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# The origins of mental toughness - prosocial behavior and low internalizing and externalizing problems at age 5 predict higher mental toughness scores at age 14

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Provisional

1           **The origins of mental toughness – prosocial behavior and low internalizing and**  
2           **externalizing problems at age 5 predict higher mental toughness scores at age 14**

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32 **Abstract**

33 Background: The concept of mental toughness has gained increasing importance among  
34 groups other than elite athletes by virtue of its psychological importance and explanatory power  
35 for a broad range of health-related behaviors. However, no study has focused so far on the  
36 psychological origins of mental toughness. Therefore, the aims of the present study were: to  
37 explore, to what extent the psychological profiles of preschoolers aged five were associated  
38 with both 1) mental toughness scores and 2) sleep disturbances at age 14, and 3) to explore  
39 possible gender differences.

40 Method: Nine years after their first assessment at age five (preschoolers), a total of 77  
41 adolescents (mean age: 14.35 years; SD = 1.22; 42% females) took part in this follow-up  
42 study. At baseline, both parents and teachers completed the Strengths and Difficulties  
43 Questionnaire (SDQ), covering internalizing and externalizing problems, hyperactivity,  
44 negative peer relationships, and prosocial behavior. At follow-up, participants completed a  
45 booklet of questionnaires covering socio-demographic data, mental toughness, and sleep  
46 disturbances.

47 Results: Higher prosocial behavior, lower negative peer relationships, and lower internalizing  
48 and externalizing problems at age five, as rated by parents and teachers, were associated with  
49 self-reported higher mental toughness and lower sleep disturbances at age 14. At age 14, and  
50 relative to males, females had lower MT scores and reported more sleep disturbances.

51 Conclusions: The pattern of results suggests that mental toughness traits during adolescence  
52 may have their origins in the pre-school years.

53 Key-words: mental toughness, sleep, origins, long-term, pro-social behavior, internalizing  
54 problems, externalizing problems

55

56 **Introduction**

57

58 In 2002, Clough, Earle, and Sewell (2002) formulated the concept of Mental  
59 toughness in its present form and since then, the ~~In recent years the~~ concept of mental  
60 toughness (MT) has gained increasing interest by virtue of its psychological importance and  
61 explanatory power with respect to psychological concepts such as coping with stress, self-  
62 esteem, and motivation and with respect to a broad range of health-related behaviors (see  
63 Table 1) (Crust, 2014, Dewhurst et al. , 2012, Gerber et al. , 2013c, Perry et al. , 2013a, Stamp  
64 et al. , 2015). Mental toughness refers to an individual’s capacity to be consistently successful  
65 in coping with difficult life circumstances and comprises the following dimensions: Control  
66 (own life and emotions), Commitment (to personal aims and achievements), Challenge  
67 (considering changes in life not as threats but as challenges), and Confidence (in own abilities  
68 and in other people) (Clough et al. , 2002a, Perry et al. , 2013b). Thus, MT refers to the  
69 tendency to appraise threats and pressure as opportunities to thrive (Thelwell, 2005), actively  
70 to seek and approach challenges (Crust, 2008a), and successfully to overcome setbacks and  
71 difficulties (Clough et al., 2002a; Dewhurst et al., 2012). Thus, as shown in and apparent from  
72 Table 1, MT embodies a range of cognitive-emotional processes closely involved in coping  
73 with stress, motivation, self-esteem, unexpected events, and social settings (confidence in  
74 other people).

75

76 =====

77 Table 1 about here

78 =====

79

80 Initially, studies in this field focused on MT in elite athletes (Clough and Strycharczyk, 2012,  
81 Crust, 2007b, 2008b, Fourie and Potgieter, 2001, Jones et al. , 2002, 2007, Loehr, 1994,  
82 Thelwell et al. , 2005); these studies showed that mentally tough athletes were able to cope

83 with stress during a competition and to remain more focused and confident (Crust, 2007a,  
84 Crust and Azadi, 2010, Kaiseler et al. , 2009, Levy et al. , 2006, Mack and Ragan, 2008,  
85 Nicholls et al. , 2008, Sheard, 2009). However, more recent studies have applied the concept  
86 of MT to other groups such as healthy older adolescents (Brand et al. , 2014c, Brand et al. ,  
87 2014e, Gerber, 2011, Gerber et al. , 2013a, Gerber et al. , 2015a, Gerber et al. , 2015b,  
88 Gerber, Kalak, 2013c, Gerber et al. , 2012, Gerber et al. , 2015c), healthy younger adolescents  
89 (Brand et al., 2014c, 2016), university students (Stamp, Crust, 2015), lower, middle and  
90 senior managers, and clerical/administrative workers in early, middle and late adulthood  
91 (Marchant et al. , 2009, Perry, Clough, 2013b), as well as those working in education (Crust,  
92 2014), and the military (Arthur, 2015). All these studies have shown higher MT scores to be  
93 associated with better coping with stress (Gerber et al., 2013a, 2013c), with better sleep  
94 quality assessed both subjectively (Brand et al., 2014d, 2014e) and objectively (Brand et al.,  
95 2014c), and with better physical performance (Crust and Clough, 2005; Gerber et al. 2012).  
96 Further, we showed that patients with multiple sclerosis (MS) at illness onset (mean age =  
97 32.3 years) reported similar MT traits as healthy adolescents and young adults did (Sadeghi  
98 Bahmani et al., 2016).

99 To date, however, no study has considered the origins of mental toughness by asking  
100 what psychological dimensions in childhood might predict MT traits in adolescence. The aim  
101 of the present study was therefore to address this question. To this end participants from a  
102 previous study when they were five years old and at kindergarten (Brand et al. , 2015,  
103 Hatzinger et al. , 2008, 2010, Hatzinger et al. , 2007) were contacted at age 14 and assessed  
104 once again. We believe that the present study has the potential to shed new light on the origins  
105 and development of mental toughness, a psychological attribute, which appears to underlie a  
106 broad range of positive behaviors. We further hold that with the present study attention in  
107 developmental psychology might shift from psychopathology towards salutogenic  
108 dimensions.

109 In this regard, a literature search on the search engine Pubmed with the items  
110 'resilience', 'hardiness' or 'mental toughness' in combination with 'development' produced  
111 very few results (note that the concepts of mental toughness, resilience, and hardiness seem to  
112 share a common basis but without being synonyms; see Table 1). For 'hardiness', no study  
113 could be identified in combination with the term 'development'. With regard to 'resilience'  
114 and 'development', the following points were identified: resilience is understood as an  
115 individual's skill in successfully adapting to stress and adversity (Skala and Bruckner, 2014).  
116 Interpersonal factors associated with resilience include male gender, higher intelligence,  
117 aspects of character, temperament, and genes. Family factors include stable and positive  
118 relations with an adult, while a broader social environmental factor is being integrated into a  
119 community. Concerning the development of resilience, Masten and colleagues (Masten, 2004,  
120 Masten et al. , 2004, Masten and Cicchetti, 2012, Masten et al. , 1999, Masten and Tellegen,  
121 2012) identified higher IQ and favorable parenting as factors with the potential to protect  
122 child development in the context of severe adversity. They also emphasized the relevance of  
123 adaptive resources, planfulness/future motivation, autonomy, adult support, and coping skills  
124 as possible factors underlying resilience and successful development. Additionally, Masten  
125 and Tellegen (2012) found that resilient adults reported high quality relationships with parents  
126 and other adults and good cognitive and socio-emotional skills during their childhood, while  
127 Sameroff and Rosenblum (2006) identified poor parenting, antisocial peers, low-resource  
128 communities, and economic hardship as the main factors impairing resilience.

129 Thus, while research examining the impact of hardiness and resilience on child  
130 development is scarce, and while the concept of mental toughness offers a basis for  
131 integrating a broad range of coping literature into a common framework (see Table 1), it must  
132 be noted that most previous studies have focused on the development of psychopathology. In  
133 fact, there is some evidence that psychopathology in preschoolers may persist over time and  
134 that childhood psychopathology could predict psychological difficulties in adolescence (Caye

135 et al. , 2016, Giedd et al. , 1999, Paus et al. , 2008, Paus et al. , 1999). In particular, attention  
136 has been given to whether behavioral problems such as internalizing and externalizing  
137 behavior in preschoolers could predict psychiatric problems in adolescence and adulthood.  
138 However, externalizing problems have been more frequently investigated than internalizing  
139 problems and, in general, results indicated greater stability over time for externalizing than for  
140 internalizing behavior problems (Pihlakoski et al. , 2006). Pihlakoski et al. (2006) have also  
141 shown that externalizing problems in boys and girls at age three strongly predicted both  
142 externalizing and internalizing problems at twelve years. Externalizing disorders are  
143 characterized by disruptive, disobedient, and harmful behaviors that are often manifested  
144 physically (e.g., in aggressive, impulsive and non-compliant behavior) (Weisz and Weiss,  
145 1991), and seemed to exhibit considerable stability over time throughout development  
146 (Pihlakoski et al. 2006). Furthermore, externalizing behaviors have been associated with  
147 social aggression, disruptive behavior, a perceived lack of constraint, and risky behaviors; in  
148 particular, aggressive and destructive behaviors in early childhood predicted later problems  
149 (Pihlakoski et al., 2006). In addition, evidence indicated that childhood psychopathology was  
150 associated with higher rates of early substance use and problem substance use (King et al.,  
151 2004). Externalizing disorders (e.g., conduct problems and ADHD) have been found to have  
152 the strongest impact on later tobacco use, and children displaying aggressive behavior at five  
153 years were more likely to consume tobacco 14 years later (though, surprisingly, no  
154 association was found between externalizing problems and a prediction of DSM-IV nicotine  
155 dependence at 21-year follow-up) (Fischer et al. , 2012). However, in general, children with  
156 an early onset of conduct problems (onset in preschool) and a high degree of continuity  
157 seemed to have a much more negative prognosis than children with a late onset (adolescence)  
158 (McMahon, 1999). In conclusion, psychopathology such as externalizing problems in  
159 childhood and adolescence appeared to predict unfavorable behaviors such as tobacco  
160 consumption in later life ~~while externalizing problems increase smoking~~ (Fischer et al., 2012).

161 Internalizing disorders are characterized by feelings of sorrow, guilt, worry, and  
162 somatization (Weisz and Weiss, 1991), and children with internalizing disorders display  
163 reactions such as social withdrawal, a lack of pleasure in enjoyable activities, and a lack of  
164 energy (Cicchetti and Toth, 1998). Internalizing problems were linked to social deficits (e.g.,  
165 submissive and inhibited interaction), poor interaction with the peer-group, social isolation  
166 and development of a negative self-concept (Fischer et al., 2012) and might lead to  
167 internalizing disorders such as depression and anxiety (McMahon, 1999). About 2-3% of  
168 children and 6-8% of adolescents suffer from depression and the lifetime prevalence of  
169 depression during adolescence was in the range 15-20% (McMahon, 1999). The estimated  
170 prevalence of anxiety disorders in childhood and adolescence varied from 9 to 21%. Girls  
171 were twice as likely to experience an anxiety disorder (McMahon, 1999), a trend recently  
172 further confirmed, in that internalizing problems had increased among recent cohorts of girls  
173 as compared to previous cohorts, but not among boys (Bor et al., 2014). Yet, findings with  
174 respect to internalizing behaviors are less consistent than those for externalizing behaviors;  
175 this may be due to young children's limited ability to express anxiety and depression.  
176 Moreover, parents seemed to have difficulties in recognizing these emotions in their  
177 preschool children (Pihlakoski, Sourander, 2006). Nevertheless, internalizing problems in 2-5  
178 years young children have proved to be relatively stable over a two-year follow-up period  
179 (Pihlakoski et al., 2006).

180 In addition, there is evidence that peer victimization (e.g., experiencing frequent  
181 verbal or physical bullying by peers) in middle childhood was a relevant predictor of  
182 internalizing behavior problems and psychological disorders during adolescence (Schwartz et  
183 al., 2015). There have been several indications of a moderate link between peer victimization  
184 and some form of internalizing behavior problem such as symptoms of depression, anxiety,  
185 loneliness and withdrawal (Schwartz et al., 2015). More specifically, Schwartz et al. (2015)  
186 provided evidence that peer victimization in middle childhood could act as a key marker of

187 disorders at later stages of development. These authors found that children who experienced  
188 frequent peer victimization in middle childhood were significantly more likely to meet criteria  
189 for a major depressive disorder during late adolescence.

190         Additionally, researchers have examined the long-term influence of sleep disturbances  
191 on several psychological problems. Existing research has shown that sleep problems were  
192 persistent and that individual differences in sleep problems were highly stable over time  
193 (Wong, 2010, Wong et al. , 2010). Thus, Wong and colleagues found that having trouble  
194 sleeping at age 3 to 8 years was significantly associated with self-reported sleep problems at  
195 age 11 to 17. Indeed those who had trouble sleeping in childhood, compared to those having  
196 no trouble sleeping, had an almost 2.5 fold greater likelihood of having trouble sleeping in  
197 adolescence (Wong, 2010; Wong et al., 2010; Brand et al., 2015 for extensive overview).

198         In summary, previous research has focused on the predictive value of internalizing and  
199 externalizing problems, and sleep disturbances during childhood for psychopathology traits in  
200 adolescence. However, no evidence is available as regards the predictive value of  
201 internalizing and externalizing problems during childhood for psychological constructs such  
202 as mental toughness, in adolescence. Therefore, the aim of the present longitudinal study was  
203 to shed some light into this issue. We hold that the present data have the potential to add to  
204 the existing literature in important ways: First, compared to other psychological constructs as  
205 listed in Table 1, the concept of mental toughness has been established only 1.5 decades ago,  
206 and to the best of our knowledge, no research has focused on psychological constructs as  
207 precursors of adolescent mental toughness. Second, in our opinion, the concept of mental  
208 toughness deserves further research, as it has the potential to cover a broad range of cognitive-  
209 emotional concepts such as coping, self-esteem, motivation, and social confidence in one  
210 single construct (see Table 1).

211         Given the lack of previous research, we drew upon findings relating to  
212 psychopathology in formulating our hypotheses. Thus, following others (Fischer et al., 2012;

213 Settles et al., 2012; Wong et al., 2010), we anticipated that positive psychological traits  
214 evident in childhood (low externalizing and internalizing problems, high prosocial behavior)  
215 would predict higher mental toughness scores and also lower sleep disturbances at age 14.  
216 Furthermore, based on previous research (Brand et al. , 2014a, b), we expected that higher  
217 mental toughness scores would be associated with lower sleep disturbances at age 14. Finally,  
218 we expected that compared to boys, girls would report lower mental toughness scores (Brand  
219 et al., 2014c, 2016) and more sleep disturbances (Armitage and Hoffmann, 2001; Brand et al.,  
220 2016; Mong and Cusmano, 2016).

221

## 222 **Method**

### 223 Procedure

224 As described elsewhere (Brand, Hatzinger, 2015), children participating in this study  
225 were assessed during their first year in kindergarten (when they were five years old;  
226 (Hatzinger, Brand, 2008, 2010, Hatzinger, Brand, 2007). These children were contacted again  
227 at age 14. Participants completed self-rating questionnaires covering socio-demographic  
228 information, mental toughness and sleep (see below). The general purpose of the follow-up  
229 study was explained to the adolescents and their parents. Prior to entry to the study both  
230 adolescents and their parents were asked to sign an informed consent form. The study  
231 protocol was carried out in accordance with the Declaration of Helsinki and was approved by  
232 the local ethics committee.

233 Parts of the ongoing longitudinal study have been already published. Specifically,  
234 Brand et al (2015) showed that sleep quality at the age of five predicted psychological traits in  
235 areas such as peer relationships and success at coping with stress while, surprisingly, sleep at  
236 the age of 14 years was unrelated. In the present study, we focused on the associations  
237 between participants' psychological traits at age five (SDQ, parents' and teachers' ratings; see

238 below) and participants' self-rated mental toughness and sleep disturbances at age 14. This  
239 pattern of associations has not been examined so far. Thus, the present data are novel.

240

#### 241 Sample

242 The core sample has been described in detail elsewhere (Brand et al., 2015; Perren et  
243 al., 2006). Briefly, preschoolers of kindergartens of Basel (Basel, Switzerland) were assessed  
244 as regards their subjective and objective sleep parameters, the level of saliva cortisol under  
245 baseline (cortisol awakening response (CAR)) and under challenge conditions (a modified  
246 social stress test), and their psychological functioning (Strengths and Difficulties  
247 Questionnaire (SDQ, see below for more details; (Goodman, 1997): internalizing and  
248 externalizing problems, hyperactivity, negative peer relationship, prosocial behavior), as  
249 assessed via parents' and teachers' ratings. Of the 95 children at age five ( $M = 5.4$  years,  $SD$   
250  $= 0.44$ ) for whom parents and kindergarten teachers completed the SDQ, 77 (81.05%) agreed  
251 to participate in the follow-up study at age 14, that is, about nine years later. Mean age at  
252 follow-up was 14.25 years ( $SD = 1.21$ ; 32 females and 45 males). As stated in Brand et al.  
253 (2015), participants and non-participants at follow-up did not significantly differ as regards  
254 age, gender, sleep profiles or psychological traits (internalizing and externalizing problems,  
255 hyperactivity, negative peer-relationship, and prosocial behavior) at baseline. Accordingly,  
256 age, gender, sleep profiles or psychological traits at baseline were not entered as covariates in  
257 all statistical equations of the present study.

258

#### 259 Tools employed at age five

##### 260 Strengths and Difficulties Questionnaire (SDQ; (Goodman, 1997)

261 Parents and teachers completed the SDQ, which consists of 25 items covering the  
262 following five dimensions: internalizing problems, externalizing problems, hyperactivity, peer  
263 problems and pro-social behavior. An overall score can also be derived, with higher scores

264 reflecting more negative psychological functioning. Each scale consists of 5 items that are  
265 rated on a three-point scale ranging from 0 (= not true) to 2 (= certainly true). The sum is  
266 calculated to generate subscale scores. In the present study, internal consistency was moderate  
267 to high (Cronbach's alpha = .87).

268

269 Tools participants employed at age 14

270 Mental toughness

271 Participants were asked to fill in the 18-item Mental Toughness Questionnaire  
272 (MTQ18; Clough et al., 2002; German version: Gerber et al., 2012; Gerber et al., 2013a,  
273 2013b). The MTQ18 is the short version of the MTQ48 questionnaire (Clough et al., 2002b),  
274 which has proved to be a valid and reliable instrument in previous research (Gerber et al.,  
275 2013b; Perry et al., 2013a). Very high correlations exist between the MTQ18 and MTQ48  
276 (Clough et al., 2002a; Gerber et al. 2014, 2015b). Answers on the MTQ18 are given on five-  
277 point Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree). Responses  
278 across items are summed, with higher scores reflecting greater MT (Cronbach's alpha = .92).

279

280 Sleep disturbances

281 To assess sleep disturbances, the Insomnia Severity Index (ISI; (Bastien et al., 2001)  
282 was employed; this is a 7-item screening measure for insomnia and an outcome measure for  
283 use in treatment research. The items, answered on 5-point rating scales (0 = not at all, 4 =  
284 very much), refer in part to DSM-IV (Diagnostic and Statistical Manual of Mental Disorders)  
285 criteria for insomnia (American Psychiatric Association, 2000) by measuring difficulty in  
286 falling asleep, difficulties remaining asleep, early morning awakenings, increased daytime  
287 sleepiness, impaired daytime sleepiness, impaired daytime performance, low satisfaction with  
288 sleep, and worrying about sleep. Evidence for the validity and reliability of this instrument  
289 has been presented previously (Fernandez-Mendoza et al., 2012, Gerber et al., 2016). The

290 higher the overall score, the more the respondent is assumed to suffer from sleep disturbances  
291 (Cronbach's alpha = .92).

292

### 293 Statistical analysis

294 First, a series of Pearson's correlations was performed between SDQ scores (parents'  
295 and teachers' ratings of children at age five) and participants' MT and sleep disturbances  
296 scores at age 14. Second, two multiple regression analyses (stepwise backward) were  
297 performed with MT scores and sleep disturbances (age 14) as dependent variables and SDQ  
298 scores (age 5) as predictors. Third, possible gender differences in MT and sleep disturbances  
299 at age 14 were calculated with a series of t-tests. Fourth, the bivariate association between MT  
300 and sleep disturbances scores at age 14 was examined with a Pearson's correlation. The  
301 nominal level of significance was set at  $\alpha < .05$ . Statistics was performed with SPSS®  
302 23.0 (IBM Corporation, Armonk NY, USA) for Apple Mac®.

303

### 304 **Results**

305

306 Descriptive statistics and bivariate correlations between strengths and difficulties (SDQ) at  
307 five years and mental toughness and sleep disturbances at 14 years

308

309 All statistical indices are reported in Table 2 and therefore not repeated in the text  
310 again.

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Table 2 about here

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317 Lower internalizing and externalizing problems, and higher pro-social behavior, as  
318 rated by parents and teachers, were associated with higher MT scores and lower sleep  
319 disturbances. Better peer relations and lower overall scores, as rated by teachers, were  
320 associated with higher MT scores and lower sleep disturbances. No significant associations  
321 were found for hyperactivity (parents' and teachers' ratings) or for negative peer relations, as  
322 rated by parents.

323

324 As regards sleep disturbances, higher sleep disturbances were associated with higher  
325 internalizing and externalizing problems, lower prosocial behavior, as rated by parents and  
326 teachers, and with more negative peer relationships and higher overall scores, as rated by  
327 teachers. No significant associations were found for hyperactivity (parents' or teachers'  
328 ratings), or for negative peer relationships and overall scores, as rated by parents.

329

330 MT scores and sleep disturbances

331 The correlation coefficient was  $r = -.45$  ( $p < .05$ ); higher MT scores were related to  
332 lower sleep disturbances.

333

334

335 Predicting Mental toughness and sleep disturbances (at 14 years) from strengths and  
336 difficulties (SDQ; at five years)

337

338 Table 3 reports the results from the two multiple regression analyses (stepwise  
339 backward) with MT scores and sleep disturbances as dependent variables and the strengths  
340 and difficulties as predictors (to avoid redundancy and biased calculations, SDQ Total scores  
341 were not entered in the equations).

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Table 3 about here

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Higher Mental toughness scores were associated with lower internalizing problems (parents, teachers), lower externalizing problems, more positive peer relationships, and higher prosocial behavior (teachers). The following variables were excluded from the equation: teachers' ratings of hyperactivity; parents' ratings of internalizing problems, prosocial behavior, hyperactivity, and negative peer relationships-

Higher sleep disturbances were associated with higher externalizing problems (parents, teachers), and more negative peer relationships (teachers). The following variables were excluded from the equation: teachers' ratings of internalizing problems, prosocial behavior, and hyperactivity; parents' ratings of internalizing problems, negative peer relationships, prosocial behavior, and hyperactivity.

Gender differences in mental toughness and sleep disturbances

A series of t-tests (see Table 4) revealed that females at 14 years, compared to males, had lower MT scores and reported more sleep disturbances.

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Table 4 about here

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368 **Discussion**

369           The key findings of the present study were that lower scores of internalizing and  
370 externalizing problems and negative peer-relationships and higher prosocial behavior scores  
371 at age five, as rated by parents and teachers, associated with higher mental toughness scores  
372 and lower sleep disturbances scores at age 14. The pattern of results adds to the current  
373 literature in an important way in that we were able to shed some light on the origins of  
374 adolescent mental toughness by relating this to favorable psychological traits at the age of five  
375 years.

376           Three hypotheses were formulated and each of these is considered now in turn.

377           Our first hypothesis was that positive psychological traits during childhood (lower  
378 internalizing and externalizing problems, lower negative peer-relationships, higher pro-social  
379 behavior) would be associated with greater MT at 14 years, and this was confirmed. We hold  
380 that the present study expands upon previous research in being the first to associate adolescent  
381 mental toughness from favorable childhood psychological traits. As shown in Tables 2 and 3,  
382 both parents' and teachers' ratings of children's lower externalizing, internalizing problems,  
383 negative peer relationships and higher prosocial behavior during preschool was associated  
384 with higher mental toughness scores during adolescence.

385           Our second hypothesis was that childhood psychological traits would be associated  
386 with lower sleep disturbances scores ~~patterns~~ in adolescence, and this hypothesis also  
387 received support. We believe that this pattern of results confirms both the assumed association  
388 between positive psychological traits and sleep quality. In this view, there is evidence from  
389 longitudinal studies that sleep quality impacts on psychological functioning (Brand et al.,  
390 2015; Hatzinger et al., 2013b, 2014; Kaneita et al., 2009; Roberts and Duong, 2014, 2015;  
391 Roberts et al., 2009); the results of a meta-analysis indicated that poor sleep predicted  
392 symptoms of depression among adolescents, and not vice versa (Lovato and Gradisar, 2014).

393 On the other hand, psychological traits also impacts on sleep patterns (see Brand et al. 2015  
394 for extensive overview), a direction of influence also confirmed in the present study.

395 Our third hypothesis was that, cross-sectionally, higher MT scores would be related to  
396 fewer sleep disturbances, and again data confirmed this. Therefore, the present pattern of  
397 results is also consistent with previous findings (Brand et al., 2014b,c,e; Brand et al., 2016),  
398 and underscores the bi-directionality of sleep and psychological functioning.

399 The data available do not shed any light on why positive psychological traits such as  
400 lower internalizing and externalizing problems, lower negative peer-relationships and higher  
401 prosocial behavior at five years, and as rated by parents and teachers, should be associated  
402 with both self-rated increased MT and lower sleep disturbances nine years later. We know  
403 from previous studies (Fischer et al, 2012; Settles et al, 2012; Shin et al., 2012; Wong et al.,  
404 2010) that increased psychological issues during childhood also increased the risk of  
405 increased psychological issues in adolescence and early adulthood. We also know that  
406 personality traits remained fairly stable from childhood to adolescence (Keefer et al. , 2013,  
407 Moffitt et al. , 2011, Roberts et al. , 2001, Shin, Sung, 2012), and in this view, we also know  
408 that higher IQ and positive parenting favor the development of resilience in childhood and  
409 provide protection under conditions of severe adversity (Masten et al., 1999). In this context,  
410 Masten and Tellegen (2012) reported that resilience increased as a function of high quality  
411 relationships with parents and other adults (see also Skala & Bruckner, 2014), cognitive  
412 quality, social-emotional skills, adaptive resources, planfulness, future motivation, autonomy,  
413 adult support, and coping skills (Masten, 2004; Masten et al., 2004), and that resilience often  
414 emerged in childhood and endured, but that there were also late bloomers. Sameroff and  
415 Rosenblum (2006) emphasized that, in addition to the behavioral and emotional self-  
416 regulation characteristic of good mental health and the cognitive self-regulation characteristic  
417 of high intelligence, environmental factors such as parenting, peers, and economic conditions  
418 may independently and bi-directionally contribute to a child's resilience.

419 How should these findings be related to the present study? Our proposal is that lower  
420 internalizing and lower externalizing problems, lower negative peer-relationships and higher  
421 prosocial behavior might be understood as the behavioral and emotional self-regulation that is  
422 characteristic of good mental health, the cognitive self-regulation element as suggested by  
423 Sameroff and Rosenblum (2006; Keefer et al., 2013, 2006), as well as aspects of the adaptive  
424 resources, autonomy and coping skills, as suggested by Masten and colleagues (Masten, 2004;  
425 Masten et al., 2004). Additionally, prosocial behavior might be understood as reflecting high  
426 quality relationships and stable social-emotional skills (Masten et al., 2004; Masten and  
427 Tellegen, 2012; Skala and Bruckner, 2014). Importantly, in the present study lower  
428 internalizing and externalizing problems and higher prosocial behavior were associated with  
429 greater mental toughness nine years later, suggesting therefore considerable stability in level  
430 of psychological traits from childhood to mid adolescence (Caspi et al, 2005; Moffitt et al.,  
431 2011; Shin et al., 2012).

432 As regards gender differences, our findings confirmed previous results, in that relative  
433 to males, females at age 14 had lower MT scores (Brand et al, 2014c, 2016) and more  
434 pronounced sleep difficulties (Armitage and Hoffmann, 2001, Mong and Cusmano, 2016).

435 Despite the novelty of the findings, several limitations warrant against their  
436 overgeneralization. First, the sample size was small, and a larger sample would have provided  
437 greater statistical power and may therefore have revealed other significant associations.  
438 Second, the pattern of results might have emerged due to further latent, but unassessed  
439 dimensions, which might have biased two or more variables in the same or opposite  
440 directions. This holds particularly true, as it is conceivable that latent MT traits and sleep  
441 patterns at the age of 5 might have conferred to the MT and sleep disturbances scores at the  
442 age of 14. Further, for instance, parenting style was not assessed at both time points. In this  
443 regards, there is evidence that children's and also adolescents' behavior and sleep are not  
444 independent of family functioning, parenting style (Brand et al. , 2009), or parents' sleep

445 patterns (Bajoghli et al., 2013; Brand et al., 2009; Kalak et al, 2012). Third, no  
446 neurophysiological data were gathered at the second time point; previous studies have shown  
447 that, for instance, cortisol secretion remained stable over time (Hatzinger et al. , 2013a), while  
448 cortisol secretion is not related to sleep patterns (sleep-EEG; actigraphy) 12 months later,  
449 suggesting therefore that cortisol secretion may also vary as a function of current physical and  
450 psychological processes. Fourth, sleep at age 14 was only assessed subjectively. Fifth, only  
451 the MT overall score was applied (MTQ18); employing the long version (MTQ48) would  
452 have allowed a more fine-grained analysis of the associations between childhood and  
453 adolescent psychological functioning. In this regard, we underscore that the current  
454 interpretations rely on the assumption that psychometric properties of the MTQ18 used with  
455 adolescents are acceptable. Sixth, it is conceivable that the strengths and difficulties at the age  
456 of five years are the result of psychosocial development from very first infancy to  
457 preschool-age, suggesting therefore that the origins of adolescents' mental toughness might be  
458 rooted even earlier in development. Seventh and last, the concept of MT has gained increasing  
459 interest for its utility among elite and non-elite athletes to explaining a broad range of coping,  
460 motivation, self-esteem and health-related behavior (see Introduction and Table 1), future research  
461 might focus on the causal relation between MT traits and such constructs as reported in Table 1.

462

463

## 464 **Conclusions**

465 Positive psychological traits as reflected in lower internalizing and externalizing  
466 problems and higher prosocial behavior at age five was associated with higher mental  
467 toughness scores and lower sleep disturbances scores at age 14. The pattern of results  
468 suggests that positive psychological traits in childhood seemed to lay the foundation for  
469 adolescent mental toughness. This is important because mental toughness has proved to be a  
470 stress resilience factor during both adolescence and young adulthood.

471

472

473 Authors' contributions

474 Study design: DSB, MH, MG, SL, PJC, SP, KVK, AVW, EHT, SB; data gathering: DSB,

475 MH, SP, AVW, SB; data analysis: DSB, MG, SL, SB; interpretation of the data: DSB, MH,

476 MG, SL, PJC, SP, KVK, AVW, EHT, SB; writing the first draft: DSB, MG, EHT, SB;

477 integration of authors' comments: DSB, MG, SL; SB; final manuscript: DSB, MH, MG, SL,

478 PJC, SP, KVK, AVW, EHT, SB.

479

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484

485

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489

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726 Table 1

727 Overview of Mental toughness traits in relation to other psychological concepts (the list doesn't claim  
 728 to be complete)

Concept	Authors	Mental toughness			
		Control	Commitment	Confidence	Challenge
Resilience	(Skala and Bruckner, 2014)			X	X
Hardiness	(Kobasa et al. , 1982)	X		X	X
Cognitive appraisal of stress	(Lazarus and Folkman, 1984)	X			X
Perceived Stress Scale	(Cohen et al. , 1983)	X		X	X
Self-esteem	(Rosenberg, 1965)			X	
Self-efficacy	(Bandura, 1977)	X		X	
Self-regulation	(Keefer, Holden, 2013, Sameroff and Rosenblum, 2006)	X		X	X
Intrinsic motivation	(Ryan and Deci, 2000)	X	X	X	
Expectancy-value theory	(Wigfield and Eccles, 2000)		X	X	

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Table 2

Descriptive statistics and correlations between mental toughness and sleep disturbances at age 14 and teachers' and parents' rating of children's psychological functioning at age 5.

	Dimensions at age 14		Descriptive statistics
	Mental toughness	Sleep disturbances	M (SD)
<b>Teachers' ratings</b>			
Internalizing problems	-.35**	.24*	1.29 (0.29)
Externalizing problems	-.36**	.25*	1.39 (0.26)
Negative peer relationship	-.25*	.24*	1.25 (0.38)
Hyperactivity	-.04	.11	1.56 (0.45)
Prosocial behavior	.38**	-.21*	1.53 (0.38)
Overall score	-.19*	.20*	1.37 (0.21)
<b>Parents' ratings</b>			
Internalizing problems	-.30**	.21*	1.31 (0.36)
Externalizing problems	-.24**	.25*	1.36 (0.27)
Negative peer relationship	-.12	.10	1.21 (0.29)
Hyperactivity	-.02	.03	1.52 (0.41)
Prosocial behavior	.21*	-.20*	1.48 (0.39)
Overall score	-.15	.12	1.35 (0.20)
Descriptive statistics M (SD)	22.31 (4.86)	5.64 (3.99)	

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739 Table 3

740 Overview of the multiple regression analyses (stepwise backward) with mental toughness and sleep  
 741 disturbances at age 14 as dependent variables and parents' and teachers' ratings of the children's  
 742 strengths and difficulties (SDQ) at children's age five as independent variables

Dimension	Variable	Non-standardized coefficients		Standardized coefficient		p	R	R <sup>2</sup>	Durbin-Watson statistics
		Coefficient beta	Standard error	beta					
Mental toughness	Intercept	23.43	1.18	-	19.89	.000	.402	.160	1.67
	Teachers' internalizing problems	-68.87	33.66	-5.04	-2.05	.045			
	Parents' externalizing problems	-61.34	32.80	-5.07	-1.96	.051			
	Teachers' externalizing problems	-66.81	33.43	-3.71	-2.00	.047			
	Teachers' negative peer-relationship	-65.26	32.50	-3.44	-1.99	.048			
	Teachers' Prosocial behavior	64.43	32.50	5.27	1.99	.049			
Excluded variables: Teachers' ratings of hyperactivity; parents' ratings of internalizing problems, prosocial behavior, hyperactivity, negative peer relationship									
Sleep disturbances	Intercept	5.98	0.96	-	6.230	.000	.339	.115	1.51
	Parents' externalizing problems	4.93	2.20	.320	2.547	.013			
	Teachers' externalizing problems	5.08	2.20	.329	2.284	.025			
	Teachers' negative peer relationships	5.956	2.05	.386	2.902	.005			
Excluded variables: Parents' ratings of internalizing problems, negative peer relationship, prosocial behavior, hyperactivity, teachers' ratings of internalizing problems, prosocial behavior, hyperactivity.									

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746 Table 4

747 Mental toughness scores and sleep disturbances, separated by gender.

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	Gender		Statistical analysis
	Females	Males	
N	32	45	
Mental toughness	19.33 (3.19)	25.02 (3.51)	$t(75) = 2.01, p = .04$
Sleep disturbances	7.97 (2.47)	4.41 (2.61)	$t(75) = 2.21, p = .03$

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