degree to
241 which five statements reflected their motivation to promote PA before/during lockdown. To
242 keep the questionnaire as short as possible and because single-item scales have been show to
243 provide acceptable validity (Gogol et al., 2014), each type of regulation was captured using a
244 single item: intrinsic (*Because I found/find it pleasant*), identified (*Because it was/is important*
245 *for me*), introjected (*Because if I hadn't done/don't to it, I would have felt/feel bad*), external
246 (*Because my PE teacher's work demanded/demands it*) and amotivation (*I didn't/don't feel*
247 *concerned because I thought/think that promoting outside-school PA among my students was/is*
248 *not a part of my job*). Answers were given on a seven-point scale, ranging from 1 (*Does not*
249 *correspond at all*) to 7 (*Totally corresponds*). Autonomous motivation was obtained by
250 averaging scores on items related to intrinsic and identified regulations (inter-item correlation
251 = $.38$ and $.53$ for before and during lockdown, respectively), while controlled motivation was
252 computed by averaging scores on items related to introjected and external regulations (inter-
253 item correlation = $.44$ and $.44$ for before and during lockdown, respectively).

254 ***Self-efficacy toward promoting PA***

255 Self-efficacy to promote PA before and during lockdown was assessed using a four-
256 item subscale (Gorozidis & Papaioannou, 2011). Participants were asked to indicate their
257 confidence in their ability to help their students in reference of four statements (e.g., *To set*

258 *goals for regular outside-school exercise and accomplish them*). Answers were given on a
259 scale ranging from 1 (*Not confident at all*) to 7 (*Absolutely confident*). Scores were averaged
260 to compute a mean score ($\alpha = .87$ and $.86$ for before and during lockdown, respectively).

261 ***Perceived usefulness and perceived ease toward digital technologies***

262 Based on previous research (Teo, 2012), perceived usefulness and perceived ease
263 toward digital technologies were both assessed using a single item: *Before/during lockdown, to*
264 *what extent did/do you think that digital technologies could be useful in promoting outside*
265 *school PA among your students?* for perceived usefulness; *Before/during lockdown to what*
266 *extent did/do you feel confident in your ability to use digital technologies to promote outside-*
267 *school PA among your students?;* for perceived ease. Answers were given on a scale ranging
268 from 1 (*Not confident at all* for perceived ease; *Not useful at all* for perceived usefulness;) to 7
269 (*Absolutely confident* for perceived ease; *Absolutely useful* for perceived usefulness).

270 ***Engagement at work***

271 Engagement at work was measured using the nine-item Utrecht Work Engagement
272 Scale (Schaufeli et al., 2006), which enables to assess three dimensions of work engagement,
273 through three items each: vigor (e.g., *At my job, I feel strong and vigorous*), absorption (e.g. *I*
274 *am immersed in my work*) and dedication (e.g., *I am proud of the job that I do*). Participants
275 were asked to focus on their general feelings about their work. They were invited to indicate
276 how often they experienced the proposed statements about their work using a seven-point scale
277 ranging from 1 (*Never*) to 7 (*Every day*). Scores were averaged to compute a mean score ($\alpha =$
278 $.93$).

279 ***Statistical analysis***

280 In a first step, measurement invariance was examined using a multi-group confirmatory
281 factor analyses (MCFA), in order to establish the comparability of measurement models across
282 the Italian and French samples (Milfont & Fischer, 2010). A step-up approach was adopted to

283 examine different forms of invariance (i.e., configural, metric, scalar) (e.g., Vandenberg &
284 Lance, 2000). A baseline model was computed by gathering scores from Italian and French
285 teachers and the expected relationships between each item and their latent factor were checked
286 (i.e., configural invariance) (Table S1). Metric and scalar invariances were then respectively
287 tested by constraining the factor loadings and intercepts of items to be the same across samples.
288 The comparisons of Root Mean Square Error of Approximation (Δ RMSEA) and in
289 Comparative Fit Indexes (Δ CFI) were used to inspect the changes in goodness of fits across
290 models. A Δ CFI \leq .01 and a Δ RMSEA \leq .015 indicate that the null hypothesis of invariance
291 should not be rejected (Chen, 2007).

292 Then, residualized change scores were obtained by regressing scored variables during
293 lockdown (e.g., intention to promote PA during the lockdown) on their respective variables
294 before lockdown (e.g., intention to promote PA before the lockdown) (Zumbo, 1999). All
295 variables were standardized before computing these regression analyses in order to improve the
296 convergence of subsequent path models. Residuals were saved and used as observed variables
297 in subsequent analyses. In addition of reducing auto-correlated errors and regression toward the
298 mean effects (Zumbo, 1999), this approach was chosen as it allowed to focus on changes in
299 variables, from before to during lockdown (see Table S2 for comparisons and associations of
300 scored variables, in reference of before and during lockdown). However, because it focuses on
301 the relationships between changes in variables rather than between their level, correlations
302 between scored variables are also provided in Table S3.

303 The hypothetical model was then tested in path analysis and CFI and RMSEA were
304 computed to examine the goodness of the models fit (Brown, 2006). A good model fit is
305 indicated by CFI $>$.95 and RMSEA $<$.05. Given the complexity of the hypothesized model,
306 we planned to adopt a backward strategy (Kline, 2015), whereby variables that do not improve
307 the fit of the model are removed.

308 Finally, using multi-group analyses, we tested whether path coefficients between the
309 different variables were invariant across countries, by comparing the fit of models with and
310 without equality constraints. Assuming that the unconstrained model (i.e., in which paths were
311 allowed to vary across samples) showed a better fit to the data than the constrained model, a
312 step-by-step approach was planned to identify which paths differed and needed to be released
313 across samples. All analyses were conducted using R-Studio, and the lavaan package was used
314 to conduct MCFA and path analyses (Rosseel, 2012).

315 **Results**

316 Descriptive statistics including means, standard-deviations, ranges are provided in
317 Table 1, for Italian and French teachers separately. Finally, correlations between residualized
318 scores are also reported in Table 2.

319 Regarding measurement invariance across the Italian and French samples, the baseline
320 model showed acceptable fit to the data (CFI = 0.901; RMSEA = .064 [90 % Confidence
321 Interval (90CI) = 0.061; 0.067]) supporting configural invariance (factors loadings are
322 presented in Table S1). When constraining factors loadings and intercept of items across
323 samples, we obtained $\Delta\text{CFI} = .004$, $\Delta\text{RMSEA} = .003$ for metric invariance, and $\Delta\text{CFI} = .006$,
324 $\Delta\text{RMSEA} = .003$ for scalar invariance. These findings suggested that measurement invariance
325 should not be rejected among the two samples (Cheung & Rensvold, 2002).

326 The hypothetical model gathering residualized scores from the two samples showed
327 poor fit to the data, with issues in the model identification. Using a step-by-step backward
328 strategy, we removed variables which did not improve the fit of the model, namely the paths
329 from controlled motivation, amotivation, perceived ease toward digital technologies, and
330 engagement at work with behaviors promoting PA. The final model showed excellent fit to the
331 data (CFI = 0.999; RMSEA = .016 [90CI = 0.000; 0.054]).

332 Figure 1B shows the parameter estimates from this final model. Changes in amotivation
333 ($\beta = -.21$, 95% Confidence Interval (95CI) $[-.26; -.17]$, $p < .001$), controlled motivation ($\beta =$
334 $.11$, 95CI $[.04; .17]$, $p = .001$), autonomous motivation ($\beta = .25$, 95CI $[.18; .32]$, $p < .001$), self-
335 efficacy ($\beta = .23$, 95CI $[.17; .30]$, $p < .001$), and perceived usefulness toward digital
336 technologies ($\beta = .12$, 95CI $[.06; .18]$, $p < .001$), from before to during lockdown, were
337 significantly associated with changes in the intention to promote PA. Changes in perceived ease
338 toward digital technologies ($p = .713$) and engagement at work ($p = .952$) were not significantly
339 associated with changes in the intention to promote PA. The model explained 30% of the
340 variance in changes in the intention to promote PA.

341 Changes in intention ($\beta = .24$, 95CI $[.19; .30]$, $p < .001$), in self-efficacy ($\beta = .27$, 95CI
342 $[.22; .32]$, $p < .001$), in autonomous motivation ($\beta = .07$, 95CI $[.01; .13]$, $p = .016$) and in
343 perceived usefulness toward digital technologies ($\beta = .13$, 95CI $[.09; .18]$, $p < .001$) were
344 significantly and positively associated with changes in behaviors promoting PA. The model
345 explained 33% of the variance in changes in behaviors promoting PA.

346 Next, multi-group analyses showed that the unconstrained model had a better fit than
347 the constrained model ($\Delta CFI = .03$, $\Delta RMSEA = .08$). According to changes in fit indices, only
348 two path coefficients were identified as significantly different by country: the paths from
349 changes in autonomous motivation to changes in intention and from changes in perceived
350 usefulness toward digital technologies to changes behaviors. When released across samples in
351 the final model, estimated parameters for the path between changes in autonomous motivation
352 to changes in intention were $\beta = .13$, 95CI $[.02; .24]$, $p = .024$ for Italian teachers and $\beta = .36$,
353 95CI $[.27; .45]$, $p < .001$ for French teachers. Estimated parameters for the path between
354 changes in perceived usefulness toward digital technologies to changes in behaviors were $\beta =$
355 $.08$, 95CI $[.01; .15]$, $p = .020$ for Italian teachers and $\beta = .17$, 95CI $[.10; .24]$, $p < .001$ for
356 French teachers.

357 **Sensitivity analysis**

358 We computed a model using residualized scores for intrinsic, identified, introjected and
359 external motivations, separately. Results were overall consistent with those reported in the main
360 analysis (Table S4) and underlined the associations of identified motivation with both intention
361 and behaviors promoting PA.

362 **Discussion**

363 **Main findings**

364 By identifying motivational determinants involved in changes in PE teachers' behaviors
365 promoting PA amidst the COVID-19 pandemic, the present study sheds light on processes
366 underlying teachers' commitment to challenging teaching situations. From before to during
367 lockdown, changes in PE teachers' amotivation, controlled and autonomous motivation, self-
368 efficacy, and perceived usefulness toward digital technologies were associated with changes in
369 their intention to promote PA. In turn, changes in their intention to promote PA, but also in self-
370 efficacy, autonomous motivation, and in perceived usefulness toward digital technologies, were
371 related to changes in behaviors promoting PA. Overall, these relationships were similar among
372 Italian and French teachers, although some small differences could be noted.

373 **The role of intention**

374 Changes in PE teachers' intention to promote PA were positively associated with
375 changes in behaviors promoting PA (H1). While previous empirical evidence was scarce and
376 contrasted in PE settings (Martin & Kulinna, 2004; Stanec, 2009), our results support the
377 intention-behavior relationship (Ajzen, 1985). The intention to promote PA during lockdown
378 may have relied on a well-elaborated decision, based upon a balance between the *pros and the*
379 *cons*, which would explain this relationship with behaviors. However, a change in intention
380 only predicted a small-to-medium change in behaviors ($\beta = .24$). In other words, a stronger
381 intention to promote PA during lockdown does not automatically translate into increased

382 behaviors promoting PA. Some teachers may have experienced difficulties in turning their
383 intention into action, either because they lacked resources (e.g., lack of theoretical knowledge
384 about the promotion of PA) or because they encountered obstacles (e.g., to create pedagogical
385 supports while keeping children at home). Future research could aim to investigate motivational
386 processes which can moderate the intention-action relationship, in order to better understand
387 how teachers can turn intention into action, especially in the case of challenging teaching
388 situations.

389 **The role of self-determined motivation**

390 Results showed that, from before to during lockdown, an increase in autonomous
391 motivation was associated with an increase in both the intention to promote PA and directly, to
392 behaviors promoting PA (H2a). As proposed by the Self-Determination Theory (Ryan & Deci,
393 2017) and consistent with previous literature in PE (Gorozidis & Papaioannou, 2014, 2016),
394 these findings suggest that autonomous motivation fosters teachers' commitment to challenging
395 situations. As exemplified by the increase of autonomous motivation from before to during
396 lockdown (Table 1), some PE teachers may have considered the promotion of PA during this
397 period as something particularly interesting or important (see Table S4), thereby committing
398 themselves to the pursuit of this goal. Moreover, this effect was more pronounced among
399 French teachers than among Italian teachers. This difference could be attributed to the fact that
400 Italian teachers were already highly autonomously motivated about the promotion of PA before
401 the COVID-19 pandemic, compared to French teachers (Table 1), thereby leading to a potential
402 ceiling effect in the French sample. For French teachers, promoting PA may have represented
403 a particularly exciting challenge, given that their habitual pedagogical practices do not integrate
404 the promotion of PA as the most central objective (Forest et al., 2017).

405 An increase in controlled motivation was related to an increase in the intention to
406 promote PA (H2e). By contrast with existing research (Gorozidis & Papaioannou, 2014), these

407 results emphasize that, during lockdown, PE teachers who expressed greater change in external
408 (e.g., to comply to educational authorities' instructions) or internal (e.g., feelings of guilt)
409 pressure also reported stronger intention to promote PA. Indeed, during this period, as teachers
410 from other fields, PE teachers may have been often solicited by their hierarchy to help their
411 students to be physically active or may have felt guilty not maintaining a certain connection
412 with their students, thereby generating controlled forms of motivations. Although controlled
413 motivation may have such positive short-term effects, the persistence of relating behaviors may
414 quickly vanish, especially when external pressures are no longer exerted (Ryan & Deci, 2017).

415 Conversely, amotivation was negatively associated with changes in the intention to
416 promote PA (H2f). This finding seems of concern as this unprecedented context may have
417 created feelings of helplessness or resignation among teachers, which may have in turn,
418 impeded their commitment to this challenging pedagogical situation.

419 **The role of self-efficacy**

420 Changes in self-efficacy toward the promotion of PA were positively associated with
421 both changes in intention and in behaviors promoting PA (H2b). These findings align with
422 previous literature which established that higher self-efficacy was associated with a greater
423 tendency to engage in new challenging teaching situations (Zee & Koomen, 2016). For
424 instance, teachers with higher self-efficacy were to be more likely to experiment different
425 teaching materials (McKinnon & Lamberts, 2014) and exhibited greater willingness in adapting
426 their pedagogical practices, even in challenging situations (Sandholtz & Ringstaff, 2014). In
427 our study, to counteract the disruption of traditional pedagogical practices, self-efficacy appears
428 as the most important precursors of teachers' readiness to take up the challenge of promoting
429 PA during lockdown.

430 **The role of perceived usefulness and ease toward digital technologies**

431 An increase in perceived usefulness toward digital technologies was associated with an
432 increase in the intention to promote PA, but also directly with changes in behaviors promoting
433 PA (H2c). This finding is in line with previous research showing that perceived usefulness
434 toward these tools was related to teachers' intention (Teo, 2012), but also to their actual use in
435 classrooms (Scherer et al., 2015). In particular, during the COVID-19 pandemic, Because of
436 distance teaching, digital technologies became indispensable in supporting students to be
437 physically active. Moreover, the association between perceived usefulness toward digital
438 technologies and behaviors promoting PA was stronger among French teachers, relative to
439 Italian teachers. This can be explained by the fact that, before the COVID-19 pandemic, French
440 teachers reported to be less familiar with these tools than Italian teachers (Table 1).
441 Accordingly, understanding the potential of such tools in the context of the COVID-19
442 lockdown may have particularly energized French teachers' willingness to promote youth's PA
443 in the context of the pandemic.

444 However, our results did not support the expected association between changes in
445 perceived ease toward digital technologies and in intention and behaviors to promote PA (H2d).
446 This finding stands in contrast with previous work which emphasized that teachers' perceived
447 ease toward digital technologies played an important role in the use of such tools (Teo, 2012).
448 This discrepancy could be accounted by the fact that, despite a more frequent use of digital
449 technologies and the possibility to develop new skills during this period (e.g., learning to create
450 video tutorials), changes in perceived ease toward these tools, from before to during the
451 lockdown, were not sufficient to have an effect on the intention to promote PA (see the strong
452 association between the variables before and during lockdown in Table S2).

453 **The role of engagement at work**

454 Engagement at work was neither significantly association to changes in the intention to
455 promote PA, nor to changes in behaviors (H2g). One explanation is statistical. Indeed,

456 engagement at work was significantly (though weakly) correlated with intention ($r = .13$, p
457 $<.001$) and behaviors promoting PA ($r = .13$, $p <.001$) (Table 2). Engagement was also
458 correlated with the different motivations (i.e., autonomous motivation, controlled motivation
459 and amotivation), as well as with self-efficacy (see Table 2), four variables that were significant
460 predictors of intention. Hence, the non-significant relationship of engagement at work with
461 intention or with behaviors could simply mean that this variable did not have sufficient
462 remaining unique variance to explain in the dependent variables, when self-determined
463 motivations and self-efficacy were controlled for. Another possible explanation was that
464 engagement at work energize individuals' global commitment, but does not focus on a
465 particular behavior (Schaufeli et al., 2006; but see Sonnentag, 2017 for a discussion) and,
466 thereby, does not affect the engagement in a very specific behavior (i.e., promoting PA).
467 Instead, engagement at work could have also favored teachers' commitment to other
468 pedagogical objectives, such as teaching students new motor skills. Finally, a last explanation
469 may be that we did not measure changes in engagement at work from before to during the
470 lockdown period. Yet, a growing number of studies propose that engagement at work may, in
471 fact fluctuate, over short periods of time (i.e., from day to day or from hour to hour), with
472 important within-person variations (Sonnentag et al., 2010). Because the COVID-19 lockdown
473 has greatly affected teachers' job demands and resources (Pöysä et al., 2021), the two main
474 precursors of engagement at work (Bakker & Demerouti, 2007), it is likely that PE teachers'
475 feelings toward their own work have evolved across this timeperiod. In this perspective, future
476 studies could seek to examine how PE teachers' engagement at work fluctuates across time and
477 how such evolutions may relate to their commitment in challenging teaching situations.

478 **Strengths and limitations**

479 The present study has several strengths. First, a theoretically-driven approach was
480 adopted to identify motivational determinants involved in changes in teachers' behaviors.

481 Second, this study was based on a large sample composed of Italian and French teachers. After
482 establishing measurement invariance in the two samples, this cross-cultural approach shed light
483 on the similarities and differences in associations across teachers from these two countries.
484 Third, although variables relating to the before-lockdown period were retrospectively assessed,
485 the longitudinal design of the study allowed to model the changes in measured constructs. A
486 well-suited statistic approach, combining residualized scores and path analysis, subsequently
487 enabled to investigate the relationships between these changes. However, this study also
488 presents several limitations which need to be acknowledged. First, behaviors promoting PA
489 were self-reported and only provided a global overview of teachers' behaviors during the
490 lockdown period. Indeed, they did not refer to other pedagogical objectives, that PE teachers
491 could have pursued during the lockdown period (e.g., teaching students new motor skills, such
492 as juggling). Second, to keep the questionnaire as short as possible, some variables (i.e., self-
493 determined motivation, perceived usefulness and ease toward digital technologies) were
494 assessed using a low number of items (but see the sensitivity analysis, Table S4). Third, another
495 limitation stems from a selection bias in our sample: teachers who were the most satisfied with
496 their work may have been more likely to participate in this study. Fourth, given the moderate
497 part of variance explained by our model, other determinants may have contributed to explain
498 teachers' behaviors promoting PA. We did not assess all variables of the theory of planned
499 behavior, especially attitude and subjective norm. We believe that these two constructs overlap
500 in part with the three forms of motivation from the self-determination theory (i.e., attitudes with
501 autonomous motivation and subjective norm with controlled motivation). Nevertheless, some
502 integrative models (e.g., Hagger & Chatzisarantis, 2009) have shown that attitude and
503 subjective norm could partially mediate the relationship between self-determined motivation
504 and intention. Future work may benefit from measuring attitude and subjective norm in order
505 to increase the percentage of variance explained for intention and/or better understand the

506 mechanisms through which self-determined motivation drives intention. Finally, as proposed
507 by socioecological models (Bronfenbrenner, 1986), other factors spanning from individual
508 (e.g., emotional states), familial (e.g., number of children at home during the COVID-19
509 lockdown), organizational (e.g., school support), to environmental levels (e.g., perceived
510 availability of PA opportunities outside of school) could have explained teachers' behaviors.
511 Future studies remain needed to examine how these different levels of factors may jointly
512 explain PE teachers' behaviors when faced to challenging teaching situations.

513 **Practical implications**

514 While the COVID-19 lockdown has asked teachers from all fields a massive effort of
515 adaptation, the present study draws important implications in better supporting professionals to
516 cope with such an unprecedented context (see Webster et al., 2021 for a practical example in
517 PE). First, promoting autonomous motivation and reducing amotivation may foster teachers'
518 intention to engage in teaching challenges. In this perspective, satisfying the three basic
519 psychological needs (i.e., autonomy, competence and relatedness) could foster autonomous
520 motivation (Jansen in de Wal et al., 2014). For example, during lockdown, encouraging
521 collaborative work and experience sharing between colleagues, could have fulfilled teachers'
522 relatedness and competence needs. In the same perspective, providing teachers with a rationale
523 about their role during this period and reinforcing their capacity for choices (e.g., pedagogical
524 supports, type of activities) could have satisfied their need for autonomy. Second, underlining
525 prior mastery experiences (e.g., encouraging teachers to collect feedbacks about their students'
526 experiences), enabling vicarious experiences (i.e., learning through the observation of another
527 teacher), promoting verbal persuasion by giving positive feedbacks, and ensuring positive
528 emotional state could represent insightful levers in supporting teachers' self-efficacy (Martin
529 et al., 2009). Finally, in the context of distance teaching, educating teachers to the possibilities
530 of digital technologies could reinforce their perceived usefulness toward these tools, which

531 may, in turn, foster the implementation of renewed pedagogical practices (Scherer & Teo,
532 2019).

533 **Conclusion**

534 This study advances literature by contributing to understand why PE teachers engaged
535 in the challenge of promoting PA during the COVID-19 lockdown. We hope that it will help
536 researchers and practitioners to better understand how to cope with disruptive educational
537 settings and that these findings will ultimately contribute to the recognition of the important
538 investment of PE teachers in an unprecedented context.

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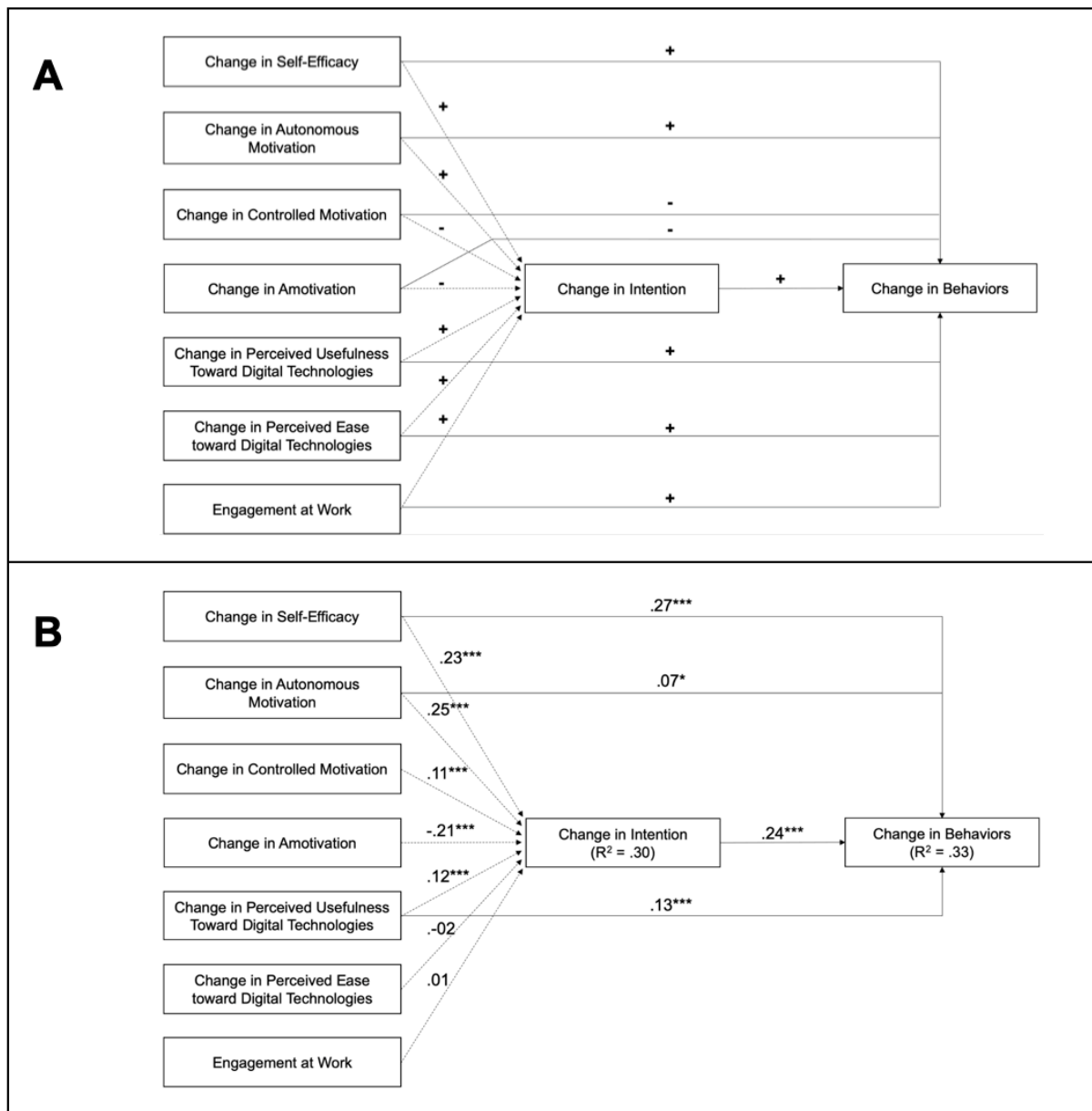
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725

726 **Figure 1.**

727 *Path diagrams illustrating the hypothetical model (A) and results of the tested model (B).*



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729 *Note.* Standardized beta coefficients (β) and R-squared (R^2) are presented. ***: $p < .001$; **:

730 $p < .01$; *: $p < .05$.

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733 **Table 1.** *Descriptive statistics.*

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	Italian Teachers (n = 497)		French Teachers (n = 434)	
	Mean (SD)	Range	Mean (SD)	Range
Sex (% of woman)	67	-	49	-
Age (years)	50 (10)	26-65	42 (12)	22-64
Years as PE teacher	21 (13)	2-43	18 (11)	1-41
Behaviors promoting PA				
Before lockdown	3.71 (0.81)	1-5	2.92 (0.80)	1-5
During lockdown	3.78 (0.89)	1-5	3.64 (0.89)	1-5
Intention to promote PA				
Before lockdown	5.34 (1.62)	1-7	5.37 (1.39)	1-7
During lockdown	6.19 (1.14)	1-7	6.14 (1.09)	1-7
Amotivation to promote PA				
Before lockdown	1.90 (1.42)	1-7	1.47 (0.98)	1-7
During lockdown	1.62 (1.25)	1-7	1.43 (1.04)	1-7
Controlled motivation to promote PA				
Before lockdown	2.85 (1.41)	1-7	3.49 (1.63)	1-7
During lockdown	5.02 (1.50)	1-7	4.84 (1.58)	1-7
Autonomous motivation to promote PA				
Before lockdown	5.50 (1.20)	1-7	4.94 (1.30)	1-7
During lockdown	5.84 (1.09)	1-7	5.48 (1.27)	1-7
Self-efficacy to promote PA				
Before lockdown	5.27 (1.14)	1-7	4.38 (1.03)	1-7
During lockdown	5.34 (1.24)	1-7	4.47 (1.22)	1-7
Perceived usefulness toward digital technologies				
Before lockdown	4.27 (1.50)	1-7	3.96 (1.54)	1-7
During lockdown	5.44 (1.57)	1-7	5.49 (1.55)	1-7
Perceived ease toward digital technologies				
Before lockdown	4.42 (1.49)	1-7	4.19 (1.70)	1-7
During lockdown	4.87 (1.40)	1-7	4.72 (1.60)	1-7
Engagement at work	6.12 (0.94)	1-7	5.75 (0.89)	1.4-7

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736 *Note.* SD = standard-deviations.

737 **Table 2.** *Correlations of residualized scores.*

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	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Behaviors promoting PA	-	.45***	-.17***	.17***	.30***	.46***	.30***	.18***	.13***
2. Intention to promote PA		-	-.33***	.24***	.38***	.36***	.25***	.09**	.13***
3. Amotivation to promote PA			-	-.09**	-.19***	-.06	-.17***	-.15***	-.07*
4. Controlled motivation to promote PA				-	.29***	.23***	.11**	.04	.13***
5. Autonomous motivation to promote PA					-	.33***	.17***	.08*	.21***
6. Self-efficacy to promote PA						-	.22***	.19***	.21***
7. Perceived usefulness toward digital technologies							-	.25***	.03
8. Perceived ease toward digital technologies								-	.03
9. Engagement at work									-

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Note. Correlation coefficients between residualized scores for the whole sample are reported. ***: $p < .001$; **: $p < .01$, *: $p < .05$.