Effect of group contingency strategy on physical education

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5 Effects of 'Fair Play Game' strategy on Moderate to Vigorous Physical Activity in Physical

6 Education

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34 **Abstract**

35 Less than 50% of a physical education (PE) lessons are usually spent in moderate to vigorous

36 physical activity (MVPA). A dependent-group contingency strategy, 'Fair Play Game,' has

37 shown effectiveness in increasing MVPA during PE lessons among students from affluent

38 schools. The purpose of this study was to determine the effectiveness of this strategy on

39 MVPA among students from an undeserved community. The 'Fair Play Game' strategy

40 consisted of goal setting, prompts, feedback, and rewards. A single-subject multiple baseline

41 design was applied across two classes of students, throughout 15 soccer lessons. Three

42 students from each class (N=6) were selected for an individual analysis according to their

43 MVPA level at baseline (low, medium and high). Students wore a waist-mounted

44 accelerometer during lessons. Students with a low level of MVPA at baseline from Year 8,

45 presented a positive change in trend, level and percentage of non-overlapping on % MVPA

46 data. The intervention was not effective to change MVPA for the other students. The 'Fair

47 Play Game' might be effective in increasing physical activity levels in students with low

48 levels of activity from undeserved areas. However, the intervention needs to be tailored for

49 each population and applied regularly for the benefits to be expanded to the whole class.

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54 *Keywords*: Fair Play Game; Single subject; Visual analysis; Accelerometer; Physical

55 education

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59   **Introduction**

60   Only one-third of children meet the current recommendation of 60 minutes of

61   moderate to vigorous physical activity (MVPA) per day in England (Health Survey for

62   England, 2008). Likewise children from lower socioeconomic status groups tend to engage in

63   lower levels of physical activity (PA) (Carlson, Mignano, Norman, McKenzie, & Kerr, 2014)

64   and higher levels of sedentary behavior (Brodersen , Steptoe, Boniface, & Wardle, 2007).

65   Schools are seen as the main setting to encourage PA in children (De Bourdeaudhuij et al.,

66   2011; van Sluijs, McMinn, & Griffin., 2008) and physical education (PE) is considered an

67   ideal opportunity for promotion of regular PA (Sallis & McKenzie, 1991).

68   In the year 2000, Healthy People 2010 (U.S. Deparment of Health and Human

69   Services, 2000) recommended that at least 50% of PE lesson time should be spent on

70   MVPA, which has been supported further by the Centre for Disease and Control (U.S.

71   Deparment of Health and Human Services, 2010). However, a review study concluded that

72   middle and high school students spent only 40% of the PE lesson in MVPA (Fairclough &

73   Stratton, 2005).

74   More recently, an analytical review by Sallis et al. (2012) described new goals for

75   achieving Health Optimizing Physical Education (HOPE), defined as: physical education that

76   encompasses curriculum and lessons focused on health-related physical activity and fitness.

77   The authors stated the importance of emphasizing high levels of MVPA during PE lessons.

78   Furthermore, they suggested goals for the next 20 years, including the need for studies on PE

79   to incorporate objective measures to assess MVPA levels, whilst also focussing on

80   developing low-cost and feasible methods for teachers to accurately assess this in classes

81   (Sallis et al., 2012).

82   Some studies have implemented interventions designed to increase MVPA levels

83   during PE lessons. Results from systematic reviews revealed that interventions tend to

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84   promote a net increase of 10% in the amount of time spent in MVPA during lesson time

85   (Kahn et al., 2002; Lonsdale et al., 2013). Several strategies have been used successfully to

86   increase MVPA levels during PE lessons including: professional learning focused on teacher

87   pedagogy, management and instruction, and adding high-intensity activity to the usual PE

88   lessons (Lonsdale et al., 2013).

89   One approach that has shown to be effective in increasing PE students' levels of

90   physical activity is the 'Fair Play Game'. The term 'Fair Play Game' was based on the Sport

91   Education Fair Play Code of Conduct (Siedentop, Hastie, & van der Mars, 2011) which

92   addresses students' participation, responsibility, effort, respect, and being a good sport that is

93   helpful and not harmful to others. The development of the strategy was inspired by The Good

94   Behavior Game (Barrish, Saunders, & Wolf, 1969), which aimed to decrease disruptive

95   classroom behaviors in an elementary school. The 'Fair Play Game' is a dependent-group-

96   contingency strategy that can help PE teachers to set goals for social or active behaviors and

97   hold students accountable, when working in teams. More specifically, the strategy consists of

98   setting daily goals to teams and awarding points to when teams accomplish them. This is not

99   done to produce competition between teams, but instead provides a challenge within teams to

100   overcome previous goals. It also includes public posting (i.e. a chart on the wall) of daily

101   goals, teacher's prompts, and feedback about the desired behaviors to be accomplished by the

102   teams. As a dependent group contingency strategy (Cooper, Heron & Heward, 2007), the

103   'Fair Play Game' requires the teacher to track one unidentified member of each team's

104   performance, against the goal-setting chart relating to that particular team. If the unidentified

105   team member accomplishes the daily goal, the team is awarded with a point, a mark or a

106   smiley face (Vidoni & Ulman, 2012). Every day a different unidentified member is randomly

107   selected. As the selected individual is not identified, this typically results in the whole team

108   making the effort to achieve the daily goal.

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109   More recently, two studies showed positive effects of the implementation of 'Fair

110   Play Game' (Vidoni, Azevedo & Eberline, 2012; Vidoni, Lee & Azevedo, 2014) on middle

111   school students' active behaviors in PE lessons, measured by heart rate monitors and

112   pedometers, respectively. However, despite the 'Fair Play Game' strategy showing positive

113   results in American middle to high socio-economic class students, there is still a need to

114   examine its effectiveness in a more undeserved community, where lower levels of physical

115   activity are evident (Brodersen et ., 2007; Stalsberg & Pedersen, 2010).

116   In addition, the 'Fair Play Game' has not yet been assessed using accelerometers,

117   which provide an objective and more accurate measure of physical activity than previously

118   used monitors (Trost, 2001; Trost, Loprinzi, Moore & Pfeiffer, 2011). Therefore, the purpose

119   of this study was to investigate the effects of the 'Fair Play Game' on objectively measured

120   MVPA levels, among secondary school students from an underserved area in the UK, with

121   different levels of physical activity, during PE lessons.

122   **Methods**

123   **Participants and Setting**

124   Participants were from two classes: Year 8 (12-13 years old) and Year 9 (13-14 years

125   old). They were boys from a secondary school in an underserved area of England, based on

126   the index of multiple deprivation (IMD) and eligibility for free school meals (FSM). IMD is a

127   small-area based marker of deprivation based on measures of income, employment, health

128   and disability, education, skills and training, barriers to housing and services, crime, and the

129   living environment. Small areas, across England, are ranked from 1 to 32,482, with a rating

130   of 1 indicating the most underserved, and 32,482 being the least underserved. (Noble et al.,

131   2004). Eligibility for free-school meals is considered another proxy measure of deprivation.

132   This particular school recruited for this study was located in an area of IMD of 5,376,

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133   therefore in lowest quintile of deprivation in England. Furthermore 48% of the students were

134   entitled to free school meals compared to an average of 16.3% in the country (Department for

135   Education, 2013).

136   This study received ethical approval from the School of Health & Social Care at

137   Teesside University (Study No 174/11). Prior to the study, the head teacher of the school

138   received written information and provided informed consent. Twenty-one boys from each

139   class then received an information pack, containing a letter to their parent or guardian, an

140   information sheet, a written informed consent form for their parent or guardian, and an assent

141   form for the child. Students who were injured or presented any condition affecting their

142   ability to undertake exercise were ineligible to participate. Eligible students who signed the

143   assent form and returned a completed parental/guardian informed consent form were included

144   in the study. In total twelve students from Year 8 and nine students from Year 9 agreed to

145   take part.

146   The school provided two, one hour PE lessons per week. Due to a previously

147   established curriculum, one of the PE lessons was allocated to gymnastics, delivered indoors,

148   and the other day to soccer, delivered outdoors. The 'Fair Play Game' study was conducted

149   during 15 soccer lessons taught by the same teacher. Although the lesson content was chosen

150   by the teacher, the option of soccer was appropriate for this intervention, due to it being an

151   'invasion game'. Previous 'Fair Play Game' studies (Vidoni et al., 2012; Vidoni et al., 2014)

152   were also conducted using invasion games (e.g. basketball and handball) as a unit of

153   instruction.

154   The school PE teacher was also formally invited to participate and signed an informed

155   consent. The PE teacher received training regarding the daily procedures of the intervention

156   and a booklet including major components of the intervention, followed by a questions and

157 answers segment. The PE teacher had 8 years of teaching experience in PE including 5.5

158 years in this particular school.

159 **Research design**

160   This study used a single-subject multiple baseline design across two classes (Cooper

161 et al., 2007) to assess the effects of a dependent-group contingency strategy: 'Fair Play

162 Game', on students' physical activity levels during PE lessons. This design was chosen to

163 examine the impact of the intervention among individual students, and in two different

164 classes. Baseline data were collected in two classes in a staggered fashion to verify if the

165 change on students' number of steps (used for goal setting), and percentage of lesson spent

166 on MVPA were effected by the intervention. An extended baseline for Year 9 enabled

167 repeated measures of students' levels of MVPA during baseline (i.e., typical teaching) and

168 intervention phase. This design has been used in general and adapted physical education, and

169 in sport and physical activity interventions (Holt, Kinchin, & Clarke, 2012; Jull & Mirenda,

170 2016; Lieberman, Dunn, van der Mars, & McCubbin, 2000; Patrick, Ward, & Crouch, 1998;

171 Samalot-Rivera & Porretta, 2013; Todd, Reid, & Kisber, 2010; Vidoni et al., 2014). Students

172 in Year 8 started the intervention in their fifth soccer lesson, whilst those in Year 9 began the

173 intervention in their eleventh soccer lesson.

174 **Procedures**

175   The same PE teacher taught soccer lessons to both classes once a week for 15 weeks.

176 The PE lesson lasted for one hour, but the active part of the lesson lasted for approximately

177 40 minutes. The lessons took place on an outdoor soccer field (approximately size: 100 m

178 length and 60 m width), during the end of autumn, and throughout the winter season, and

179 consisted of approximately: (a) 10 minutes warm-up, (b) 15 minutes drills, (c) 10 minutes

180 game, and (d) 5 minutes closure.

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181   In the first day of the soccer unit of instruction, the PE teacher divided the students

182   from each class into four teams with five students in each team. Each team had a minimum of

183   two and a maximum of three students who were taking part on the study. The teacher

184   explained that the participants would wear an accelerometer, which would measure their

185   physical activity and steps during the lesson. The students were instructed to wear the

186   accelerometer around the hip during the PE lesson. One accelerometer was assigned for each

187   student and they used the same accelerometer throughout the 15 lessons.

188   **Baseline condition.**

189   The teacher taught typical soccer lessons during the first four days for the Year 8

190   class, and ten days for the Year 9 class. Participants were asked to wear the accelerometers,

191   but goals were not established and there was no reinforcement in relation to effort.

192   **Intervention.**

193   During the intervention, students were exposed to the 'Fair Play Game' intervention

194   package. The package consisted of:

195   1. Goal setting: a chart was posted on the wall with information about goals set and

196   goals achieved. The first goal was based on the average number of steps

197   (measured by accelerometers) that the class has taken during the baseline

198   condition.

199   2. Prompts: The teacher prompted the students at the beginning of the lesson to "give

200   their best effort" to increase the number of steps taken during the lesson.

201   Examples of prompts used are: "Let's go, let's go!", "Keep moving!", "Pass and

202   run!". During lesson closure, the teacher asked students to provide examples of

203   how they could demonstrate effort during lessons, and students came up with the

204   following ideas: moving on the field, passing the ball, engaging with their team,

205   and avoiding staying still. Specifically, prompts were delivered at the beginning of

206   each lesson segment (warm-up, practice and game, and closure). There was no

207   control of how many prompts were delivered because the lesson was not

208   videotaped, but at least one prompt was provided as a reminder at the beginning of

209   each segment.

210   3. Unidentified Student: The teacher explained that one unidentified student per

211   team would be monitored and if this student accomplished the goal, the whole

212   team would be awarded with a "YES" mark on the chart.

213   4. Reinforcement: At the end of the lesson the teacher pinpointed some good

214   examples of students' active behaviors that were observed during lesson, for

215   example: staying active around the field, fast passes, getting the ball quickly when

216   it goes out of the field, and rapid transitions for defence or attack.

217   5. Feedback: At the following PE lesson, the teacher then reviewed progress against

218   the goal set on the chart. If the team achieved the goal this was further increased

219   by 200 steps for this current lesson, otherwise it remained the same.

220   6. Reward: By the end of the 15 weeks observation period, each child from the teams

221   which achieved 80% of the goals were rewarded with a Teesside University

222   indoor soccer ball.

223 **Social Validity**

224   At the end of the intervention, all participants in the study, including the teacher, were

225 invited to complete a social validity questionnaire (Vidoni et al., 2014). This assessed

226 participants' acceptability of the behaviors that were reinforced, the procedures used and

227 social importance (Cooper et al., 2007).

228   The teacher was asked five questions relating to the 'Fair Play Game' strategy

229 implementation: (a) if it was effective in increasing students' engagement in PE, (b) if it was

230 complicated to implement, (c) if it impinged on the time needed for their usual PE

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231   instruction, (d) if it was an acceptable strategy to be used in all types of PE classes, and (e) if

232   he would use the strategy in future classes. Responses to these questions were open-ended

233   written comments.

234   The student questionnaire was anonymous and had four open-ended questions: (a) if

235   they liked participating in the 'Fair Play Game' and why, (b) if it was important to give the

236   best effort during PE and why, (c) if their teammates showed their best effort during the

237   lessons and why, and (d) what they did to show their best effort during the lessons.

238   **Treatment Integrity**

239   During the intervention, a checklist was used to verify the treatment integrity. The

240   checklist for the first lesson included: (a) if the teacher talked about best effort in the lesson,

241   (b) if the teacher asked the students about examples of effort in the lesson, (c) if the teacher

242   explained the chart on the wall, and (d) if the teacher explained that just one unidentified

243   student per team would be targeted.

244   During the remaining lessons the checklist consisted of: (a) reminding the students

245   that one team member would be tracked, (b) prompting students to show their best effort

246   during lessons, (c) giving feedback about good examples of effort during lessons, and (d)

247   adding the result of the previous lesson to the chart. The checklist was completed by one of

248   the researchers in all the sessions and reliability was checked by a second researcher during

249   40% of the lessons.

250   **Data recording, measures of the dependent variables and analysis**

251   Number of steps and MVPA were recorded using Actigraph GT1M accelerometers

252   (Pensacola, FL, USA) during all lessons. Actigraph GT1M has shown to provide a reliable

253   measurement of counts and steps (Silva , Mota, Esliger & Welk, 2010). Accelerometer data

254   were recorded in every lesson at 15 seconds epochs, and accelerometers were set to initiate at

255   the beginning of the PE lesson and stop at the end of the lesson. The exact start and finish

256   time of the lessons were recorded manually by the researcher. Data were processed after each

257   lesson, and the number of steps checked for the selected participant in each team to establish

258   if the goal was achieved.

259   Data were processed with Actilife version 6.5.4 software (Actigraph, LLC, Pensacola,

260   FL) and filtered to the period of each lesson. Evenson cutpoints (Evenson, Catellier,

261   Gill,Ondrak & Mc Murray, 2008) were applied to estimate MVPA during lesson. These

262   cutpoints are considered the most accurate to estimate time spent at different exercise

263   intensities in children and adolescents from 5 and 15 years old (Trost at al., 2011). To

264   account for variation in lesson time, results are presented as a percentage of lesson time in

265   MVPA. The lesson time was recorded for each session. This consisted of the time between

266   the beginning of warm-up period to the end of the game, before the teacher provided the

267   feedback for the students.

268   Only participants who attended a minimum of 80% of the lessons were included in

269   the analysis. Three subjects from each class were selected for a single-subject analysis. The

270   participants were selected according to their mean time spent in MVPA per lesson at

271   baseline. The groups were subdivided as low, medium and high MVPA, defined by the

272   standard deviation (SD) of the mean: 1. Low MVPA: < 0.3 SD; 2. Medium MVPA: ± 0.3 SD

273   and; 3. High MVPA: >0.3 SD. Participants from each category with the highest number of

274   attendance were selected. A line graph was produced in which percentage of lesson time in

275   MVPA in each session was plotted as a single datum point and connected to subsequent

276   points throughout lessons. Results were analysed as within and between conditions (baseline

277   and intervention) for the three selected individuals in each class. Analysis of trend, level and

278   stability of the graphical data were based on the guidelines suggested by Lane and Gast

279   (2014).

280   **Results**

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281   The intervention was applied as planned in all the lessons. Inter-observer reliability of

282   treatment integrity showed 100% agreement across 40% of lessons.

283   Nine (out of 12 participating) students from Year 8 and seven (out of 9 participating)

284   students from Year 9 attended 80% of the lessons and were included in the study. On average

285   the Year 8 participants (N=9) increased the % MVPA from baseline to intervention from 41.7

286   % to 49.1% (7.4% difference). Likewise, Year 9 participants (N= 7) increased the % MVPA

287   from 49.7% at baseline to 58.3% at intervention (8.7% difference).

288   The Year 8 class had the set target of 1800 steps for the first lesson. After the 11

289   lessons, the target went up to 3600 steps for one team (met the goal in 10 of 11 lessons, 91%

290   of the goals accomplished), two teams reached 3400 steps (met the goal in 9 of 11 lessons,

291   82% of the goals accomplished) and one team reached 3200 steps (met the goal in 8 of 11

292   lessons, 72% of the goals accomplished). For the Year 9 class the first target was set as 2700

293   steps, after 5 lessons the target raised to 3100 steps for three teams (met the goal in 4 of 5

294   lessons, 80% of goals accomplished) and 2900 steps for one of the teams (met the goal in 3 of

295   5 lessons, 60% of goals accomplished).

296   Figures 1 shows the percentage of lesson at MPVA of six participants with low,

297   medium and high MVPA at baseline from Years 8 and 9. As explained in the methods section

298   the selection of participants in each category was defined by standard deviation from the

299   mean and based on highest attendance.

300   **Low MVPA**

301   Results from the visual analysis using the method suggested by Lane & Gast, 2014

302   show that the participant with low MVPA from Year 8, presented a variable, but a positive

303   change in trend (decelerating- deteriorating to accelerating – improving) and improvement in

304   level between baseline and intervention. Likewise, there was a large magnitude of change

305   confirmed by the percentage of non-overlapping data (PND =100%).

306   The participant with low MVPA from Year 9 showed a continuous positive pattern of

307   trend direction (accelerating – improving) which did not change between the baseline and

308   intervention period and there was a low PND (40%) between conditions. However, data

309   appeared to improve in stability during the intervention (within stability envelope: baseline =

310   55.5% and intervention = 80%).

311   Functional relation is demonstrated when a controlled experiment shows that the

312   change in the dependent variable was a reliable outcome of the specific manipulations of the

313   intervention rather than confounding variables (Cooper et al., 2007). Results from Figure 1

314   and visual analysis interpretation show that despite the fact that a positive change was seen

315   between the baseline and intervention phase for the low MVPA Year 8 student, it is

316   suggested that a weak functional relation is demonstrated for low MVPA students due to the

317   lack of consistency during the replication with the low MVPA Year 9 student.

318   **Medium MVPA**

319   Results from the visual analysis (Lane & Gast, 2014) suggest that the participant with

320   medium MVPA from Year 8 showed a positive pattern of change in trend (decelerating-

321   deteriorating to accelerating- improving) and level. However, there was a low magnitude of

322   change (Medium PND = 27.3%). In contrast to Year 8, the participant with medium MVPA

323   from Year 9 showed a negative trend, moving from accelerating- improving to decelerating –

324   deteriorating and minimum or negative change in level and PND. Therefore, taking into

325   consideration Figure 1 and the visual analysis interpretation, a functional relation was not

326   demonstrated for the medium MVPA students.

327   **High MVPA**

328   The participant with high MVPA from Year 8 showed nearly the same positive

329   pattern of change in trend (decelerating- deteriorating to accelerating- improving) compared

330   to the low and medium MVPA participants. However, there was a relatively low magnitude

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331   of change (High PND = 60%). In contrast to Year 8, the participant with high MVPA from

332   Year 9 showed a negative trend, moving from accelerating- improving to decelerating –

333   deteriorating and a negative change in level and 0% PND. Therefore, the results from Figure

334   1 and visual analysis interpretation (Lane & Gast, 2013) show that a functional relation can

335   not be confirmed for the high MVPA students.

336   **Social Validity Questionnaires**

337   **Teacher's responses**

338   The acceptability of the strategy was verified by the social validity questionnaire. The

339   teacher responded that the 'Fair Play Game' helped students to extend their levels of

340   engagement in the lessons. He reported that the strategy was not complicated, however PE

341   teachers might have other learning targets rather than fitness. The teacher felt that the 'Fair

342   Play Game' strategy took time away from learning soccer technique and knowledge. He

343   reported that the use of accelerometers as a strategy would not be effective if the focus of the

344   lesson was on teaching skill, development, and tactics. However, the teacher responded that

345   he would use 'Fair Play Game' strategy again to help some students to increase their

346   engagement in the lesson.

347   **Students' responses**

348   Twenty students responded to the questionnaire (12 students from Year 8 and 8

349   students from Year 9). All students responded that they liked participating in the study. The

350   majority of the students responded that 'Fair Play Game' was fun and challenging. Other

351   students responded that they liked knowing the number of steps taken and that they got to

352   play more soccer.

353   The majority of students responded that being told to "give your best effort" in PE

354   class is important because it helped them to be fit and move more. The majority of students

355   reported that their teammates showed their best effort in the PE classes. Other students

356 responded that some teammates did not give their best effort because they were not

357 participating in the study. Students responded that to show their effort they did not stop

358 jogging or running during the lesson, they tried harder, and they also accomplished the tasks

359 proposed by the teacher.

360 **Discussion**

361 The purpose of this study was to investigate the effect of a group contingency

362 strategy: 'Fair Play Game', using accelerometers. This research also examined for the first

363 time the effects of the 'Fair Play Game' strategy on PE students from an underserved area

364 outside the USA. Single subject analysis revealed that the 'Fair Play Game' intervention

365 showed a positive, but weak treatment effect on low active participants. Students with

366 medium and high MVPA did not show positive changes between baseline and intervention

367 phases.

368 The results from this study do not support the findings of previous studies, where the

369 'Fair Play Game' strategy has been applied in PE classes (Vidoni et al., 2012; Vidoni et al.,

370 2014). Several reasons might explain these differences in results. One possible reason is that

371 the intervention was only delivered on one day a week. Therefore, the intervention took three

372 months to complete because of several school breaks. In previous studies (Vidoni et al., 2012;

373 Vidoni et al., 2014), students were exposed to daily PE lessons therefore the intervention was

374 delivered continually. It is known that dose (intensity, frequency and duration) of delivering

375 school-based physical activity is an important determinant of practice efficiency (Sun et al.,

376 2013). Although the duration of the actual intervention was similar when comparing the

377 interventions (14 to 17 days – 35 to 45 minutes long), the frequency at which it was delivered

378 (weekly) was considerably lower in this study compared to previous studies.

379 Another possible reason was that the soccer lessons were delivered in an outdoor

380 soccer field during the winter season while in previous studies similar interventions were

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381   delivered in a gymnasia (Vidoni et al., 2012; Vidoni et al., 2014). Although prompts,

382   feedback and goal settings were provided in the same manner as previous studies, the varied

383   weather conditions might have impacted on students' participation in the classes. It has been

384   stated that environmental variables in specific weather need to be taken into account when

385   developing physical activity interventions (Tucker & Gilliland, 2007) and poor weather has

386   been identified as a barrier to being physically active (Belanger, Gray-Donald, O'Loughlin,

387   Paradis & Hanley, 2009). Furthermore, despite our efforts to provide prompts in a consistent

388   manner, we have not recorded the number of prompts provided. The lack of information

389   concerning the number of prompts delivered during the lesson can be considered a limitation

390   of this study. Vidoni & Ward (2009) found that when the teacher did not deliver prompts the

391   occurrence of target behaviors decreased in comparison with those that were frequently

392   prompted. In addition, in previous studies the participants were from schools located in

393   middle to high socio-economic areas in United States, whereas in this study the school was

394   located in an underserved area of England. Previous studies performed in America showed

395   that children attending schools in high SES areas had 4.4 minutes per day more of MVPA

396   compared to children who attended schools in low SES areas (Carlson et al., 2014).

397   Similarly, British adolescents (11-12 years old) from low SES areas present higher levels of

398   sedentary behavior compared to children from affluent areas (Brodersen et al., 2007).

399   Therefore, the unsuccessful results seen in this study might be partly associated with a

400   population that is potentially more physically inactive, and therefore might require different

401   triggers to change their behavior.

402   The number of students involved in this study was low compared to previous studies

403   (Vidoni et al., 2012; Vidoni et al., 2014). Less than 60% of the students from the Year 8 class

404   and 40% of students from the Year 9 class agreed to participate in the study. Although

405   researchers explained the importance of the study and mentioned the incentive at the end, few

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406   students provided the signed parental/guardian informed consent. Considering that goals were

407   set to individuals within a team, and not all students in the team were participating in the

408   intervention, this might have prevented individuals who were taking part in the study from

409   showing their best effort. Perhaps if all participants were placed within the same groups it

410   would encourage their team affiliation and would impact the results.

411   Similarly, it is important to note that only one teacher responded the social validity

412   questionnaire, and his views might not be representative of most teachers' opinion. The PE

413   teacher emphasized that "not all PE lessons are about fitness" . It is known that the goals of

414   PE are wider than fitness and include improvement of motor competencies, knowledge of

415   principles and concepts, and development of personal and social skills (National Association

416   for Sport and Physical Education & American Heart Association, 2012). However, this

417   intervention was limited to target MVPA in PE classes. Although the intervention package

418   was implemented as planned (fidelity of treatment), it could be suggested that the teachers'

419   prompts or feedback to students were not enough to increase students' levels of participation.

420   As mentioned before, it is also possible that this particular group of children requires more

421   frequent and/or varied stimuli in order to change their behavior in class.

422   One of the limitations of this study was the use of a multiple baseline across two

423   classes. Although it involved three replications across students (low, medium and high

424   MVPA), it demonstrated a relatively weak experimental control. Perhaps a third tier in the

425   multiple baseline design would provide a better representation of replications, predictions and

426   verifications of the experiment.

427   This study has some strengths including a more accurate measure of physical activity

428   (i.e. accelerometers) compared to other studies which applied the same intervention (i.e. heart

429   rate monitors and pedometers) (Vidoni et al., 2012; Vidoni et al., 2014). Accelerometers are

430   considered the most valid objective measure of physical activity (Eston, Rowlands, &

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431   Ingledew, 1998). However, the use of accelerometers in everyday practice might be

432   unfeasible because of the cost of equipment and skills necessary for data processing. The use

433   of pedometers might be more appropriate for everyday use. However, the limitations of using

434   pedometers to measure physical activity should be taken into account, such as inability to

435   measure non-ambulatory activities (McNamara, Hudson, & Taylor, 2010).

436   It is also important to understand the contribution of PE towards helping children to

437   meet the minimum guidelines for physical activity. Accelerometry data from Health Survey

438   England 2008 indicates that only 7% of the boys aged 11 to 15 old children meet the current

439   recommendation of at least 60 minutes of MVPA per day (Health Survey for England, 2008).

440   Schools and in particular PE classes are seen as important settings for physical activity

441   promotion (Bailey, 2006). 'Fair Play Game', might be an important strategy to support

442   children to increase MVPA during PE lessons (U.S. Department of Health and Human

443   Services, 2010). However, it is important to note that the frequency at which the intervention

444   is delivered, and the number of students in class that are taking part on the intervention are

445   important for the intervention to be effective.

446   In summary, 'Fair Play Game' might be an important strategy to increase MVPA in

447   low active children during PE lessons. The use of this strategy might support the objective

448   stated in a recent paper by Sallis et al. (2012) that PE classes should focus on health-related

449   physical activity and fitness, and students should be active for at least 50% of the lesson time.

16

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