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5 **Youth Motor Competence Promotion Model: A Quantitative**

6 **Investigation into Modifiable Factors**

7

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24

25 **Abstract:**

26 Objectives: This study aimed to quantify the relationships between enabling, predisposing and  
27 reinforcing ecological factors on motor competence and investigate potential sex, weight status, and  
28 school level differences.

29 Methods: Data were collected from 429 children (52% boys; aged  $11.1 \pm 0.6$  years; 87% white British).  
30 Cardiorespiratory fitness (20m Multistage Shuttle Run), muscular strength (Handgrip Strength) and  
31 online questionnaire (Child Health and Activity Tool; CHAT) data on moderate-to-vigorous physical  
32 activity, sport participation and available surrounding physical activity facilities were included as  
33 enabling variables. Three predisposing variables were determined from self-report data on  
34 benefits/barriers to exercise, adequacy, and predilection. Parental/guardian physical activity levels and  
35 persons whom participate in physical activity and sport with the participant (CHAT) were selected as  
36 reinforcing variables. Motor competence was determined from cumulative scores for Dragon  
37 Challenge tasks (Balance Bench, Core Agility, Wobble Spot, Overarm Throw, Basketball Dribble,  
38 Catch, Jumping Patterns, T-Agility, Sprint). Confirmatory Factor Analysis assessed the fit of  
39 measured variables into latent factors. Structural equation modelling evaluated relationships between  
40 these latent factors.

41 Results: Motor competence was directly affected by the enabling factor ( $\beta=0.50, p<0.001$ ) but  
42 indirectly affected by reinforcing and predisposing factors, mediated by the enabling factor ( $\beta=0.13,$   
43  $p=0.014; \beta=0.25, p=0.002$ ). Multi-group comparisons showed that each of these effects did not differ  
44 by sex, weight status or school level ( $p>0.05$ ).

45 Conclusions: This study demonstrated that enabling factors are crucial for the development of motor  
46 competence. This is the first study to quantify an ecological model with motor competence as the  
47 endogenous variable and is key to future interventions.

48

49 **Key words:** Motor competence, Children, Ecological Model, Enabling, Predisposing, Reinforcing.

50 **Practical Implications:**

- 51 • This study presents an ecological model to provide an understanding of the multiple influences on  
52 motor competence and identify multiple potential pathways that could improve motor competence  
53 in children.
- 54 • Each direct and indirect effect in the model did not differ by school level, weight status or sex,  
55 supporting the notion that the model may be applicable across many groups of primary and  
56 secondary level school children.
- 57 • This study provides insight for interventions and programmes to promote motor competence that  
58 can be used by schools, families, communities, practitioners and academics.
- 59 • Given the study revealed a direct effect of the enabling factor on motor competence, actively  
60 promoting physical activity, sport participation and health-related fitness, as well as increasing the  
61 accessibility of surrounding physical activity facilities, could improve overall motor competence  
62 in children.
- 63 • Motor competence promotion strategies should also focus on enhancing social support  
64 mechanisms such as parental/guardian physical activity levels, the number of persons whom take  
65 part in physical activity and sport with children, and children's perceived benefits to, adequacy in,  
66 and predilection to physical activity, while decreasing children's perceived barriers to physical  
67 activity.

68 **Introduction:**

69 Motor competence, as a global term relating to the development and performance of human  
70 movement, represents an individual's ability to perform skilfully on a wide range of motor tasks<sup>1-3</sup>,  
71 and plays an important role in the growth and development of children<sup>1,2</sup>. Movement skills are  
72 imperative to develop, and indeed enhance, motor competence<sup>1-4</sup>. Moreover, movement skills consist  
73 of three interrelated constructs: fundamental movement skills (FMS; balance, core stability,  
74 coordination, speed variation, flexibility, control, proprioception, and power), combined movement  
75 (poise, fluency, precision, dexterity, and equilibrium), and complex movement (bilateral coordination,  
76 inter-limb coordination, hand-eye coordination, turning, twisting and rhythmic movements, and  
77 control of acceleration/deceleration)<sup>1,4</sup>. Whilst FMS develops rapidly from the age of 3 years, children  
78 have the potential for FMS mastery by 7-8 years<sup>1</sup>. Movement patterns, described as general (e.g.,  
79 sending, receiving, running, jumping), refined (e.g., throwing, catching, sprinting, hopping) and  
80 specific (i.e. sport-specific movement patterns), are amalgamations of movements that stem from the  
81 selection and application of movement skills<sup>1,4</sup>. More refined and specific movement patterns are  
82 achieved when FMS (e.g., balance), combined movement skills (e.g., poise) and complex movement  
83 skills (e.g., rhythmic movements) are utilised simultaneously (e.g., jumping patterns)<sup>1,4</sup>. Therefore, the  
84 development of combined and complex movement skills is speculated to be imperative to increasing  
85 levels of motor competence in children over 8 years old<sup>1,4</sup>.

86 There is a vast array of evidence identifying motor competence as a critical precursor for  
87 increasing positive health trajectories, particularly physical activity, across the lifespan<sup>5,6</sup>.  
88 Specifically, systematic reviews and longitudinal studies have reported strong evidence for positive  
89 associations between motor competence and physical activity levels<sup>3,5</sup>, health-related fitness<sup>3,7</sup> and  
90 perceived competence<sup>3</sup>, as well as an inverse association with weight status<sup>3,8</sup>, in paediatric  
91 populations. Furthermore, studies have shown that enhanced motor competence during childhood  
92 tracks across the lifespan by leading to higher levels of physical activity and health-related fitness  
93 during adolescence<sup>3,5</sup>, and by supporting functional independence, general health and quality of life in  
94 later life, as well as reducing the risk of all-cause mortality<sup>6,9</sup>. Thus, enhanced motor competence in

95 children and young people is foundational for physical activity promotion and associated health  
96 benefits, with transferable value throughout the life course.

97 Ecological models provide a framework of potential influencing factors on health-related  
98 behaviours and are useful in emphasising social and psychological influences and environmental  
99 contexts<sup>5</sup>. The Youth Physical Activity Promotion Model (YPAP-M)<sup>10</sup>, offers an ecological  
100 conceptual model framing factors that may enable (e.g., movement skills/motor competence, health-  
101 related fitness, environmental attributes, and access), predispose (e.g., perceived competence and self-  
102 efficacy) or reinforce (e.g., parental physical activity and family, peer and coach influence) physical  
103 activity in children. Although research has investigated the mediating variable framework of the  
104 YPAP-M<sup>11</sup>, the examination of the influencing factors on motor competence, guided by the model,  
105 remains to be explored. Further, few studies have investigated both psychological influences and  
106 environmental factors on motor competence<sup>5</sup>. Therefore, the development of an ecological model with  
107 motor competence as the endogenous variable would afford new insight and an in-depth  
108 understanding of the multiple influences on motor competence. Although the association between  
109 motor competence and other factors such as physical activity, health-related fitness, and perceived  
110 competence, are expected to be reciprocal<sup>2,3</sup>, such a model would enable the investigation of factors  
111 that could be specifically modified to increase motor competence. Such a targeted approach could  
112 therefore inform intervention development with the objective to promote motor competence in  
113 children, as well as explain effects or lack of effects in current intervention strategies.

114 The aim of the current cross-sectional study was to quantify the direct and indirect  
115 relationships between enabling, predisposing and reinforcing ecological factors on motor competence  
116 and to investigate potential sex, weight status, and school level differences.

117

## 118 **Methods:**

119 Following written informed head teacher and parent consent and participant assent, 429  
120 children (52% boys; aged 11.1±0.6 years; 87% white British) from 11 socio-demographically  
121 representative primary and secondary schools (Welsh Index of Multiple Deprivation (WIMD) scores:  
122 815.9±615.8, ranging from 25 (high deprivation) to 1898 (low deprivation); proportion of children in

123 most deprived WIMD quintile rank (<382) = 38.7% and least deprived WIMD quintile rank (>1527)  
124 = 21.4%) in South Wales, UK, participated in the study between 2015-2018 as part of the serial Swan-  
125 Linx programme<sup>12,13</sup>. Ethical approval was obtained from the Institutional Research Ethics Committee  
126 [PG/2014/007; PG/2014/037; PG/2016/003].

127 Using standard anthropometric techniques<sup>14</sup>, stature and body mass were measured to the  
128 nearest 0.001m and 0.1kg, with a portable stadiometer [Seca 213, Seca Ltd, Birmingham, UK] and  
129 electronic weighing scales [Seca 876, Seca Ltd, Birmingham, UK], respectively. Body Mass Index  
130 (BMI) was calculated and age- and sex-specific BMI cut-points were used to classify overweight and  
131 obese participants<sup>15</sup>. Participants completed two functional tests from the EUROFIT Test Battery<sup>16</sup>,  
132 the 20m Multistage Shuttle Run Test (20m MSRT), as measure of cardiorespiratory fitness, and the  
133 Handgrip Strength Test, as a measure of upper-body muscular strength.

134 Children completed a 29-item health and lifestyle online questionnaire (Child Health and  
135 Activity Tool; CHAT), akin to the online-based Sportslinx Lifestyle Survey, that has provided valid  
136 and reliable results<sup>12</sup>. Children reported the number of days they had engaged in moderate-to-vigorous  
137 physical activity (MVPA), described as “any activity or sport where your heart beats faster, you  
138 breathed faster and you felt warmer”, for  $\geq 60$  min·day<sup>-1</sup> in the last week<sup>17</sup>. Children also detailed the  
139 number of organised sports clubs they participated in outside of school<sup>18</sup>. Surrounding physical  
140 activity facilities were reported by children as the number of areas close to their home that they could  
141 play or take part in physical activity in, such as a garden, grassy area/playing field, playground, park,  
142 street, leisure/sport centre or school<sup>18</sup>. Children further reported the number of times a week their  
143 parent/s or guardian/s engaged in physical activity (0 days=0, 1-2 days=1, 3-4 days=2, 5+ days=3)<sup>18</sup>.  
144 Children reported both parents/guardians or a single parent/guardian that they live with. Where  
145 participants reported two parents/guardians, the scores were added together. Thus, larger total scores  
146 (out of a maximum total of 6) show more physically active parents, who provide active role  
147 modelling. Additionally, participants reported the persons they most prominently participated in  
148 physical activity and sport with during and outside of school time (i.e., on their own (=0) or with  
149 parents/guardians, siblings, friends, coaches/teachers/other (=1))<sup>18</sup>. The questions used within this  
150 study are also utilised as part of valid and reliable national surveillance surveys<sup>17,18</sup>.

151 Benefits (desired outcomes from taking part) and barriers (perceived blocks or hindrances to  
152 taking part) to exercise were measured using a nine-item benefits and ten-item barriers subscale from  
153 the Children's Perceived Benefits/Barriers to Exercise Questionnaire<sup>19</sup>, with responses ranging from 1  
154 (disagree a lot) to 5 (agree a lot). Validity and reliability of the questionnaire has been shown to be  
155 good (internal consistency Cronbach's alpha = 0.95 and 0.89, for the benefits and the barriers  
156 subscales, respectively; construct and factorial validity were also established)<sup>19,20</sup>. A benefits/barriers  
157 differential score was calculated by subtracting the mean barriers' score from mean benefits' score,  
158 with higher scores indicating greater perceived benefits compared to perceived barriers to exercise.

159 Perceived adequacy, the perception of capability to achieve some acceptable standard of  
160 success, and perceived predilection, the likelihood that one would select a physical activity when  
161 given the choice, were measured using a seven-item adequacy and nine-item predilection subscale  
162 from the Children's Self-perceptions of Adequacy in and Predilection for Physical Activity  
163 Questionnaire<sup>21</sup>. Hay<sup>21</sup>, demonstrated adequate validity and strong reliability of the questionnaire  
164 (internal reliability ranged from 0.65 - 0.85; test-re-test reliability ranged from 0.78 - 0.91; factorial,  
165 construct and predictive validity were also established)<sup>21</sup>. Each item consisted of two mutually  
166 exclusive descriptions and children decided which of the two descriptions were most like them and  
167 whether the selected description was "sort of" or "really" true for them. The most inactive or  
168 inadequate response was scored 1 and the most active/adequate response 4. A cumulative score for  
169 both adequacy and predilection were calculated.

170 Details of the Dragon Challenge have been reported elsewhere<sup>4</sup>. Briefly, the Dragon  
171 Challenge consists of nine tasks (Balance Bench, Core Agility, Wobble Spot, Overarm Throw,  
172 Basketball Dribble, Catch, Jumping Patterns, T-Agility, and Sprint) which require the application of a  
173 different combination of fundamental, combined and complex movement skills, to form refined and  
174 specific movement patterns<sup>4</sup>. The Dragon Challenge was administered and assessed using the  
175 established methodology<sup>4</sup>. Scoring was completed in situ by expert gold assessors (>50 hours of DC  
176 training and in situ experience), in accordance with the instructions specified within the Dragon  
177 Challenge manual<sup>4</sup>. Children were scored on their technique and outcome for each task. Good inter-  
178 and intra-rater reliability across all tasks and scoring components (all ICCs >0.85), as well as validity,

179 has been previously shown<sup>4</sup>. A cumulative score (0-4) for each task was calculated by summing the  
180 technique scores and twice the outcome score, with four showing high motor competence at that task<sup>4</sup>.

181 Descriptive statistics are presented as mean  $\pm$  SD. All statistical tests were completed using  
182 SPSS and SPSS AMOS, v25 [IBM SPSS Statistics Inc., Chicago, IL, USA], with statistical  
183 significance set at  $p < 0.05$ . Missing data (6.9%) were imputed using an expectation-maximisation  
184 algorithm, an iterative method. Specifically, the missing values are first predicted based on assumed  
185 values for the parameters and then these predictions are used to update the parameter estimates<sup>22</sup>. This  
186 method is iterated, until the sequence of parameters converges to maximum-likelihood estimates<sup>22</sup>.  
187 Independent samples t-tests were used to determine sex differences in measured variables. A  
188 Confirmatory Factor Analysis (CFA) was performed to assess the fit of the measured variables into  
189 four hypothesised latent variables. Specifically, the 20m MSRT and the handgrip strength test, as well  
190 as responses to questions from the CHAT on MVPA, sport participation and available surrounding  
191 physical activity facilities were included as indicators of the enabling factor; the benefits/barriers  
192 differential score, the adequacy score, and the predilection score were included as indicators of the  
193 predisposing factor; responses to questions on parental/guardian physical activity levels and persons  
194 whom participate in physical activity and sport with the participant were included as indicators of the  
195 reinforcing factor; and cumulative scores for each Dragon Challenge task were included as indicators  
196 of the motor competence factor<sup>4</sup>. Comparative fit index (CFI), Goodness of fit index (GFI),  
197 Incremental fit index (IFI) and Root mean square error of approximation (RMSEA) were used to  
198 assess model fit, with CFI, GFI, and IFI of  $> 0.90$  and RMSEA of  $< 0.05$  indicating a good fit<sup>23,24</sup>. SEM  
199 was then used to evaluate the relationships between enabling, reinforcing, and predisposing latent  
200 variables on the motor competence latent variable. The fit was tested at a global level using CFI, GFI,  
201 IFI, and RMSEA. Direct effects were measured using direct path coefficients between latent  
202 variables. In the case of a mediating latent factor, the indirect effect was measured by taking the  
203 product of the two direct effects between the three latent factors. Multi-group comparisons were made  
204 using Chi-squared difference tests to determine whether path relationships differed based on the value  
205 of a moderator: sex (boys vs. girls), weight status (healthy vs. overweight/obese), and school level



206 (primary vs. secondary). Paths that were non-significant at an overall level, as well as for all values of  
207 the moderators, were removed from the final SEM.

208

209 **Results:**

210 Mean and standard deviations of the measured variables are presented in Table 1.

211

212 **[INSERT TABLE 1 ABOUT HERE]**

213

214 The fit for the hypothesised CFA (Figure 1) was good (CFI, 0.927; GFI, 0.944; IFI, 0.929;  
215 RMSEA, 0.035; 90% CI 0.026–0.044), after the addition of three correlations between error terms  
216 within the same factor.

217

218 **[INSERT (A) FIGURE 1: Confirmatory Factor Analysis of the measured variables into four**  
219 **hypothesised latent factors ABOUT HERE]**

220

221 The hypothesised SEM is shown in Supplementary Material 1 (*see hypothesised SEM, (B)*  
222 *Supplementary Material 1, which displays the paths in the hypothesised model*). The paths from  
223 (i)the reinforcing factor to the motor competence factor and (ii)the predisposing factor to the motor  
224 competence factor were not significant ( $p>0.05$ ). Moreover, these relationships did not differ  
225 significantly based on the value of any of the moderators, and so both paths were removed in the final  
226 model. *Post-hoc* power analysis identified sufficiency to detect significant effects (statistical power  
227  $>0.8$ ).

228 The final SEM (Figure 2) demonstrated a good fit on a global level (CFI, 0.925; GFI, 0.944;  
229 IFI, 0.926; RMSEA, 0.036; 90% CI 0.027–0.044). The model revealed that the reinforcing factor was  
230 directly related to the predisposing ( $\beta=0.45, p<0.001$ ) and enabling factors ( $\beta=0.25, p=0.021$ ). An  
231 indirect relationship was found between the reinforcing and motor competence factors, mediated by  
232 the enabling factor ( $\beta=0.13, p=0.014$ ). The predisposing factor was found to have a direct effect on  
233 the enabling factor ( $\beta=0.49, p<0.001$ ), and an indirect effect on motor competence mediated by the

234 enabling factor ( $\beta=0.25, p=0.002$ ). The enabling factor had a direct effect on the motor competence  
235 factor ( $\beta=0.50, p<0.001$ ). Multi-group comparisons showed that each of these direct effects did not  
236 differ by sex, weight status or school level ( $p>0.05$ ).

237

238 **[INSERT (C) FIGURE 2: Final SEM evaluating the relationships between enabling,**  
239 **reinforcing, predisposing, and motor competence latent variables. ABOUT HERE]**

240

241 **Discussion:**

242 This is the first study to report the direct and indirect relationships between enabling,  
243 predisposing, and reinforcing factors on motor competence. This study presents an ecological model  
244 with motor competence as the endogenous variable to provide understanding of the multiple  
245 influences on such an outcome<sup>5</sup>. Results from the CFA showed that the fit of the measured variables  
246 into the four hypothesised latent factors based on the YPAP-M<sup>10</sup> was good, confirming that the  
247 selected measures were associated with the appropriate latent factor.

248 The finding that the enabling factor had a direct effect on the motor competence factor  
249 purports that an increase in the enabling factor resulted in an increase in motor competence, and thus  
250 an improvement in competence in movement skills and advanced movement patterns. In accord with  
251 systematic reviews, there was a positive association between motor competence and MVPA<sup>3,5</sup>, sport  
252 participation<sup>3,5,25</sup> and aspects of health-related fitness<sup>3,7</sup>. Further, research suggests that a positive  
253 feedback loop exists, in which children with greater levels of physical activity and sport participation  
254 develop better motor competence and fitness, consequently further increasing engagement<sup>2,3</sup>. Whilst  
255 environmental and access factors have been previously reported to support physical activity<sup>10,26</sup>, little  
256 evidence has shown the impact on motor competence<sup>5</sup>. It is therefore noteworthy that available  
257 surrounding physical activity facilities loaded onto the enabling factor, which was positively  
258 associated with motor competence. Overall, the finding that the enabling factor had a direct effect on  
259 motor competence supports previous literature, as well as provides further evidence of an association  
260 between physical activity<sup>3,5</sup>, sport participation<sup>3,5,25</sup>, fitness<sup>3,7</sup>, and surrounding facilities and motor  
261 competence.

262 In line with previous research that has displayed positive associations between parental  
263 influence and family support (reinforcing variables), and physical activity levels and fitness (enabling  
264 variables), in children and adolescents<sup>10,26</sup>, the direct relationship between the reinforcing and  
265 enabling factor further supports the importance of parental/guardian modelling and friends/family  
266 encouragement. Conversely, few studies have demonstrated that reinforcing variables can  
267 simultaneously influence predisposing variables<sup>11</sup>. The proposed model is of importance since it  
268 shows that an increase in the reinforcing factor resulted in an increase in perceived benefits to,  
269 adequacy in, and predilection to physical activity (predisposing factor). Given that previous literature  
270 has shown a parental influence on movement skills competence<sup>5</sup>, it was hypothesised that the  
271 reinforcing factor would also have a direct relationship on the motor competence factor, though this  
272 direct relationship was not apparent. Rather, results showed an indirect relationship between the  
273 reinforcing factor and motor competence factor, mediated by the enabling factor. Consequently,  
274 increasing the reinforcing factor (i.e., social support/monitoring) may result in improvements in  
275 enabling measured variables as well as motor competence. Overall, the findings regarding the  
276 reinforcing factor provide evidence for the impact of psychosocial variables on biological,  
277 environmental, behavioural, and psychological variables, as well as indirectly on motor competence  
278 levels.

279 Congruent with previous research, whereby higher levels of self-efficacy, perceived  
280 competence, and overall motor competence were related to higher levels of physical activity<sup>26,27</sup>, the  
281 SEM showed that the predisposing factor (i.e., perceived benefits to, adequacy in, and predilection to  
282 physical activity) had a direct effect on the enabling factor (i.e., physical activity, sport participation,  
283 health-related fitness, and available surrounding physical activity facilities). While it was  
284 hypothesised that the predisposing factor may have a direct relationship on the motor competence  
285 factor, an indirect effect, mediated by the enabling factor, was found. Indeed, previous research has  
286 shown that perceived competence has a mediating effect on the association between motor  
287 competence and physical activity in children and adolescents<sup>28,29</sup>. This study therefore provides  
288 further support to the contention that an increase in the predisposing factor will result in an increase in

289 physical activity, sport participation, and health-related fitness, and subsequently an increase in levels  
290 of motor competence.

291 Overall, previous research supports the synergistic relationships of biological, environmental,  
292 psychosocial and behavioural factors on the evolution and continued development of motor  
293 competence across the lifespan<sup>3,5,6</sup>. The current study supports the strength of these relationships,  
294 particularly in terms of promoting motor competence in an ecological model that can be used to  
295 inform interventions. One such intervention strategy would be to promote physical activity, sport  
296 participation, health-related fitness, and available surrounding physical activity facilities, given the  
297 direct effect of the enabling factor on motor competence in the current results. Potential strategies to  
298 enhance these variables could be that schools offer additional after-school programmes (given the  
299 pressures that exist on curricular time) to provide opportunities for physical activity and sport  
300 participation, particularly vigorous and muscle/bone strengthening activities that enhance health-  
301 related fitness. Parents should also be aware of the importance of providing additional opportunities  
302 for their children to participate in. Furthermore, schools could enable access to school grounds outside  
303 of the daily timetable and term times, to provide additional physical activity facilities for children to  
304 easily access. Moreover, whilst both the reinforcing and predisposing factor only had a direct effect  
305 on the enabling factor, the indirect effect of these factors on motor competence, indicates that an  
306 increase in either reinforcing or predisposing factor was indirectly associated with an increase in  
307 motor competence. Thus, interventions to promote motor competence could also focus on enhancing  
308 social support mechanisms such as parental/guardian physical activity levels, the number of persons  
309 whom take part in physical activity and sport with children, and children's perceived benefits to,  
310 adequacy in, and predilection to physical activity, while decreasing children's perceived barriers to  
311 physical activity. Contrary to previous findings that show increasing age, healthy weight status and  
312 being male are correlates for certain aspects of motor competence<sup>5</sup>, multi-group comparisons did not  
313 display these differences. Consequently, the SEM revealed an ecological model that can be used to  
314 inform interventions for the improvement of motor competence in children via multiple pathways  
315 regardless of age, weight status, and sex.

316 The use of SEM in the current study provides a novel approach to identifying modifiable  
317 factors that can increase motor competence in children, allowing the investigation of the concurrent  
318 influences of multiple variables. Indeed, SEM explicitly models measurement error, thereby providing  
319 more accurate relationships among latent factors, a frequently cited limitation of many studies<sup>30</sup>.  
320 Furthermore, the assessment of fundamental, combined and complex movement skills and varying  
321 complexities of movement patterns provides a more inclusive measure to inform motor competence<sup>4</sup>.

322 Whilst there are numerous strengths, the current study is not without limitations. Specifically,  
323 the measures chosen to best predict each latent variable in the model were selected from measures  
324 involved in the Swan-Linx programme, and therefore other quantitative measures (e.g., accelerometer  
325 data) may have increased the strength of the model. Future research could also expand the measures  
326 used to assess enabling and reinforcing factors (e.g., reinforcing factors could include encouragement  
327 for motor competence from peers and parents or other aspects of social support), as well as investigate  
328 whether there is a difference between single parent versus dual parent role-modelling. Further, an  
329 expectation-maximisation algorithm was used to impute missing data, although this imputation  
330 method has previously been validated<sup>22</sup>. Whilst no differences were found between primary and  
331 secondary school level children, it is possible that age differences may be apparent with a larger age-  
332 range, or that biological age may account for greater variation. Finally, the sample within the current  
333 study was largely homogenous, with 87% of the sample being white British children. Whilst this is  
334 closely aligned to the ethnicity proportions of the population in Wales, the results cannot be  
335 generalised beyond this particular racial/ethnic group. Future studies should aim to adopt the current  
336 analyses to test the significance of the model across a larger age range and differing ethnic groups, as  
337 well as across different countries. The replication of the current study with the inclusion of a wider  
338 range of participants would enhance the significance of the model and make it more generalisable.

339

340 **Conclusion:**

341 In conclusion, the present study found that the enabling factor had a direct effect, whilst the  
342 reinforcing and predisposing factors had an indirect effect, on motor competence. Each direct and  
343 indirect effect did not differ by school level, weight status or sex, supporting the contention that the

344 model is applicable across many groups of primary and secondary level school children. These  
345 findings are the first to be set in this framework and reveal that there are multiple potential pathways  
346 that could inform future interventions that aim to promote motor competence.

347

348

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357 participated in Swan-linx and the Dragon Challenge.

358

359

360 **Conflict of Interest:**

361 The authors declare there are no known conflicts of interest in the present study. The results

362 of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate

363 data manipulation.

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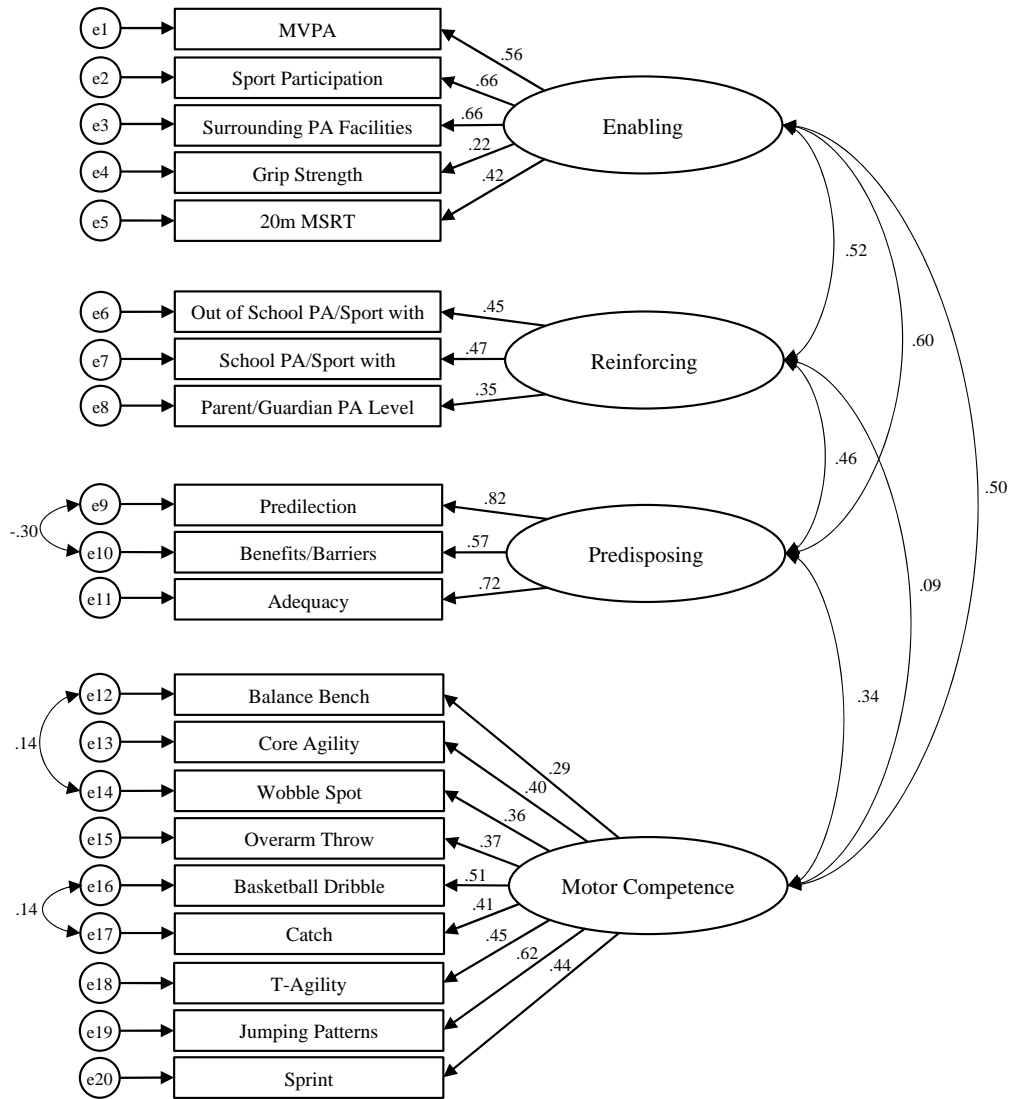
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- 448

449 **Table 1. Descriptive statistics, mean  $\pm$  SD, of measured variables**

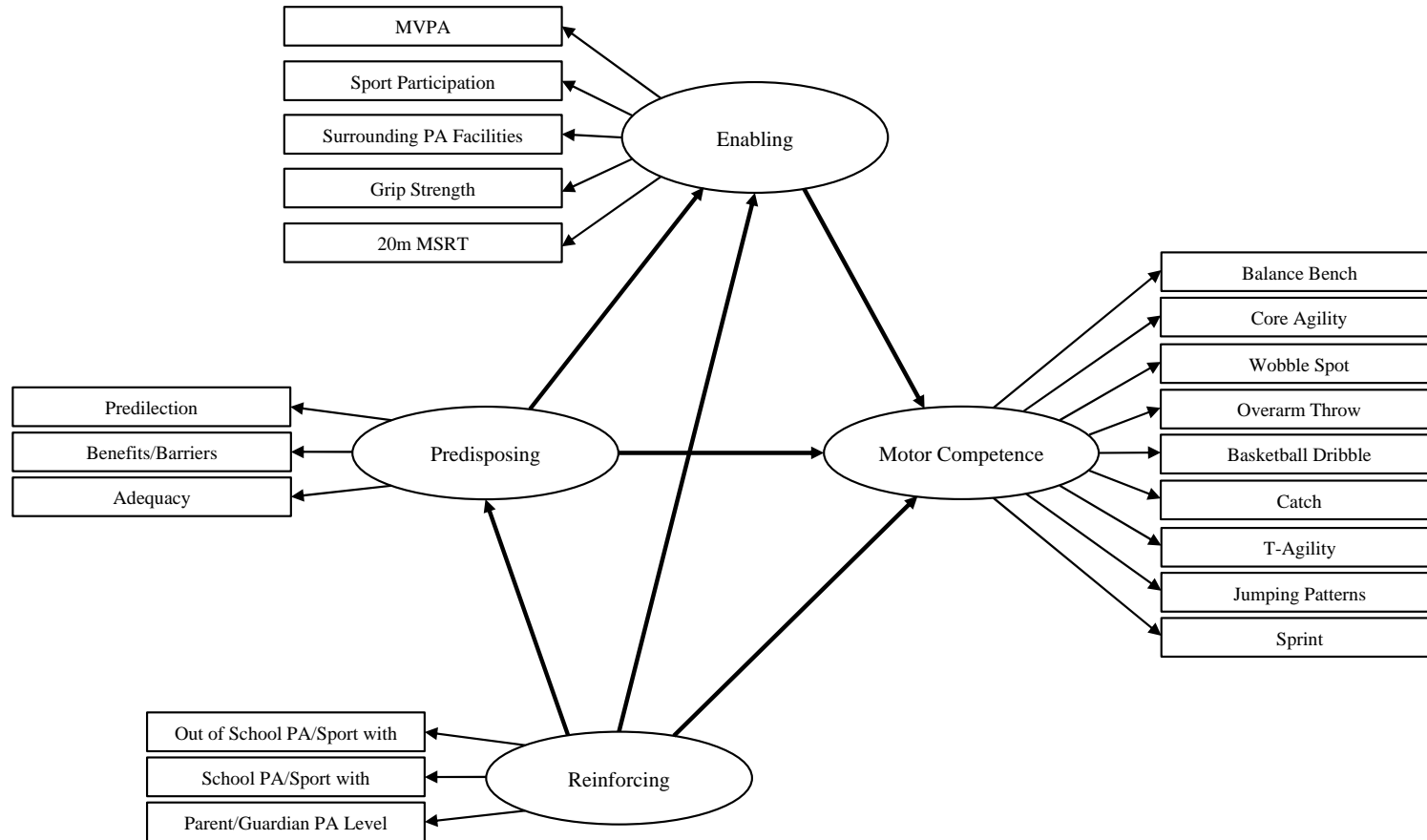
<b>Variables</b>	<b>Boys</b>	<b>Girls</b>	<b>All</b>
Primary School	73.5%	67.9%	70.9%
Secondary School	26.5%	32.1%	29.1%
Unhealthy Weight	35.9%	40.0%	37.9%
Healthy Weight	64.1%	60.0%	62.1%
MVPA (0-7 days)	2.4 $\pm$ 1.2	2.2 $\pm$ 1.1	2.3 $\pm$ 1.2
Sport Participation (number of sports)	2.7 $\pm$ 2.7*	2.3 $\pm$ 2.1	2.5 $\pm$ 2.4
Surrounding PA Facilities (0-8 facilities)	3.0 $\pm$ 2.0	3.2 $\pm$ 2.0	3.1 $\pm$ 2.0
Grip Strength (kg)	17.7 $\pm$ 3.9	17.1 $\pm$ 3.8	17.4 $\pm$ 3.8
20m MSRT (shuttles)	31.9 $\pm$ 18.1**	22.5 $\pm$ 11.9	27.4 $\pm$ 16.1
Out of School PA/Sport with (0-1)	0.9 $\pm$ 0.3	0.8 $\pm$ 0.4	0.9 $\pm$ 0.3
Out of School PA/Sport with others	86.7%	84.4%	85.6%
School PA/Sport with (0-1)	0.9 $\pm$ 0.2	0.9 $\pm$ 0.2	0.9 $\pm$ 0.2
School PA/Sport with others	95.2%	95.4%	95.3%
Parents PA Levels (0-6)	2.4 $\pm$ 1.5	2.7 $\pm$ 1.4	2.5 $\pm$ 1.5
Predilection (9-36)	28.3 $\pm$ 4.5	28.2 $\pm$ 5.3	28.2 $\pm$ 4.9
Benefits/Barriers to PA (-41-35)	1.4 $\pm$ 0.9	1.3 $\pm$ 0.8	1.4 $\pm$ 0.8
Adequacy (7-28)	21.1 $\pm$ 3.6	20.8 $\pm$ 3.7	20.9 $\pm$ 3.6
Balance Bench (0-4)	1.4 $\pm$ 1.1	1.6 $\pm$ 1.2*	1.5 $\pm$ 1.1
Core Agility (0-4)	1.3 $\pm$ 0.9	1.5 $\pm$ 1.0	1.4 $\pm$ 1.0
Wobble Spot (0-4)	1.3 $\pm$ 1.5	1.4 $\pm$ 1.5	1.4 $\pm$ 1.5
Overarm Throw (0-4)	2.1 $\pm$ 0.9**	1.3 $\pm$ 1.0	1.7 $\pm$ 1.0
Basketball Dribble (0-4)	2.3 $\pm$ 1.0**	1.7 $\pm$ 1.2	2.0 $\pm$ 1.1
Catch (0-4)	1.5 $\pm$ 1.3**	0.9 $\pm$ 1.1	1.2 $\pm$ 1.3
T-Agility (0-4)	1.3 $\pm$ 1.1	1.2 $\pm$ 1.0	1.2 $\pm$ 1.1
Jumping Patterns (0-4)	2.0 $\pm$ 1.0	2.0 $\pm$ 1.0	2.0 $\pm$ 1.0
Sprint (0-4)	2.5 $\pm$ 0.8*	2.3 $\pm$ 0.9	2.4 $\pm$ 0.8

Note. MVPA = Moderate-to-vigorous physical activity; PA = Physical activity; 20m MSRT = 20m Multistage Shuttle Run Test; Independent samples t-test: \* = <0.05, \*\* = <0.001

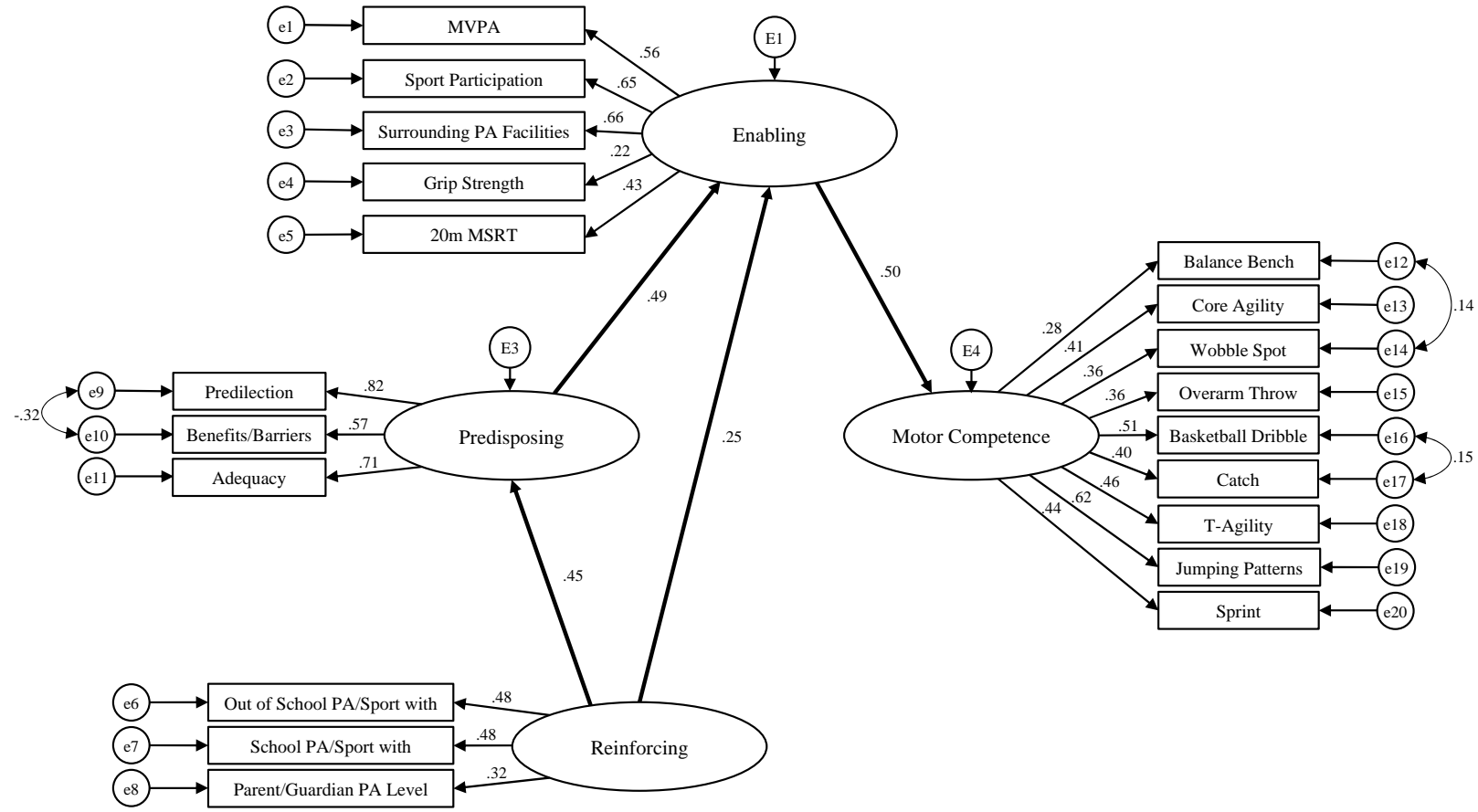
- 451      **A. Figure 1:** Confirmatory Factor Analysis of the measured variables into four hypothesised  
452              latent factors
- 453      **B. Supplementary Material 1.** Hypothesised model, which presents the paths in the  
454              hypothesised structural equation model. Pdf
- 455      **C. Figure 2:** Final SEM evaluating the relationships between enabling, reinforcing,  
456              predisposing, and motor competence latent variables.
- 457



(A) Figure 1: Confirmatory Factor Analysis of the measured variables into four hypothesised latent factors



(B) Supplementary Material 1. Hypothesised SEM, which displays the paths in the hypothesised structural equation model



(C) Figure 2: Final SEM evaluating the relationships between enabling, reinforcing, predisposing, and motor competence latent variables.