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Who stays on? The link between psychosocial patterns and changes in exercise and sport behaviour when adolescents make transitions in education

Julia Schmid, Vanessa Gut, Takuya Yanagida, and Achim Conzelmann

#### Author Note

Institute of Sport Science, University of Bern, Switzerland; Department of Economic Psychology, Educational Psychology and Evaluation, University of Vienna, Austria.

Corresponding author: Julia Schmid, Institute of Sport Science, University of Bern, Bremgartenstrasse 145, 3012 Bern, Switzerland, [julia.schmid@ispw.unibe.ch](mailto:julia.schmid@ispw.unibe.ch), +41 (0)31 631 51 16.

#### Declaration

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No author has a conflict of interest to disclose.

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## Abstract

**Background:** The first aim of the present study was to identify psychosocial patterns among adolescents at lower secondary school. Employing the motivation and volition process model and a socioecological framework, self-concordance, action planning, social support, and club-related exercise and sport activities were included as indicators. The second aim was to examine how these patterns are associated with the maintenance of exercise and sport during students' transition to upper secondary education. The last aim was to investigate whether the associations were moderated by individuals' subjective evaluation of the transition. **Methods:** One-year longitudinal data of 392 adolescents were analysed. All variables were measured via online self-report. **Results:** Based on latent profile analysis, four patterns were found: 'averages', 'club enthusiasts', 'club engaged planners', and 'less motivated and social uncommits'. Regression analyses showed that the club engaged planners were more likely to adopt and maintain exercise and sport than to drop out. Additionally, moderation analyses revealed that the averages were less likely to be maintainers/adopters when they evaluated the transition more negatively. **Conclusion:** People with relatively high action planning and a high number of club-related activities were less vulnerable to decreasing their activity time during the transition to upper secondary education. Furthermore, transitional stress bore no negative association with students' exercise and sport behaviour.

*Keywords:* club, planning, intrinsic motivation, social support, person-oriented approach, (stressful) life event

## Abbreviations

BIC = Bayesian information criterion; BLRT = bootstrapped likelihood-ratio test; E = kurtosis; FIML = full-information maximum likelihood; LPA = latent profile analysis; MLR = maximum likelihood estimation with robust standard errors; MoVo = motivation and volition process model; RQ = research question; S = skewness; VET = vocational education and training

## WHO STAYS ON?

25 Who stays on? The link between psychosocial patterns and changes in exercise and sport be-  
26 haviour when adolescents make transitions in education

27 Individuals often reduce their level of physical activity during adolescence and young  
28 adulthood (Corder et al., 2017), and the transition from lower to upper secondary education<sup>1</sup>,  
29 occurring between 14 and 16 years of age, appears to have an impact on the physical activity  
30 behaviour of these adolescents. A representative, longitudinal study revealed that there is  
31 around a 20% decrease in the number of individuals who engage in the recommended amount  
32 of physical activity (e.g. Li et al., 2016). In view of the various positive, long-term effects on  
33 health and well-being (Beauchamp, Puterman, & Lubans, 2018; Lubans et al., 2016; War-  
34 burton & Bredin, 2017), it is vital to promote physical activity among adolescents during this  
35 transition. However, to develop interventions that promote physical activity, it is essential not  
36 only to identify factors that influence physical activity behaviour, but also to understand their  
37 interplay within each individual.

### 38 **Psychological and Social Factors Influencing Physical Activity Behaviour**

39 Policy, environmental, biological, psychological, and social factors all influence ado-  
40 lescents' physical activity behaviour (Biddle, Atkin, Cavill, & Foster, 2011). In this study, we  
41 examined the impact of the latter two and derived specific variables from two theories. These  
42 variables are explained below, and the relevant literature was reviewed; however, few studies  
43 have specifically investigated exercise and sport behaviour during students' transition from  
44 lower to upper secondary school. Consequently, we have taken a wider view, and we present  
45 research that deals with a variety of educational transitions during adolescence and young  
46 adulthood. It should be noted that the varied age groups and transitional structures (UNESCO

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<sup>1</sup> The terms lower and upper secondary education refer to the international standard classification of education from UNESCO Institute of Statistics (2012). In many educational systems, the end of lower secondary education is the end of general, compulsory schooling. In contrast, upper secondary education typically prepares students more specifically for tertiary education or provides skills relevant for employment.

## WHO STAYS ON?

47 Institute of Statistics, 2012) investigated in earlier research may limit the comparability with  
48 our results.

49         The motivation and volition process model (MoVo) of Fuchs, Göhner, and Seelig  
50 (2011) is relevant as it focusses on psychological antecedents of exercise and sport behaviour.  
51 According to MoVo, *self-concordance* is an important motivational factor for adopting and  
52 maintaining physical activity. It refers to the degree that a specific goal intention is congruent  
53 with one's basic needs and personal values. Self-concordance is seen as a continuum, ranging  
54 from a person's intrinsic motivation mode, where the physical activity is inherently interest-  
55 ing, to an external motivation mode, where the person wants to be active owing to external  
56 pressure or positive consequences (Sheldon & Elliot, 1999). Prospective studies showed that  
57 intrinsic motivation generally promotes physical activity behaviour not only during adoles-  
58 cence and young adulthood (Carraro & Gaudreau, 2011; Teixeira, Carraca, Markland, Silva,  
59 & Ryan, 2012), but also specifically during educational transitions (Ullrich-French, Cox, &  
60 Bumpus, 2013).

61         An important volitional factor is *action planning* (Fuchs et al., 2011), which refers to  
62 forming precise plans about when, where, how, and with whom one will be physically active  
63 in the future. By forming such plans, individuals mentally link situational cues (e.g. 6 p.m. on  
64 Monday) to behavioural responses (e.g. go to the gym with Maria), which, in turn, increases  
65 the likelihood of implementing the intended behaviour (Bélanger-Gravel, Godin, &  
66 Amireault, 2013). Most prospective and experimental research indicates that action planning  
67 supports adherence to physical activity in young adulthood (Bélanger-Gravel et al., 2013).  
68 However, the few existing studies focussing specifically on its impact during the transition in  
69 education have produced inconsistent results (Bray et al., 2011; Brown, Bray, Beatty, &  
70 Kwan, 2014; Li et al., 2016).

71         In contrast to MoVo, the socioecological framework of Sallis et al. (2006) emphasises  
72 factors in the social-cultural environment and behaviour setting. According to this framework,

## WHO STAYS ON?

73 *social support of the family* influences adoption and maintenance of physical activity. Parents  
74 can influence adolescents' behaviour in many ways: transporting them to the sport facilities  
75 and performing the activity together (instrumental support), speaking with them about the im-  
76 portance of an active lifestyle and about how to be active (informational support), and encour-  
77 aging them and praising their efforts (emotional support; Schwarzer & Knoll, 2007). Most  
78 studies demonstrated positive associations between social support of the family and youths'  
79 physical activity (Beets, Cardinal, & Alderman, 2010; Yao & Rhodes, 2015), including dur-  
80 ing educational transitions (Li et al., 2016; Molina-Garcia, Queralt, Castillo, & Sallis, 2015;  
81 Simons et al., 2015; van Dyck, de Bourdeaudhuij, Deliens, & Deforche, 2015). Furthermore,  
82 *being in a club* fosters regular physical activity (Sallis et al., 2006). A club is a setting where  
83 adolescents participate voluntarily in guided exercise and sport activities beyond the school  
84 curricula, and where they can cultivate friendships with peers (Breuer, Hoekman, Nagel, &  
85 van der Werff, 2015)<sup>2</sup>. Prospective studies confirmed that club membership supports adher-  
86 ence to physical activity from adolescence to adulthood (Wichstrøm, von Soest, & Kvaalem,  
87 2013; Zimmermann-Slouthskis, Wanner, Zimmermann, & Martin, 2010); in particular, after  
88 leaving compulsory schooling (Eime et al., 2016; Simons et al., 2015). Studies have also indi-  
89 cated sex differences for both aforementioned social factors; e.g. boys are more likely to en-  
90 gage in organised exercise and sport activities than are girls (Biddle et al., 2011).

### 91 **Interplay Between Psychological and Social Factors**

92 In the socioecological framework (Sallis et al., 2006), psychological and social factors  
93 of physical activity behaviour are believed to interact with each other. However, the mecha-  
94 nism that reflects this interplay is not clearly specified. According to Schröder (1997), two  
95 mechanisms have been proposed: (a) the synergistic effect, in which individuals with high

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<sup>2</sup> In German-speaking countries, club activities do not only include competitive sport activities such as soccer or tennis, but also health-oriented activities such as jogging or fitness (Breuer et al., 2015).

## WHO STAYS ON?

96 values in psychological variables profit more from a stimulating social environment and set-  
97 ting as they are more likely to translate this into their own behaviour. Put differently, psycho-  
98 logical and social factors strengthen one another regarding their impact on physical activity;  
99 and (b) the compensation effect, in which individuals with high values in psychological varia-  
100 bles can compensate for their lack of social resources, or vice versa.

101         When investigating the mechanism of psychological and social factors within individ-  
102 uals, the person-oriented approach could be relevant (Bergman & Lundh, 2015; Bergman &  
103 Magnusson, 1997). This approach assumes that an individual's psychological and social fac-  
104 tors do not develop independently of one another; rather, they develop in a complex recipro-  
105 cal interplay. Consequently, one should use statistical procedures for the investigation, which  
106 allow inferences about single individuals. Variable-oriented methods do not usually fulfil this  
107 requirement as variables are analysed on an aggregated group-level. For example, if a rela-  
108 tively high correlation coefficient between a psychological and social variable has been calcu-  
109 lated for a sample (e.g.  $r = .60$ ), it cannot be assumed that the found correlation will be the  
110 same for every single individual (Bergman & Lundh, 2015; Bergman & Wångby, 2014). An-  
111 other methodological consequence of the person-oriented approach is that the focus is on indi-  
112 vidual psychosocial patterns. This means that the configuration of variable values *within* a  
113 person is analysed (Bergman & Lundh, 2015; Bergman & Wångby, 2014).

114         The few previous studies that tested the synergistic and/or compensation effect used a  
115 variable-oriented approach. While two studies found evidence of the synergistic effect of psy-  
116 chological and social variables on physical activity (Dishman, Saunders, Motl, Dowda, &  
117 Pate, 2009; Warner, Ziegelmann, Schüz, Wurm, & Schwarzer, 2011), one study provided sup-  
118 port for both synergistic and compensatory effects (Hamilton, Warner, & Schwarzer, 2017).  
119 Although the above-mentioned research concentrated on slightly different variables (e.g. self-  
120 efficacy), it is reasonable to assume that synergistic and compensation effects also occur in  
121 the psychological (self-concordance and action planning) and social variables (social support

## WHO STAYS ON?

122 and being active in a club) discussed in the present study. This assumption is underpinned by  
123 evidence demonstrating that the effect of action planning on behaviour is strengthened by a  
124 supportive social environment (Hagger & Luszczynska, 2014). Furthermore, Gerber, Mallett,  
125 and Pühse (2011) showed that there is an interplay between action planning and club member-  
126 ship. Taken together, these findings may support the proposed interplay; however, existing  
127 studies tested the effect on an aggregated group-level and therefore do not allow conclusions  
128 on the interaction *within* individuals. Consequently, further research focussing on psychoso-  
129 cial patterns and their link to physical activity change is needed.

### 130 **Moderating Effect of Subjective Evaluation of the Educational Transition**

131 A factor that may influence the association between psychosocial patterns and physi-  
132 cal activity change is the subjective evaluation of the educational transition. Although all ado-  
133 lescents face the same life event, it is likely that the transition is not perceived in the same  
134 way by all individuals and this, in turn, may affect behaviour (Lazarus & Folkman, 2006;  
135 Stults-Kolehmainen & Sinha, 2014). For instance, individuals who evaluate the transition as  
136 stressful could conceivably be more vulnerable to ceasing physical activity. This perceived  
137 stress seems to be especially high (a) when changes are beyond the control of the individual  
138 (uncontrollability), (b) when the individual could not have expected the event to occur (unpre-  
139 dictability), (c) when the individual needs to adapt their usual activities (impact), and (d)  
140 when the individual's most important goals are attacked (centrality Dohrenwend, 2000; Geyer,  
141 Broer, Haltenhof, Bühler, & Merschbächer, 1994; Schwarzer & Luszczynska, 2013). To our  
142 knowledge, no study has examined the influence of this subjective evaluation of the transi-  
143 tion.

### 144 **The Present Study**

## WHO STAYS ON?

145           Our current aim was to examine how psychological and social factors are associated  
146 with exercise and sport behaviour change during students' transition from lower to upper sec-  
147 ondary education. Compared to existing research, this investigation adds value owing to the  
148 following extension. First, a person-oriented approach was used to investigate the research  
149 question (RQ). By focussing on psychosocial patterns, this study helps to clarify how psycho-  
150 logical and social factors interact *within* an individual. In contrast to variable-oriented re-  
151 search (e.g. Hamilton et al., 2017; van Dyck et al., 2015), these results allow us (to some ex-  
152 tent) to make inferences pertaining to individual adolescents rather than the entire group. It is  
153 beneficial to know more about individual mechanisms as it helps in creating appropriately tai-  
154 lored interventions, which promote exercise and sport.

155           Second, we focussed on exercise and sport, which are both planned, structured, and  
156 performed during leisure time (Strath et al., 2013). Most existing research has investigated  
157 changes in physical activity (e.g. Li et al., 2016; Simons et al., 2015); however, physical ac-  
158 tivity is an omnibus construct and comprises diverse behaviours (e.g. chores, climbing stairs,  
159 exercise, sport). Not only might these diverse behaviours change differently during the transi-  
160 tion period (Butler, Black, Blue, & Gretebeck, 2004), but they could also be influenced by  
161 varying factors. Consequently, it seems reasonable to focus on the two similar subsets of exer-  
162 cise and sport.

163           Third, to examine medium-term changes in exercise and sport behaviour, a longitudi-  
164 nal observational study was conducted over a 1-year period. This contrasts many previous  
165 studies that either had a relatively short period of observation (e.g. Bray et al., 2011) or whose  
166 reports were initiated only after the transition period (e.g. Brown et al., 2014).

167           Lastly, we also considered the subjective evaluation of the transition. Previous studies  
168 considered only the objective characteristic of the life event. However, as mentioned earlier, it  
169 is likely that adolescents perceive the transition differently, thus affecting their behaviour  
170 (Lazarus & Folkman, 2006).



## WHO STAYS ON?

171           Considering the extensions applied to the present study, the following three RQs were  
172 posed:

173           1.     Which psychosocial patterns exist in adolescents at lower secondary education?

174           Here, the aim was to identify patterns from two psychological (self-concordance, ac-  
175 tion planning) and two social indicators (social support of the family, being active in a club).  
176 Additional characteristics, such as sex and actual exercise and sport behaviour, were used to  
177 further characterise the detected patterns. Owing to the lack of knowledge about the existence  
178 of specific psychosocial patterns in adolescents, we had no prior assumptions about the re-  
179 sults.

180           2.     Are certain patterns positively associated with maintaining exercise and sport  
181                 during the transition to upper secondary education?

182           First, we expected that adolescents displaying patterns with high values in both psy-  
183 chological and social factors were more likely to maintain their exercise and sport behaviour  
184 than to drop out. This first hypothesis assumes a synergistic effect (Schröder, 1997). Second,  
185 we expected high scores – either in the psychological or in the social factor alone – to be ben-  
186 efcial. We hypothesised that individuals showing such patterns would be more likely to stay  
187 active than to drop out of exercise and sport. This second prediction assumes a compensation  
188 effect (Schröder, 1997).

189           3.     Are the associations between psychosocial patterns and exercise and sport be-  
190                 haviour change moderated by a subjective evaluation of the transition?

191           One might speculate the subjective evaluation of the life event to have an enforcing or  
192 weakening effect (Stults-Kolehmainen & Sinha, 2014). However, this RQ is more explorative  
193 in nature since there is no clear evidence of exactly how a subjective evaluation of the transi-  
194 tion affects behaviour.

195

## Methods

196 **Participant Recruitment and Procedures**

197 Participants of this prospective study were recruited from 77 different school classes  
198 in rural and urban areas of Switzerland. The first data collection was performed in spring  
199 2016 (T1), when adolescents were in their 9th and final year of lower secondary school. The  
200 second data collection was performed in spring 2017 (T2), after these adolescents had either  
201 switched to a baccalaureate school<sup>3</sup>, started vocational education and training (VET), or had  
202 entered a transitional option.

203 At T1, questionnaires were distributed during regular school lessons, supervised by  
204 one of the authors. Adolescents provided their postal addresses and e-mail if they agreed to be  
205 contacted again one year later. At T2, online questionnaires were used. If adolescents com-  
206 pleted both surveys, they received a voucher for 15 Swiss francs. Figure S1 in the supporting  
207 information shows a flow chart of the study recruitment. Of the 953 originally recruited ado-  
208 lescents, 392 comprised the final sample. Adolescents were excluded if they had physical dis-  
209 abilities preventing them from exercising or doing sport on a regular basis, or when they had  
210 no basic language skills in German. One of the authors checked study eligibility during data  
211 collection at T1 in consultation with the teacher.

212 Participants provided their informed written consent to participate. The Ethics Com-  
213 mission of the Faculty of Human Sciences of the University of Bern approved the study de-  
214 sign and procedures.

215 **Participants' Characteristics and Study Dropouts**

216 On average, the age of the adolescents was between 15 and 16 years at T1 (full sample  
217 = 15.34 years; longitudinal sample = 15.27 years). Slightly more girls (full sample = 54.5%;  
218 longitudinal sample = 62.2%) than boys (full sample = 45.2%; longitudinal sample = 37.8%)  
219 participated. Further characteristics of the sample are summarised in supporting information

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<sup>3</sup> The baccalaureate school prepares students who aspire to an academic career at a tertiary level (e.g. university).

## WHO STAYS ON?

220 Table S1. Dropout analyses<sup>4</sup> were conducted to compare individuals who were eligible for the  
221 study but did not participate at T2 (study dropouts,  $n = 553$ , 58.5%) with those who com-  
222 pleted both questionnaire assessments (completers,  $n = 392$ , 41.5%) concerning the main  
223 study variables and socio-demographic variables. No differences were found for exercise and  
224 sport (minutes per week), social support of family, action planning, or percentage of exercise  
225 and sport time in a club. However, t-tests and chi-square tests showed that there were differ-  
226 ences in self-concordance ( $t(941) = 2.89$ ,  $p_{\text{bonferroni-corrected}} = .020$ ,  $d = 0.191$ , 95% CI [.06,  
227 .32]), in that study dropouts had a lower self-concordance than did completers. Furthermore,  
228 the study dropout rate was lower for older participants ( $t(865.93) = -2.62$ ,  $p_{\text{bonferroni-corrected}} =$   
229  $.045$ ,  $d = 0.18$ ; 95% CI [.05, .31), girls ( $\chi^2(1) = 15.54$ ,  $p < .0005$ ,  $\phi_{\text{corr}} = 0.28$ , 95% CI [.23,  
230 .35]), Swiss ( $\chi^2(1) = 8.49$ ,  $p = .004$ ,  $\phi_{\text{corr}} = 0.23$ , 95% CI [.17, .30]), and those with a school  
231 level B ( $\chi^2(1) = 24.12$ ,  $p < .0005$ ,  $\phi_{\text{corr}} = 0.32$ , 95% CI [.26, .39]). As the reported effect sizes  
232 are rather small, the sample might be biased negligibly.

### 233 Measures

234 **Exercise and Sport Behaviour Change.** Leisure time exercise and sport behaviour  
235 were measured at T1 and T2 using a German-language questionnaire developed and validated  
236 by Fuchs, Klaperski, Gerber, and Seelig (2015). Participants named a maximum of three exer-  
237 cise or sport activities they had regularly engaged in within the last four weeks. They indi-  
238 cated the frequency and duration per episode in minutes for each activity. Based on the re-  
239 ports, a total index value was calculated in ‘min per week’.

240 Because the present study focussed on adolescents dropping out of exercise and sport,  
241 a new variable was calculated using information about exercise and sport behaviour at T1 and  
242 T2 from the questionnaire by Fuchs et al. (2015). Following the recommendation of the  
243 World Health Organization (2010), adolescents performing less than 75 minutes of exercise

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<sup>4</sup> Please be aware that study dropouts are not the same as exercise and sport dropouts (as introduced on p. 11)

## WHO STAYS ON?

244 and sport were categorised as insufficiently active, whereas those doing more were catego-  
245 rised as sufficiently active. Next, four categories of exercise and sport behaviour change were  
246 formed: (a) we called adolescents who were insufficiently active at both T1 and T2 *resisters*  
247 ( $n = 77$ , 19.6%), (b) those who were sufficiently active at both T1 and T2 *maintainers* ( $n =$   
248  $223$ , 56.9%), (c) those who were insufficiently active at T1 but sufficiently active at T2  
249 *adopters* ( $n = 29$ , 7.4%), and (d) those who were sufficiently active at T1 but insufficiently  
250 active at T2 *exercise and sport dropouts* ( $n = 63$ , 16.1%). Owing to the small sample size of  
251 the adopters ( $n < 30$ ), and the fact that the weekly time spent exercising and doing sport at T2  
252 did not differ ( $t(249.00) = -1.76$ ,  $p = .080$ ), the adopters were merged with the maintainers to  
253 create one group for future data analyses.

254 **Exercise and Sport in a Club.** Directly following the aforementioned questionnaire  
255 by Fuchs et al. (2015), adolescents were asked if they had engaged in any exercise or sport ac-  
256 tivities in a club. This information was used to calculate a percentage of weekly exercise and  
257 sport time in a club.

258 **Perceived Social Support from Family.** Social support from family at T1 was as-  
259 sessed using a six-item German-language scale by Krebs, Baaken, Hofmeier, Göhner, and  
260 Fuchs (2015). Adolescents had to assess how they perceived instrumental (e.g. ‘they exercise  
261 and do sport with me’) and emotional support (e.g. ‘they encourage me to exercise and do  
262 sport regularly’) from their parents and siblings on a 5-point scale ranging from 1 (*not true*) to  
263 5 (*totally true*). The internal consistency of the scale was good ( $\alpha = .78$ ).

264 **Self-concordance.** The self-concordance of an exercise and sport-related goal inten-  
265 tion was measured at T1 with a validated, German-language questionnaire by Seelig and  
266 Fuchs (2006). Four subscales measured intrinsic, identified, introjected, and external inten-  
267 tions to exercise. Each subscale consists of three items. The item stem was: ‘I intend to exer-  
268 cise regularly within the next weeks and months because...’ and were followed by different  
269 statements (e.g. ‘it is just fun for me’). The response format was a 6-point scale ranging from

## WHO STAYS ON?

270 1 (*not true*) to 6 (*exactly true*). Overall, the subscales had satisfactory to good internal consist-  
271 encies ( $.66 \leq \alpha \leq .80$ ; Table S2). The self-concordance index was calculated by summing the  
272 identified and intrinsic mean scores and subtracting the introjected and external mean scores  
273 (Seelig & Fuchs, 2006).

274 **Action Planning.** Action planning of exercise at T1 was assessed via a German-lan-  
275 guage 5-item-scale by Sniehotta, Scholz, and Schwarzer (2005). The item stem was: ‘I have  
276 made a detailed plan for...’, followed by statements such as ‘...when to exercise’ or ‘where to  
277 exercise’. Adolescents responded on a 5-point scale ranging from 1 (*not true*) to 5 (*exactly*  
278 *true*). The internal consistency of the scale was good ( $\alpha = .86$ ).

279 **Subjective Evaluation of the Transition.** Subjective evaluation of the transition from  
280 lower to upper secondary education was measured at T2 using five validated items of the Ger-  
281 man-language Inventory for Life-changing Events (Geyer et al., 1994; Siegrist & Geyer,  
282 2014). Participants rated uncontrollability (e.g. ‘at first, I was completely at the mercy of the  
283 event’), unpredictability (e.g. ‘the event was unpredictable for me’), impact (e.g. ‘the event  
284 forced me to plan my everyday life differently’), and centrality (e.g. ‘the event hit me at my  
285 very core’) of the transition on a 5-point scale ranging from 1 (*not true*) to 5 (*totally true*).  
286 The internal consistency of the scale was good ( $\alpha = .75$ ).

## 287 **Statistical Analyses**

288 To identify psychosocial patterns in adolescents at lower secondary school (RQ 1), la-  
289 tent profile analyses (LPA) were conducted. Variances in all profiles in the LPA models were  
290 freely estimated. However, it was not possible to fully implement this specification due to  
291 convergence problems caused by the ‘exercise and sport in a club’ variable. Following the  
292 recommendation of Morin and Wang (2016), model complexity was reduced by constraining  
293 the variance to be invariant across profiles. Statistical indicators and theoretical considerations  
294 were combined to decide the optimal number of profiles. The bootstrapped likelihood-ratio

## WHO STAYS ON?

295 test (BLRT), the Bayesian information criterion (BIC), and the entropy were used as statisti-  
296 cal indicators. Furthermore, the latter two were plotted to apply the elbow-criterion (Morin,  
297 Meyer, Creusier, & Biétry, 2016). As content-related indicators, the principle of parsimony,  
298 theoretical consideration, and the interpretability of the identified profiles were applied. For  
299 easier interpretation and labelling of the profiles, first, z-scores of variables constituting the  
300 latent profiles were used. The effect sizes (Cohen's *d*) of differences of self-concordance, ac-  
301 tion planning, social support of the family, and exercise and sport in a club were calculated  
302 among the profiles. To further characterise the profiles identified regarding sex distribution  
303 and level of exercise and sport behaviour at T1, descriptive statistics were applied.

304 We then conducted a multinomial logistic regression analysis to investigate if the psy-  
305 chosocial patterns were linked with change in exercise and sport behaviour during the transi-  
306 tion to upper secondary education (RQ2). The categorical latent variable was used to repre-  
307 sent the identified latent patterns as an independent variable, and the three-level exercise and  
308 sport change variable was used as a dependent variable. Note that the parameters of the latent  
309 profile measurement model were fixed to conduct multinomial logistic regression analysis,  
310 while accounting for the measurement error without re-estimating the measurement model.

311 To analyse if the association between psychosocial patterns and behaviour change are  
312 moderated by a subjective evaluation of the transition (RQ3), a multinomial logistic regres-  
313 sion analysis was once again conducted. The psychosocial patterns, the subjective evaluation,  
314 and the interactions were included as independent variables, whereas the exercise and sport  
315 change categories were used as a dependent variable. Owing to estimation problems, this  
316 analysis was done - not on latent - but rather on a manifest level. All models were estimated  
317 in Mplus Version 8.0 (Muthén & Muthén, 1998-2019) using maximum likelihood estimation  
318 with robust standard errors (MLR).

319 Missing data were limited to the variable exercise and sport in a club. The targeted  
320 percentage value could not be calculated for six adolescents (0.31% missing data); however,

## WHO STAYS ON?

321 this missing data were accommodated with full-information maximum likelihood (FIML).  
322 The significance level for testing regression coefficients was set at  $\alpha = .05$  (one-tailed for  
323 RQ2 and two-tailed for RQ3).

## 324 **Results**

### 325 **Psychosocial Patterns**

326 Two to six different latent-profile-solutions were tested and reported (Table 1). In gen-  
327 eral, BIC and entropy constantly improved when profiles were added. This indicates that the  
328 relative data-to-model fit, and the precision of the classification improved with more profiles.  
329 However, the elbow-criterion (Figure S2 and S3) supported the four-profile-solution. Further-  
330 more, because it was the most meaningful and parsimonious model (only one profile was  
331 small with  $n = 33$ ; 8.4%), this solution was selected in subsequent analyses.

332 The four patterns are illustrated in Figure 1 and Figure S4. They can be described and  
333 labelled as *averages*, *club enthusiasts*, *club engaged planners*, and *less motivated and social*  
334 *uncommits*. The averages are characterised by scores for self-concordance, action planning,  
335 social support from family, and club activities placed slightly above the mean. Further anal-  
336 yses showed that this group had been physically active before the educational transition  
337 (100% > 74 min/week exercise and sport) and consists of a comparatively large number of  
338 boys (58.6%). The club enthusiasts are similar to the averages regarding self-concordance ( $d$   
339 = 0.06), action planning ( $d = 0.09$ ), and social support ( $d = 0.12$ ). They do, however, vary  
340 widely in time spent in a club ( $d = 13.45$ ). The club enthusiasts work out exclusively in a  
341 club. Adolescents with this pattern were sufficiently active for the most part (92.2% > 74  
342 min/week exercise and sport). Compared to the sex distribution of the whole sample, this  
343 group included more boys (51.1%). The club engaged planners defined their upcoming exer-  
344 cise and sport activities in more detail than did the club enthusiasts ( $d = 0.28$ ) and the aver-

## WHO STAYS ON?

345 ages ( $d = 0.39$ ). Furthermore, it is characteristic for them to be active mainly in a club, alt-  
346 hough not to such a large extent as the club enthusiasts ( $d = 6.73$ ). Subsequent analysis  
347 showed that the club engaged planners were a physically active group before the educational  
348 transition (100% > 74 min/week exercise and sport). The less motivated and social uncommits  
349 had below average self-concordance, action planning, and social support. Particularly noticea-  
350 ble is that they did not engage in a club at all. Thirty percent of this group were inactive be-  
351 fore transition, whereas 51% performed > 74 min of exercise and sport per week. The group  
352 of less motivated and social uncommits included a relatively large number of girls (72%).

353 --- insert Table 1 and Figure 1 about here ---

### 354 **Associations Between Psychosocial Patterns and Exercise and Sport Maintenance**

355 The results of the multinomial logistic regression analysis are summarised in Table 2,  
356 and conditional probabilities are presented in Figure 1. Conditional probabilities indicate how  
357 likely it is that an adolescent from a certain psychosocial pattern belongs to a certain category  
358 of exercise and sport behaviour change. As reference groups, the less motivated and social un-  
359 commits and the exercise and sport dropouts were used. These references were chosen because  
360 the comparisons with less favourable groups is of interest. The club engaged planners were  
361 more likely to be maintainers/adopters versus exercise and sport dropouts ( $B = 1.431, p = .012,$   
362  $95\% \text{ CI } [0.389, \infty]$ ). This finding means that these people were less susceptible to reducing  
363 their exercise and sport time.

364 --- insert Table 2 about here ---

### 365 **Moderating Effect of the Subjective Evaluation of the Transition**

366 The multinomial logistic regression analysis revealed a moderation of subjective eval-  
367 uation for only one psychosocial pattern: the averages were less likely to be maintain-



## WHO STAYS ON?

368 ers/adopters versus exercise and sport dropouts when they evaluated the transition more nega-  
369 tively ( $B = -1.21, p = .030, 95 \% CI [-2.30, -0.12]$ ; Table 2). Hence, the risk of those people  
370 reducing their exercise and sport time increased with increased transitional stress.

### 371 **Discussion**

372 The aim of this study was to test 1) what psychosocial patterns can be identified in ad-  
373 olescents at lower secondary school, 2) if certain patterns are positively associated with the  
374 maintenance of exercise and sport during the transition to upper secondary education, and 3)  
375 if the associations are moderated by a subjective evaluation of the transition. Our study ex-  
376 tends previous variable-oriented research on physical activity change during transition by  
377 looking at the interplays of psychological and social factors *within* a person rather than exam-  
378 ining isolated variables. Furthermore, it provides a greater understanding of the mechanism by  
379 sampling adolescents who are making the transition from lower to secondary education, and  
380 by questioning them about their subjective evaluation of the event. This combination of an  
381 objective life event and the perception of transitional stress is important considering the lack  
382 of research in this area (Schwarzer & Luszczynska, 2013).

383 Four patterns were found regarding self-concordance, action planning, social support  
384 from the family, and exercise and sport in a club. These patterns can be characterised as aver-  
385 ages, club enthusiasts, club engaged planners, and less motivated and social uncommits. The  
386 pattern identified as club engaged planners is supported by Gerber, Mallett, and Pühse (2011),  
387 in which adolescents who were members of a club had higher action planning than did adoles-  
388 cents who participated in non-organised exercise. In methodological literature, a distinction is  
389 often made between so-called ‘level patterns’ and ‘shape patterns’ (Morin, Boudrias, Marsh,  
390 Madore, & Desrumaux, 2016; Morin & Marsh, 2015). Level patterns have overall low, me-  
391 dium, or high values in all studied factors and can, therefore, be placed on a continuum. In  
392 contrast, shape patterns have differing ratings across the factors. In our study, the averages

## WHO STAYS ON?

393 had a typical level pattern, whereas the club enthusiasts, the club engaged planners, and the  
394 less motivated and social uncommits tended towards a shaped pattern. Thus, these interactions  
395 of variables within the person would probably have gone undetected using a variable-oriented  
396 approach. Our results illustrate the advantage of using a person-oriented approach when stud-  
397 ying influencing factors on exercise and sport behaviour change. Further analyses also  
398 showed that patterns for boys often indicate a relatively high level of exercise and sport time  
399 in a club. This additional finding is consistent with existing research about sex differences in  
400 physical activity patterns (Biddle et al., 2011).

401         In the present study, it was hypothesised that adolescents in patterns with high psycho-  
402 logical and social factors are more likely to stay active than to drop out of exercise and sport  
403 (synergistic effect; Schröder, 1997). In fact, people with high levels in both domains – the  
404 club engaged planners – were more likely to be exercise and sport maintainers/adopters than  
405 exercise and sport dropouts. This result suggests that the combination of having detailed ac-  
406 tion planning and being active in a club part-time protects people from reducing their exercise  
407 and sport activities. One can interpret this as meaning that the club engaged planners were al-  
408 ready used to regulating their behaviour and doing exercise and sport in an organised and  
409 flexible way before the transition. When faced with increased academic demands and time  
410 pressure at upper secondary school, they were able to rely on these skills to maintain or adopt  
411 their behaviour.

412         Furthermore, it was hypothesised that individuals with high values in psychological  
413 variables can compensate for their lack of social resources, or vice versa (compensation ef-  
414 fect; Schröder, 1997). More precisely, individuals in patterns with either a high value in psy-  
415 chological or social factors are assumed to be more likely to stay active than to drop out of ex-  
416 ercise and sport. The results, however, did not support this hypothesis. The results of the club  
417 enthusiasts illustrate that an average level of action planning cannot be compensated by a vast  
418 amount of time spent in a club. It can be speculated that the exercise and sport behaviour of

## WHO STAYS ON?

419 the club enthusiasts became a habit before the transition. Their behaviour was possibly trig-  
420 gered by contextual cues of the club training, such as doing exercise and sport at the same  
421 time and the same place. This learned cue-behaviour association did not require conscious  
422 regulatory processes, such as planning (Rebar et al., 2016; Rhodes & Rebar, 2018). However,  
423 new life challenges might have forced these adolescents to change to less organised exercise  
424 and sport activities (Eime et al., 2016). Owing to a lack of structure and a lack of contextual  
425 cues (Bélanger-Gravel et al., 2013), they had more difficulty maintaining their behaviour.

426 To summarise, results regarding RQ2 showed, for the first time, the potential mecha-  
427 nism between psychological and social factors within an individual. The findings support the  
428 synergistic effect of action planning (as a psychological factor) and exercise and sport in a  
429 club (as a social factor) on behaviour (Schröder, 1997). However, the results illustrate that  
430 this mechanism does not occur in all adolescents, but rather in a relatively small group of in-  
431 dividuals (11.7% of the whole sample). A similar synergistic effect has been found in varia-  
432 ble-oriented studies with adolescents (Dishman et al., 2009; Hamilton et al., 2017) and older  
433 adults (Warner et al., 2011).

434 Subjective evaluation of the transition moderated the association between psychoso-  
435 cial patterns and behaviour change. However, this was true only among the averages. The  
436 likelihood of this group being maintainers/adopters versus exercise and sport dropouts de-  
437 creased with increased transitional stress. These results emphasise the fact that an objective  
438 life event and its subjective evaluation could have distinct impacts on health behaviour (Laza-  
439 rus & Folkman, 2006; Stults-Kolehmainen & Sinha, 2014).

### 440 **Limitations and Future Directions**

441 The current study has multiple limitations that must be addressed: First, dropout anal-  
442 ysis showed that our longitudinal study sample was distorted. For example, adolescents were

## WHO STAYS ON?

443 more likely to participate in the survey twice when they had a higher (vs. lower) self-concord-  
444 ance and when they were girls (vs. boys). A potential consequence of this self-selection bias  
445 is that the sample is no longer representative of the whole population of Swiss adolescents.  
446 However, it is important to note that the effect sizes of study dropout analyses were rather  
447 small and, therefore, may have affected our findings only marginally. Furthermore, one  
448 should keep in mind that the response rate (41.5%) was high compared to other longitudinal  
449 studies (Eime et al., 2016).

450         Second, one must be cautious when transferring the findings to other populations ow-  
451 ing to the particularities of the Swiss school system. Educational transitions are internation-  
452 ally very different (UNESCO Institute of Statistics, 2012). For instance, whereas upper sec-  
453 ondary education is typically more general in English-speaking countries (e.g. high schools in  
454 USA), there are many different, more specialised paths in Switzerland. Adolescents in Swit-  
455 zerland can enrol in a baccalaureate school or in VET, or they may take a transitional option.  
456 Therefore, the sample in the present study consisted of adolescents with diverse transitions  
457 (e.g. from lower secondary school to baccalaureate school versus from lower secondary  
458 school to VET). It is possible that the type of transition experienced influenced individuals'  
459 exercise and sport behaviour change (Table S3). Furthermore, one must keep in mind that, at  
460 the time of the educational transition, most Swiss adolescents still live with their parents be-  
461 cause the upper secondary school is typically close to their place of residence. This fact might  
462 have influenced the association of psychosocial patterns and change in exercise and sport be-  
463 haviour (van Dyck et al., 2015).

464         Finally, there are limitations regarding the measurement of study variables. Exercise  
465 and sport behaviour was assessed by self-report. Therefore, adolescents' statements may not  
466 accurately represent their real behaviour, as people often overestimate their physical activity  
467 (Vanhelst et al., 2018). In addition, as the questionnaire used requested respondents to list  
468 only three activities, this could have led to a response bias (Fuchs et al., 2015). However, as

## WHO STAYS ON?

469 change in exercise and sport was analysed in broad categories, neither of the above should af-  
470 fect the findings substantially. Additionally, the subjective evaluation of the transition was as-  
471 sessed retrospectively; i.e. eight months after beginning upper secondary education. During  
472 this assessment, personal and situational factors were not accounted for, which may have in-  
473 fluenced adolescents' judgement.

474 An important direction for future research involves replication of the psychosocial pat-  
475 terns identified, as they often depend on the specific sample. A cross-validation of the patterns  
476 may ensure the robustness and generalisability of the findings. In addition, future research  
477 should investigate how stable psychosocial patterns are across time—at both the group and  
478 individual level (Bergman & Wångby, 2014). Ideally, study designs should consider a longer  
479 period and more than two measurement points. The present study focussed on changes in ac-  
480 tivity time. However, adolescents reported various types of exercise and sport activities (Ta-  
481 ble S4), which might be linked with diverse intensities as well as social and organisational  
482 contexts. Future research should examine if these activity types change during transition  
483 (Eime et al., 2016; Eime, Payne, Casey, & Harvey, 2010).

### 484 **Conclusion**

485 Psychosocial patterns are associated with changes in exercise and sport behaviour dur-  
486 ing the educational transition among Swiss adolescents. This link is partially moderated by  
487 the subjective evaluation of the transition. Keeping in mind that this article is entitled 'Who  
488 stays on?', the pattern with relatively high action planning and many activities in a club is es-  
489 pecially noteworthy. Not only are people with such a combination of variables less likely to  
490 drop out of exercise and sport, there appear to be no signs that transitional stress has a nega-  
491 tive effect on their exercise and sport behaviour.

492 If the interplay between psychological and social factors within individuals is better  
493 understood, and if it is better known how these factors are associated with changes in exercise

## WHO STAYS ON?

494 and sport behaviour during educational transitions, health can be promoted more effectively.  
495 Thus, the patterns identified in this study can be used to develop tailored interventions for  
496 specific subgroups of young people.

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Table 1

*Latent profiles of psychosocial factors for exercise and sport: LPA models for two-to six-latent-profile-solutions*

Latent-profile-solution	<i>n</i> (%)	Self-concordance <i>M</i> ( <i>SD</i> )	Action planning <i>M</i> ( <i>SD</i> )	Social support family <i>M</i> ( <i>SD</i> )	Exercise and sport in a club <i>M</i> ( <i>SD</i> <sup>1</sup> )	BIC	Entropy	BLRT
<i>Two latent profiles</i>								
1.	213 (54.3%)	3.69 (2.45)	3.37 (1.05)	3.21 (0.28)	0.03 (0.14)	4064.74	0.96	< .0005
2.	179 (44.7%)	4.96 (2.32)	3.91 (0.91)	3.59 (0.81)	0.87 (0.14)			
<i>Three latent profiles</i>								
1.	130 (33.2%)	4.90 (2.31)	3.82 (0.96)	3.57 (0.81)	0.97 (0.10)	3823.57	0.96	< .0005
2.	201 (51.3%)	3.62 (2.45)	3.35 (1.06)	3.20 (0.93)	0.01 (0.10)			
3.	61 (15.6%)	5.03 (2.30)	4.05 (0.77)	3.61 (0.81)	0.57 (0.10)			
<i>Four latent profiles</i>								
1.	33 (8.4%)	4.75 (2.32)	3.77 (0.83)	3.63 (0.67)	0.45 (0.04)	3662.02	0.98	< .0005
2.	115 (29.3%)	4.90 (2.33)	3.85 (0.93)	3.54 (0.80)	0.99 (0.04)			
3.	45 (11.5%)	5.19 (2.22)	4.10 (0.85)	3.66 (0.89)	0.72 (0.04)			
4.	199 (50.8%)	3.61 (2.45)	3.35 (1.07)	3.19 (0.93)	0.00 (0.04)			
<i>Five latent profiles</i>								
1.	44 (11.2%)	5.10 (2.25)	4.17 (0.73)	3.63 (0.90)	0.72 (0.00)	3658.80	0.98	< .0005
2.	200 (51.0%)	3.62 (2.50)	3.35 (1.07)	3.20 (0.94)	0.01 (0.00)			
3.	111 (28.3%)	4.80 (2.33)	3.94 (0.79)	3.53 (0.81)	0.99 (0.00)			
4.	32 (8.2%)	4.78 (2.41)	3.77 (0.84)	3.63 (0.71)	0.45 (0.00)			
5.	5 (1.3%)	7.63 (0.88)	1.48 (1.34)	4.01 (0.52)	0.96 (0.00)			
<i>Six latent profiles</i>								
1.	28 (7.1%)	4.70 (2.20)	3.83 (0.85)	3.72 (0.67)	0.51 (0.03)	3550.64	0.99	.004
2.	194 (49.5%)	3.57 (2.47)	3.34 (1.08)	3.19 (0.93)	0.00 (0.03)			
3.	108 (27.6%)	4.82 (2.29)	3.97 (0.80)	3.53 (0.70)	0.99 (0.03)			
4.	7 (1.7%)	6.73 (1.87)	1.37 (0.73)	3.90 (0.92)	0.97 (0.03)			
5.	41 (10.5%)	5.22 (2.09)	4.13 (0.76)	3.61 (0.89)	0.73 (0.03)			
6.	14 (3.6%)	4.63 (2.63)	3.82 (0.66)	3.40 (0.76)	0.27 (0.03)			

*Note.* BIC = Bayesian information criterion; BLRT = bootstrapped likelihood-ratio test; <sup>1</sup>Due to convergence problems variances of exercise and sport in a club were hold equal between profiles.

Table 2

*Associations between psychosocial profiles and change in exercise and sport behaviour (analysis 1) as well as the moderating effects of subjective evaluation on these associations (analysis 2)*

	Categories of exercise and sport behaviour change					
	Resisters		Maintainers and adopters		Dropouts	
	<i>B</i> [95% CI]	<i>p</i> -value	<i>B</i> [95% CI]	<i>p</i> -value	<i>B</i> [95% CI]	<i>p</i> -value
Analysis 1 (latent level)						
Averages	n.c.	n.c.	-0.32 [1.04, +∞]	.234	–	–
Club enthusiasts	n.c.	n.c.	0.45 [-0.09, +∞]	.086	–	–
Club engaged planners	n.c.	n.c.	1.43* [0.39, +∞]	.012	–	–
Less motivated and social uncommits	–	–	–	–	–	–
Analysis 2 (manifest level)						
Averages x subjective evaluation	n.c.	n.c.	-1.21* [-2.30, -0.12]	.030	–	–
Club enthusiasts x subjective evaluation	0.72 [-0.51, 1.94]	.250	-.75 [-1.49, 0.00]	.051	–	–
Club engaged planners x subjective evaluation	n.c.	n.c.	-1.35 [-2.99, 0.30]	.108	–	–
Less motivated and social uncommits x subjective evaluation	–	–	–	–	–	–

*Note.* For the analyses of the main effects of the psychosocial profiles one-sided significance tests were applied.

*B* = unstandardised B-regression coefficient; \* *p* < .05. CI = confidence interval for unstandardised B-regression coefficient. n.c. = values were not calculable due to small cell populations (Averages – resisters: *n* = 0; Club enthusiasts – resisters: *n* = 5, Club engaged planners – resisters: *n* = 0); reference groups: Less motivated and social uncommits and Dropouts.

For the moderation analyses the interaction term “psychosocial profile x subjective evaluation” were added to the predictors “psychosocial profile” and “subjective evaluation”. For simplification, only the results of the interaction terms are showed. For the moderation analyses two-sided significance tests were applied.



**Psychosocial patterns**

**Exercise and sport behaviour change categories**

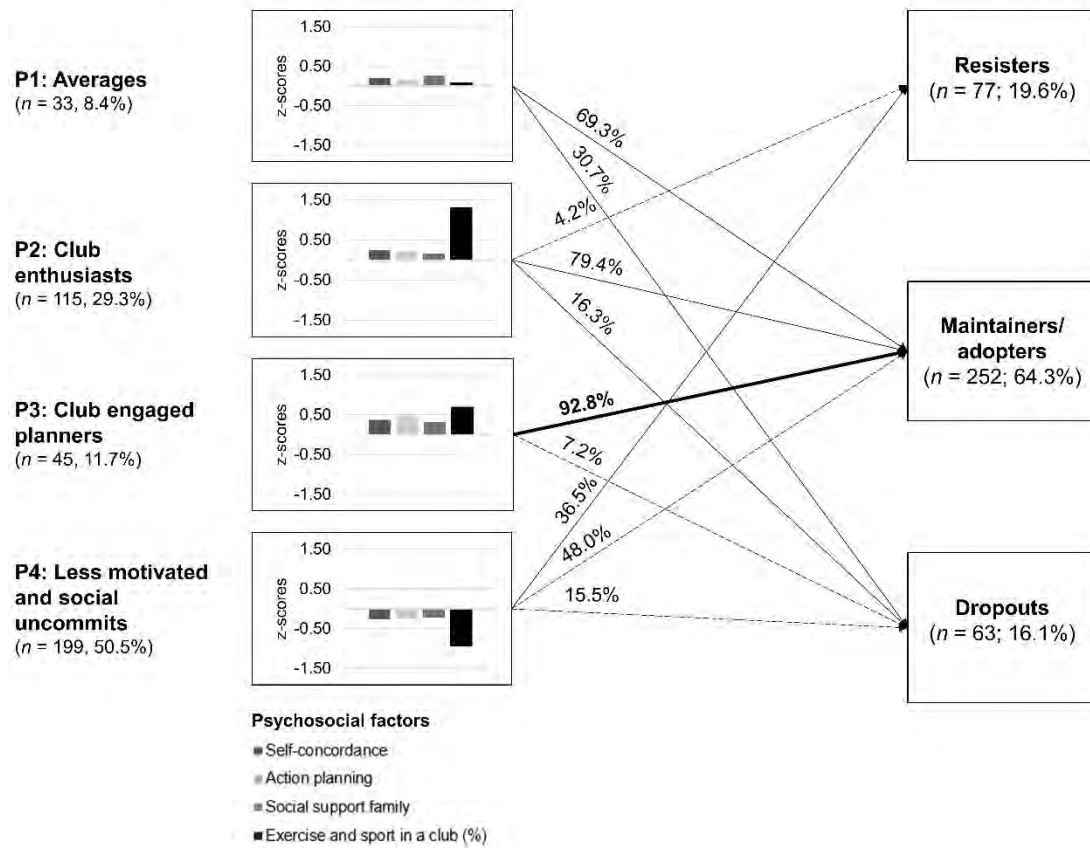


Figure 1. Z-standardised psychosocial patterns (P1-P4) and the conditional probabilities to exercise and sport behaviour change categories. Boldfaced solid line indicates significant higher probability compared to the less motivated and social uncommits (P4) as well as to the dropouts.