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**A case study objectively assessing female physical activity levels within the
National Curriculum for Physical Education**

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Abstract

The purpose of this study was to assess the impact of the National Curriculum for Physical Education (NCPE) lesson themes and contexts on the profile of moderate to vigorous physical activity (MVPA). Fifteen, Year 9 PE lessons were assessed within the lesson themes of Outwitting Opponents (OO) (delivered through field hockey and netball) and Accurate Replication (AR) (delivered through gymnastics) using the System for Observing the Teaching of Games in Physical Education. Accelerometry identified MVPA within Physical Education Lessons (Actigraph-GTM1, 10-second epoch, MVPA ≥ 2296 counts/min). Among 112 females MVPA averaged 20.8% of available learning time. Significantly more MVPA was facilitated during OO than AR (22.7 vs. 15.9%, $p < 0.001$, $d = 0.88$). Within both lesson themes, warm-up was the most active lesson *context* while pre- and post-lesson general management were the least active. Contrary to expectations, neither small-sided nor modified games, vs. full sided games, increased MVPA within OO. During AR technical and applied skill practice resulted in low MVPA. Objective evidence has justified concerns about female adolescent MVPA within PE. At current levels an additional 17.5 minutes of MVPA per 60 minute PE lesson would be needed to meet the minimum 50% guideline.

Keywords:

National Curriculum for Physical Education, accelerometry, The System for Observing the Teaching of Games in Physical Education (SOTG-PE), moderate to vigorous physical activity

Introduction

Schools have long been identified as wide reaching, cost-effective settings for promoting physical activity (PA) to adolescents (Alderman et al. 2012; Dobbins et al. 2013). However, there is an apprehension about the level of PA achieved by female adolescents (Knuth & Hallal 2009; Riddoch et al. 2007). Consequently, girls may not experience the benefits of adequate PA, which in the short term leads to missed critical opportunities to improve physical, mental and social wellbeing (Janssen & LeBlanc, 2010). Furthermore, the wider implications of inactivity then transfer to short and long term health care costs (Biddle & Asare 2011; DH 2011). Physical Education (PE) lessons clearly represent an important opportunity for achieving PA for all children (OFSTED 2013). However, within PE lessons PA may be below optimal levels, possibly due to pursuing wider education aims (Fairclough & Stratton, 2005b).

One concern resulting from low activity in PE is that girls may not learn to regulate their own involvement in PA (Knuth & Hallal, 2009). Developing positive PA habits early in life, which includes the management of exercise intensity, may represent fundamental skills that lead to long term health, mental well-being and happiness (DH 2011; Trudeau & Shephard 2008). More immediately, being active during the school day as well as in PE lessons can produce significant cognitive benefits such as improved

concentration and working memory (Dobbins et al. 2013; Pate, O'Neill & McIver 2011; Haapala, 2012).

Notwithstanding that these ideas are well accepted, little research has explored the factors such as gender, grade and subject matter that may feed into the variability of PA intensity within contemporary PE (Lai, Kliber and Reed 2003; Laurson et al. 2008). Addressing this shortfall could help teachers and stakeholders to understand the different levels of physical intensity within their lessons so that girls can begin to regulate their own PA (Roberts and Fairclough, 2011). Recently, it was stated that pupils should spend at least 50% of time in PE being physically active (OFSTED 2013; AfPE 2013). However, OFSTED (2013) recently expressed the concern that PE lessons lacked sufficient physicality. Furthermore, in a review of 40 studies of adolescent girls, between 27% and 47% of available learning time consisted of moderate-to-vigorous physical activity (Fairclough and Stratton, 2005b). Well below the 50% recommended guideline.

An objective assessment of PA in PE lessons is central to resolving this issue, particularly in light of new curriculum developments (QCA 2007). PE teachers deliver lessons based around the priority established by *lesson themes*, which are made up of specific *lesson contexts*. *Lesson themes*, i.e. Outwitting Opponents and Accurate

Replication, established within the recently revised NCPE may influence MVPA levels (Mersh and Fairclough, 2010). Equally, the proportions of time spent in different *lesson contexts*, such as technical skill practice and general management may also overemphasise low levels of PA (OFSTED 2013; Mersh and Fairclough 2010; Chow, McKenzie and Louie 2008). Finally and most significantly, no published literature has yet combined an objective measurement of accelerometry with an observational tool that is sensitive to *lesson themes and contexts*. The System for Observing the Teaching of Games in Physical Education (SOTG-PE) is a recently validated observational tool which clearly defines different *lessons contexts*. Therefore, the two aims of this study are to deploy the SOTG-PE alongside accelerometry to identify time spent in MVPA (a) within current NCPE lessons and (b) in the respective *lesson themes and contexts*.

Methods

Participants and settings

A convenience sample of female participants (N=55, aged 13-14 years) was drawn from a mixed gender, state and urban High School in the north of England. The school was socio-economically privileged (Income Deprivation Affecting Children Index (IDACI) Rank: 30418/32482), followed the statutory NCPE and data collection was undertaken in the autumn term of the academic calendar (DfCLG 2008). The study received ethical approval from the University Ethics Committee and the assent of all pupils, the consent

of their parents and teachers were then obtained. Across lessons, 55 participants were observed; seven pupils took part in three observed lessons - resulting in 21 observations, 39 in two observed lessons (78 observations) and 13 in one (13 observations), collectively producing 112 observations. An average of 7 pupils per class wore accelerometers.

Physical education lessons

Three classes were observed three times, plus three classes observed twice, producing a total of 15 lessons. Classes were mixed ability, year nine and female-only. Four female teachers, with 8 to more than 20 years teaching experience, delivered these 60-minute lessons which were characterised by a teacher: pupil ratio of 1:24. All lessons were delivered within a three-week period. Teachers were informed of the purpose of the study and were asked not to alter their behaviour or instructional content of their lessons. Lesson plans were reflective of a typical lesson, which generally consisted of a warm-up activity, skills development or skills application in a modified setting (small sided-games, partner work) and then finally a game-like activity or larger group work.

It is difficult to quantifiably assess whether the lessons were indicative of a typical PE lesson as perhaps seen nationally in England, as, although there is a National Curriculum for Physical Education (NCPE), its interpretation is highly subjective. In

essence, the most recent guidelines for the statutory delivery of NCPE (QCA 2007) suggest that pupils follow programmes of study that develop knowledge, skills and understanding of key concepts, themes and process related to Physical Education. The aim is for all young people to be: ‘successful learners who enjoy learning, make progress and achieve; confident individuals who are able to live safe, healthy and fulfilling lives; and, responsible citizens who make a positive contribution to society’ (p. 189). Most pertinent to this study, as evidenced within the lesson plans provided by PE teachers, was the focus on two of the six NCPE range and content themes; Outwitting Opponents (OO) and Accurate Replication (AR).

The NCPE defines OO activities as those ‘in which the concept of success is to overcome an opponent or opponents in a face-to-face competition. Opponents can directly affect each other’s performance and the key is to outwit the opposition’ (p.194), with examples cited from invasion games, net/wall games, striking/fielding games and combat activities. AR includes ‘activities in which success is judged on the ability to repeat actions, phrases and sequences of movement as perfectly as possible. Examples include: synchronised swimming, diving, rebound tumbling, ballroom dancing, gymnastics and skateboarding’ (p.194). Ten games-based lessons (field hockey and netball) emphasised the *lesson theme* of Outwitting Opponents, while five gymnastics-based lessons were focused on the *lesson theme* of Accurate Replication. All field

hockey and netball lessons were delivered on a tarmac outdoor sports area whilst the gymnastics lessons were delivered in the school sports hall.

Protocol

The protocol was established to support a larger study assessing patterns of PA throughout the segmented school day. Accelerometer initialisation and observation of the PE lessons was carried out over two 10-day phases within a three-week school period. Participants received their accelerometers at the beginning of the week and were uniquely coded so individuals could be tracked throughout observation. To ensure high quality recording, an explanation was provided to pupils during tutor periods (pastoral periods at the beginning of the school day) to ensure accelerometers fitted tightly on hips and were removed during full contact activities. At the completion of each data collection period (day10) accelerometers were collected and data downloaded using USB hubs and Actilife5. Data was saved to a secure location and backed-up.

Physical Education lessons that occurred within the scheduled school timetable were identified in the accelerometer traces by marrying the data with the school timetable. The start and stop time of each PE lesson was recorded and synchronised with the time on the accelerometers upon initialisation. Within each PE lesson the *lesson theme* was

identified by the teacher prior to commencement. The System for Observing the Teaching of Games in Physical Education (SOTG-PE) established time devoted to *lesson contexts* in PE. Pupil accelerometer profiles were then aligned with the SOTG-PE lesson coding to identify the proportion of time spent within each *lesson context*.

Measurement

A uni-axial Actigraph-GT1M accelerometer objectively measured MVPA. This device provides a reliable and valid measure of MVPA (De Vries et al. 2009; Trost, McIver and Pate 2005). A 10-second EPOCH was utilised in order to capture the sporadic nature of PA in adolescents (Trost, McIver and Pate, 2005). Evenson's (2008) cut-points of ≥ 2296 -4011 were used to identify MVPA and the accelerometer was placed tightly on the right hip to facilitate accuracy. Accelerometer data was included based on a fully complete 60 minutes of data, 55 observations were therefore obtained for further analysis.

The *lesson context* categories from the SOTG-PE which have been previously validated in a similar population were used to code lessons (Roberts and Fairclough, 2012). Originally instructional time is included within the general management (GM) context. Within the current study, the definition was amended to only include management time outside of all other lesson contexts (e.g. getting changed). Teacher instruction was then coded within the specific lesson context rather than under the

generic GM context. Including instruction time within each context therefore enabled an accurate picture of the amount of MVPA within a particular context. Active Learning Time (ALT) therefore includes instruction time within in each context. Instructions for the warm-up for instance were coded as warm-up.

Observer training was provided one month before the PE lesson observations were made in accordance with SOTG-PE protocols (Roberts and Fairclough, 2012). Observers (N=4) were undergraduate students and underwent 3 hours of theoretical training around observation protocol and coding practices prior to real-life observations. Inter-observer agreements of 89% were then established in the first PE lesson to confirm agreement between different observers (Roberts and Fairclough, 2011). Observers were placed on the periphery of lessons therefore reducing influence on student and teacher behaviour. *Lesson themes and contexts* were observed and recorded through 10-second sampling. Activities were coded based on teacher instruction. *Lesson contexts* were coded using the criteria in table one and could occur in any order. As the SOTG-PE is validated in the teaching of games the definition for accurate replication was adapted (Table.1).

Insert table 1 here

Data analysis

Data was screened for missing or erroneous values and the significance level was set at $p < 0.05$. All analyses were conducted using SPSS (V19) and tests for normality using Shapiro-Wilk analyses revealed that MVPA data was normally distributed. The dependent variable was MVPA with *lesson themes* and *context* being the independent variables. The eight *lesson contexts* were categorised by the SOTG-PE. These were then summed and converted into percentage of available learning time in MVPA.

An independent t-test analysed the difference in total MVPA between the two *lesson themes* of OO and AR. Subtracting time to change pre and post lesson (GM) from the full 60 minutes provided a more accurate reflection of available learning time (ALT) which could be used to achieve MVPA. A one-way ANOVA with Scheffe post-hoc tests identified differences between the eight *lesson contexts* within the two *lesson themes*. An effect size (Cohen's d) was then calculated to assess the difference between the two *lesson themes* of OO and AR.

Results

Pupils averaged 12.4 minutes, ($SD=5.13$, 20.8%) of their 60-minute lessons in MVPA. Lessons focusing on OO ($N=10$) achieved 4.1 more minutes of MVPA than those addressing AR ($N= 5$) (13.6minutes $SD=5.0$, 9.5minutes $SD=4.27$) $P < 0.001$. This represents a 6.8% difference, which is also a large effect size ($d=0.88$). At current

levels an additional 17.5 minutes of MVPA per 60 minute PE lesson would be needed to meet the minimum 50% guideline.

Insert figure one here

Across the 112 individual observations in overall PE lessons, none achieved 50% or more of available learning time in MVPA. As shown in Table 2 most observations spent between 10-19% of the lesson in MVPA. Overall, twelve percent of observations achieved 30-39% of the lesson in MVPA whereas only two percent of observations spending between 40-49% of the lesson time in MVPA. Nine percent of observations spent less than 10% of the lesson time in MVPA. When broken down by *theme*, within OO the highest proportion of participants achieved 20-29% of available learning time in MVPA. In the AR *theme* the highest proportion of participants achieved 10-19% of available learning time in MVPA with thirty eight percent of observations spending 20-29% of the lesson time in MVPA.

Insert table 2 here

When the general management *lesson contexts* were factored out, total MVPA (12.5mins SD=5.13) represented a greater proportion of available learning time (24.9%,

Figure 1). Additionally, in relation to *lesson themes*, OO averaged 10.1mins (SD=4.5, 27.1%) and AR averaged 6.5mins (SD= 3.81, 19.7%).

Insert figure 2 here

During OO, warm-up (2.3mins SD=1.9, 38.8% of available learning time in MVPA) elicited the highest proportion of available learning time in MVPA, significantly more than general management-pre (2.3mins SD=1.5, 13.9%), technical practice (2.4mins SD=2.1, 17.5%), full game (9.1mins SD=2.5, 33.2%), general management-post (1.2mins, SD=0.8, 18.8%) ($p<0.001$) and small-sided games (5.2mins SD=3.8, 25.5%) ($p<0.01$). Modified games (5.5mins SD=3.4, 29.9%) facilitated a significantly higher percentage of available learning time in MVPA than general management-pre and full games ($p<0.001$) as well as technical practice and general management-post ($p<0.05$). Small-sided games ($p<0.01$) and applied skill practice (5.2mins SD=2.2, 28.6%, $p<0.05$) accumulated significantly more available learning time in MVPA than general management-pre. Full games provided significantly more available learning time in MVPA than general management-post ($p<0.01$). Fitness was not reported during OO PE lessons. Fitness was not reported due to it being included as a separate and discrete theme within the wider curriculum.

Overall 10% of available learning time was devoted to warm-up, 12% to applied skill practice and 10% to general management-post. Moderate amounts of available learning time were devoted to technical practice (18%), with more available learning time spent in modified (38%), small-sided games (30%), full games (46%) and general management-pre (27%).

Insert figure 3 here

During AR (Figure 3), warm-up resulted in significantly higher proportion of available learning time in MVPA (1.3mins SD=1.3, 24.9%) than applied skill practice (2.0mins SD=2.2, 13.1%), general management-pre (2.2mins SD= 1.4, 13.1%) ($p<0.01$) or general management-post (0.9mins, SD=1.0, 9.3%) ($p<0.001$). Technical practice (3.9mins SD=2.3, 20%) produced a higher percentage of MVPA in available learning time than general management-post (9.1%) ($p<0.01$).

Small amounts of available learning time were devoted to general management-post (14%) and warm-up (9%). Moderate amounts of available learning time were devoted to applied skill practice. Whilst larger amounts of available learning time were dedicated to general management-pre (29%) and technical practice (32%).

Discussion

This study identified MVPA levels within the most recent NCPE and highlighted differences between *lesson theme and contexts*. Female adolescents averaged 20.8% or 12.5 minutes of available learning time (ALT) in PE in MVPA and no single pupil met the minimum guideline of being active for greater than 50% of ALT (OFSTED 2013). At current levels an additional 29.2% or 17.5minutes of MVPA per PE lesson would be needed to meet the minimum 50% guideline of a 60 minute PE lesson. Outwitting Opponents (OO) elicited a significantly higher number of pupils with higher thresholds of ALT in MVPA compared to the Accurate Replication (AR) *lesson theme*. *Lesson context* also affected the total MVPA that pupils accumulated; warm-up was consistently the most active *context* across both *lesson themes* with general management facilitating the least activity.

Physical Activity within Physical Education

This study confirms that PE lessons failed to provide the recommended minimum of 50% of ALT in MVPA (20.8% or 12.5minutes per 60min PE lesson in MVPA). Most participants actually spent just 10-19% of the PE lesson in MVPA. Crucially, this falls short of what is needed to optimise the physicality of PE lessons and for pupils to begin to appreciate how to regulate their own involvement in PA (Knuth and Hallal 2009; Trudeau and Shephard 2008; Fairclough and Stratton 2005a). Worryingly, these low

levels of MVPA have been facilitated by the most recent version of the NCPE, which may mean that PE lessons across the country with a similar orientation are similarly inactive (QCA 2007). As highlighted by a review of MVPA in PE, accelerometers offer a highly sensitive and accurate measure of MVPA. However, of the 10% of the included studies that used accelerometry results were generally greater than our findings varying from 28.0 to 61.3% of lesson time spent in MVPA (Fairclough and Stratton, 2005b). Importantly, given that PE is usually timetabled once or twice a week, and combined with the low levels of PA, female adolescents may be missing one of the critical opportunities to develop the experience that underpins the understanding, confidence and attitudes required to be active in their own time (AfPE 2013; AfPE 2011).

It seems more needs to be done to heighten the MVPA experienced within PE to justify claims about making a substantial contribution to better health and fitness in adolescent females (Dobbins et al. 2013). It is important that curricular PE meets the activity needs of all pupils. Many pupils, especially those without transport, disabilities, who have significant household chores or who act as carers may rely heavily on PE to provide MVPA. They may have little opportunity to compensate by engaging in activity opportunities outside of PE. PE may represent a rare viable opportunity to learn what sufficient physical activity is and feels like. Although it is known that other factors such as subject matter, ability or fitness affect PA levels; teachers in this study may also be

coming to terms with how to adapt the NCPE to effectively optimise MVPA during lessons (OFSTED 2013). However, it is also possible that low levels of MVPA are especially affected by the *lesson themes* (Mersh and Fairclough 2010; Van Mechelen 2000).

Physical Activity within Lesson Themes

If increasing PA levels is an outcome of the PE lessons, helping PE teachers understand the profile of MVPA within *lesson themes* may help increase MVPA. For instance, pupils in OO achieved a greater percentage of ALT in the higher thresholds of activity. Yet, it is clear that neither of the *lesson themes* of OO and AR met the minimum of 50% guideline (OFSTED 2013). During OO most pupils spent 20-29% of this time in MVPA, while in AR the majority of pupils spent 10-19% in MVPA; this equates to 12-17 and 6-11 minutes of a 60 minute PE lesson. As suggested previously, these results are lower than previous findings (Barnett et al. 2002; McKenzie et al. 2006) possibly because of the use of accelerometers, which offer a highly sensitive measure of MVPA (Chen et al. 2012). This compares with others studies, which based their estimates of MVPA purely on observation for instance SOFIT (The System for Observing Fitness Instruction Time). This approach may be less sensitive because it classifies anything above walking as vigorous PA.

Nonetheless, this difference between MVPA levels highlights the variability inherent to the NCPE (Mersh and Fairclough, 2010). This may reflect the nature of the activity within each *lesson theme*. Gymnastics is often used as a vehicle for teaching AR, which emphasises observation and analysis of performance and is typically delivered indoors (QCA 2007). Both gymnastics and indoor lessons have a negative association with MVPA levels (AfPE 2011; McKenzie et al. 2006). The type of activity taught within each *theme* may therefore provide both female adolescents and teachers with limited scope for MVPA during AR. If increasing PA levels is an outcome of the PE lesson manipulation of *lesson themes* may increase PA. If this is not feasible increasing the proportion of time dedicated to more active *contexts* may increase activity.

Physical Activity within Lesson Contexts

It is becoming important to understand how PE lessons can be structured with PA objectives in mind. A three tier profile of MVPA in *lesson contexts* were identified throughout both *lesson themes* with warm-up consistently facilitating the greatest and general management (to start and end the lesson) delivering the least MVPA. These results do not support certain *contexts* over others; they merely inform practitioners on the *contexts* that gave rise to particular levels of MVPA (Chow, McKenzie and Louie 2008; Yelling, Penney and Swaine 2000). For example, although general management may be an inactive *context* it contributes an important opportunity to learn about rather

than participate directly in MVPA and allow teachers to manage behaviour and pedagogical objectives (Bailey, 2001). Despite this, OFSTED (2013) state that practitioners should aim to reduce time devoted to management contexts. Plausibly, this could also provide opportunities to increase time spent in MVPA in more active *contexts* (Roberts and Fairclough, 2011). However, MVPA worryingly failed to reach the minimum 50% guideline in even the most active *lesson contexts* such as warm-up. Making PE ‘active enough’ may therefore be challenging, especially considering the competing aims of the NCPE. Given the results of this research, offering a balanced approach to physically educating children in a way that supports the wide ranging aims of the NCPE and to maintain appropriate physical activity levels for children is a seemingly problematic dilemma.

To increase MVPA previous recommendations have been made to adapt full games into small games (only the playing area and numbers in each team are reduced) or modified-games (includes modification of rules, conditions and equipment) (Arnett 2001; Arnett and Lutz 2003). However, this study contradicts this message as full games elicited a higher proportion of ALT in MVPA. If an increase in PA is the intended outcome full games may provide pupils with more scope for involvement in MVPA (Bailey, 2001). On the other hand, small or modified games may therefore provide more opportunity for inclusion and skill acquisition (Davids et al. 2013). Importantly, although game-play as

a whole produced relatively high levels of MVPA compared to other *contexts*, pupils still fell short of being active for a minimum of 50% of ALT (OFSTED 2013).

Within OO, applied-skill and technical practice may be important in the development of skills especially during key stage 3 (KS3) (Roberts and Fairclough, 2011) however, they do not elicit high amounts of MVPA during OO. Furthermore, from a motivational and developmental perspective and in order to increase PA it may be more challenging for students to apply these skills in a modified game format, rather than within isolated practice. Recent models such as The Teaching Games for Understanding (TGfU) and Sport Education encapsulate this applied practice. However, it is also important to consider that in a third of primary schools visited by OFSTED (2013) pupils did not progress beyond basic ball techniques such as sending and receiving skills due to low expectations and limited subject knowledge of the teacher (OFSTED 2013). Therefore, performing these skills within small-sided or modified game by KS3 may be beyond the capacity of most pupils in mixed ability class due to a lack of initial development of fundamental movement skills in KS1 and KS2 (Merish and Fairclough, 2010).

Within AR the applied-skill and technical practice *contexts* differ sufficiently to generate somewhat lower levels of MVPA. For instance, the subject matter of AR is structured to permit pupils to observe, assess and analyse performance where applied-

skill practice may come from performing a low intensity, technical routine in front of peers (QCA 2007). AR may therefore promote strength and flexibility which is considered equally as important as PA for the health and wellbeing of young people (Čuljak et al. 2011). In agreement with OFSTED (2013) promoting physical activity, fitness and health should now be prioritised in NCPE. However, in contrast this will not be achieved through learning the value fitness and health by regularly working hard, at vigorous intensities, even when tired and for sustained periods of time. A balanced PE curriculum that offers sufficient moderate-to-vigorous physical activity may be more effective in promoting lifelong PA for female adolescents.

This is the first study to combine accelerometry and the observation tool SOTG-PE. It provides a unique and objective insight into the profile of MVPA within the most recent NCPE in England (QCA 2007). However, the study is limited by the use of one school making findings difficult to generalise. The lesson themes of OO and AR were only delivered through the medium of field hockey, netball and gymnastics respectively. In the future, a greater range of activity areas could be observed within each *lesson theme* to more fully represent the idiosyncrasies that exist across a range of activity contexts. Furthermore, having only observed a short academic period the focus of *lesson themes and contexts* may shift dependent upon the stage of the NCPE module being taught (Skala et al. 2012). Finally, including more contextual information on game-play

observations such as playing area size, number of players per side and elimination type may reveal why some *contexts* are more active.

Conclusion

Accelerometry measured MVPA highlighted that the NCPE is less active than previously thought with only 20.8% of ALT in MVPA (Fairclough and Stratton 2005b; Mersh and Fairclough 2010; Fairclough 2003). Considering the overall drop in activity at adolescence PE provides an ideal opportunity to intervene (Riddoch et al. 2007; DH 2011). However, due to the low levels of MVPA, PE may not be fulfilling its potential contribution to lifelong PA and health (Knuth and Hallal 2007; Baggett et al. 2008). Not one individual observation across either *lesson theme* met the target to be active for a minimum of 50% of available learning time. The most active *lesson context* was warm-up although this still fell short of being active for a minimum of 50% of available learning time. In contrast to previous research, full-games were moderately active with modified and small-sided games not fulfilling their previously reported potential to increase MVPA (Arnett 2001; Arnett and Lutz 2003; Fairclough and Stratton 2006).

Low PA levels within PE may not help female adolescents regulate their own involvement in PA. If PE is to be active for a minimum of 50% of available learning time, teachers and associated practitioners need to maximise opportunities for PA with a

priority on health across all *lesson themes* and *contexts*. In agreement with OFSTED (2013) we suggest best practice may be to keep pupils physically active throughout the lesson. However, instead of regularly engaging pupils in *high intensity* activity for sustained periods of time (OFSTED 2013) teachers should balance the amount of MVPA across lessons by:

- Reducing time spent in less active contexts such as general management.
- Increasing MVPA across all PE lessons by embedding physical activity and health related learning outcomes within lesson plans and schemes of work.

References

- Alderman, B, L., Benham-Deal, T., Beighle, A., Erwin, H, E., and Olson, R, L. (2012) Physical education's contribution to daily physical activity among middle school youth. *Pediatric Exercise Science*, 24 (4), pp.634–648.
- Arnett, M, G. (2001) The effect of sport-based physical education lessons on physical activity. *The Physical Educator*, 58 (3), pp.158–168.
- Arnett, M, G., and Lutz, R, B. (2003) Measurement of moderate to vigorous physical activity of middle school girls, using TriTrac activity monitors during small-sided, game-based lessons. *Measurement of Physical Education and Exercise Science*, 7 (3), pp.149–159.
- Association for Physical Education (AfPE). (2011) *AfPE response: new government guidelines on physical activity for children and adults*. Worcester, AfPE.
- Association for Physical Education (AfPE). (2013) *Health position paper: Physical Education Matters*. Worcester, AfPE.
- Baggett, C., Stevens, J., McMurray, R., Evenson, K, R., Murray, D, M., Catellier, D, J., and He, K. (2008) Tracking of Physical Activity and Inactivity in Middle School Girls. *Measurement of Physical Education and Exercise Science*, 40 (11), pp.1916–1923.
- Bailey, R. (2001) *Teaching Physical Education: a handbook for primary and secondary school teachers*. London, Kogan Page.

- Barnett, L., Beurden, E, V., Zask, A., Brooks, L., and Dietrich, U. (2002) How active are rural children in Australian physical education? *Journal of Science and Medicine in Sport*, 5 (3) September, pp.253-265.
- Biddle, S, H., and Asare, M. (2011) Physical activity and mental health in children and adolescents: a review of reviews. *British Journal of Sports Medicine*, 45 (11), pp.886–895.
- Boyle, S, E., Jones, G, L., and Walters, S, J. (2010) Physical activity, weight status and diet in adolescents: are children meeting the guidelines? *Engineering*, 2 (10), pp.1142–1149.
- Chen, K., Janz, K., Zhu, W., Brychta, R. Re-defining the roles of sensors in objective physical activity monitoring. *Medicine and Science in Sports and Exercise*, 44 (1), 13–23.
- Chow, B, C., McKenzie, T, L., and Louie, L. (2008) Children’s physical activity and environmental influences during elementary school physical education. *Journal of Teaching Physical Education*, 27 (1), pp.38–50.
- Čuljak, Z., Čavar, M., Crnjac, D., Marić, K., and Čorluka, M. (2011) Effectiveness of the school of gymnastics in 7 years old children. *Sport Science and Practical Aspects*, 8 (2), pp.41–46.

- Davids, K., Araújo, D., Correia, V., and Vilar, L. (2013) How small-sided and conditioned games enhance acquisition of movement and decision-making skills. *Exercise and Sport Sciences Reviews*, 41 (3), p154-162.
- De Vries, S. I., Van, Hirtum, H, W, J., Bakker, I., Hopman-Rock, M., Hirasing, RA., and Van-Mechelen, W. (2009) Validity and reproducibility of motion sensors in youth: a systematic update. *Measurement of Physical Education and Exercise Science*, 41 (4), pp.818–827.
- Department for Communities and Local Government (DfCLG). (2008) *The English Indices of Deprivation 2007*. London, Department for Communities and Local Government.
- Department of Health (DH). (2011) *Start active, stay active: a report on physical activity from the four home countries' Chief Medical Officers*. London, DH.
- Dobbins, M., Husson, H., DeCorby, K., and LaRocca, R, L. (2013) School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database Systematic Review*, 28 (2), pp.1–26.
- Evenson, K, R., Catellier, D, J., Gill, K., Ondrak, K, S., and McMurray, R, G. (2008) Calibration of two objective measures of physical activity for children. *Journal of Sports Science*, 26 (14), pp.1557–1566.
- Fairclough, S, J. (2003) Physical activity levels during key stage 3 physical education. *Journal of Teaching in Physical Education*, 34 (1), pp.40–45.

- Fairclough, S, J., and Stratton, G. (2005a) Improving health enhancing physical activity in girls physical education. *Health Education Research*, 20 (4), pp.448–457.
- Fairclough, S, J., and Stratton, G. (2005b) Physical activity levels in middle and high school physical education: a review. *Paediatric Exercise Science*, 17 (3), pp.217–236.
- Fairclough S, J., and Stratton, G. (2006) Effects of a physical education intervention to improve student activity levels. *Physical Education and Sport Pedagogy*, 11 (1), pp.29–44.
- Haapala, E. (2012) Physical activity, academic performance and cognition in children and adolescents - a systematic review. *Baltic Journal of Health and Physical Activity*, 4 (1), pp.53-62.
- Janssen, I., and LeBlanc, A. (2010) Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioural Nutrition and Physical Activity*. 7, pp.40-55.
- Knuth, A, G., and Hallal, P, C. (2009) Temporal trends in physical activity: a systematic review. *Journal of Physical Activity and Health*, 6 (5), pp.548–559.
- Lai, Q., Kliber, A., and Reed, B. (2003) Contents Student Physical Activity Patterns: Grade, Gender, and Activity Influences. *Journal of Teaching in Physical Education*, 22 (3), pp.298-310.

- Laurson K, R., Brown, D, D., Cullen, R, W., Dennis, K, K. (2008) Heart rates of high school physical education students during team sports, individual sports, and fitness activities. *Research Quarterly for Exercise and Sport*, 79 (1), pp.85-91.
- McKenzie, T, L., Catellier, D, J., Conway, T., Lytle, L, A., Grieser, M., Webber, L, A., Pratt, C, A., and Elder, J, P. (2006) Girls activity levels and lesson contexts in middle school PE: TAAG baseline. *Medicine and Science in Sports and Exercise*, 38 (7), pp.1229–1235.
- Mersh, R., and Fairclough, S, J. (2010) Physical activity, lesson context and teacher behaviors within the revised English National Curriculum for Physical Education: a case study of one school. *European Physical Education Review*, 16 (1), pp.29–46.
- OFSTED (Office for Standards in Education, Children's Services and Skills). (2013) *Beyond 2012 - outstanding physical education for all*. London, OFSTED.
- Pate, R, R., O'Neill, J, R., and McIver, K, L. (2011) Physical Activity and Health: Does Physical Education Matter? *Quest*, 63 (1), pp.19–36.
- Qualifications and Curriculum Authority (QCA). (2007) *Physical Education: programme of study for key stage 3 and attainment target*. London, QCA.
- Riddoch, C, J., Mattocks, C., and Deere, K., Saunders, J., Kirkby, J., Tilling, K., Leary, S, D., Blair, S, N., Ness, A , R. (2007) Objective measurement of levels and patterns of physical activity. *British Medical Journal*, 92 (11), pp.963–969.

- Roberts, S, J., and Fairclough, S. (2011) Observational analysis of student activity modes, lesson contexts and teacher interactions during games classes in high school (11—16 years) Physical Education. *European Physical Education Review*, 17 (2), pp.255–269.
- Roberts, S, J., and Fairclough, S. (2012) A five-stage process for the development and validation of a systematic observation instrument: the system for observing the teaching of games in physical education (SOTG-PE). *European Physical Education Review*, 18 (1), pp.97–113.
- Skala, K, A., Springer, A, E., Sharma, S, V., Hoelscher, D, M., and Kelder, S, H. (2012) Environmental characteristics and student physical activity in PE class: findings from two large urban areas of Texas. *Journal of Physical Activity and Health*, 9 (4), pp.481–491.
- Trost, S, G., McIver, K, L., and Pate, R, R. (2005) Conducting accelerometer-based activity assessments in field-based research. *Medicine and Science in Sports and Exercise*, 37 (11), pp.531–543.
- Trudeau, F., and Shephard, R. (2008) Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioural Nutrition and Physical Activity*, 25 (5), pp.1–12.

- United States Department of Health and Human Services (USDHHS). (2010) *The association between school-based physical activity, including physical education, and academic performance*. Atlanta, USDHHS.
- Van Mechelen, W., Twisk, J, W, R., Post, G, B., Snel, J., and Kemper, H, C, G. (2000) Physical activity of young people: the Amsterdam Longitudinal Growth and Health Study. *Medicine and Science in Sports and Exercise*, 9 (32), pp.1610–1616.
- Yelling, M., Penney, D., and Swaine, I, L. (2000) Physical activity in physical education: a case study investigation. *European Journal of Physical Education*, 5 (1), pp.45–66.

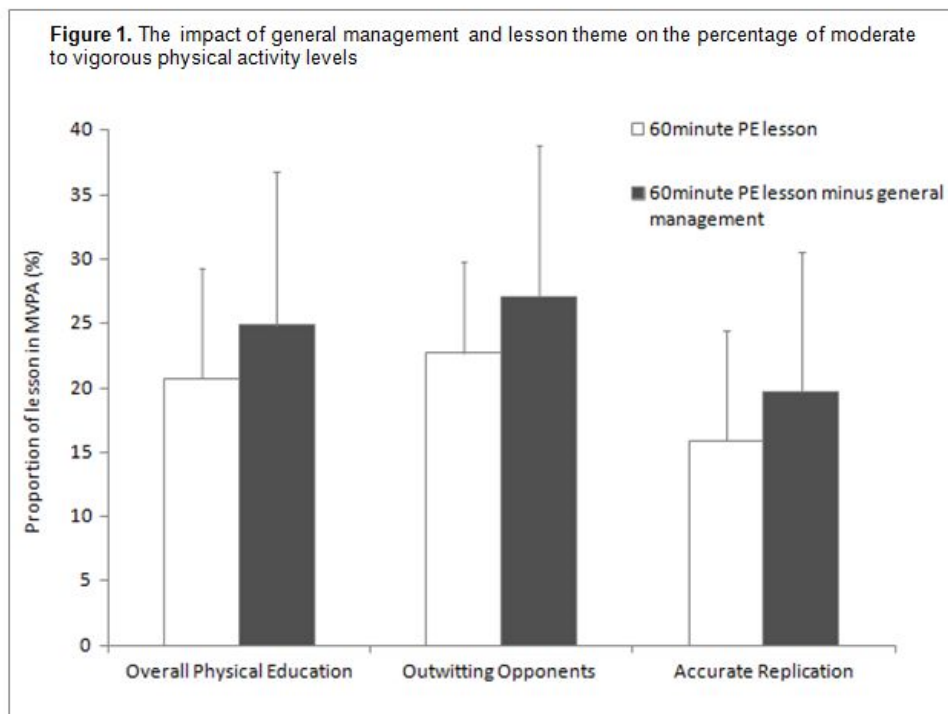
Figures and tables

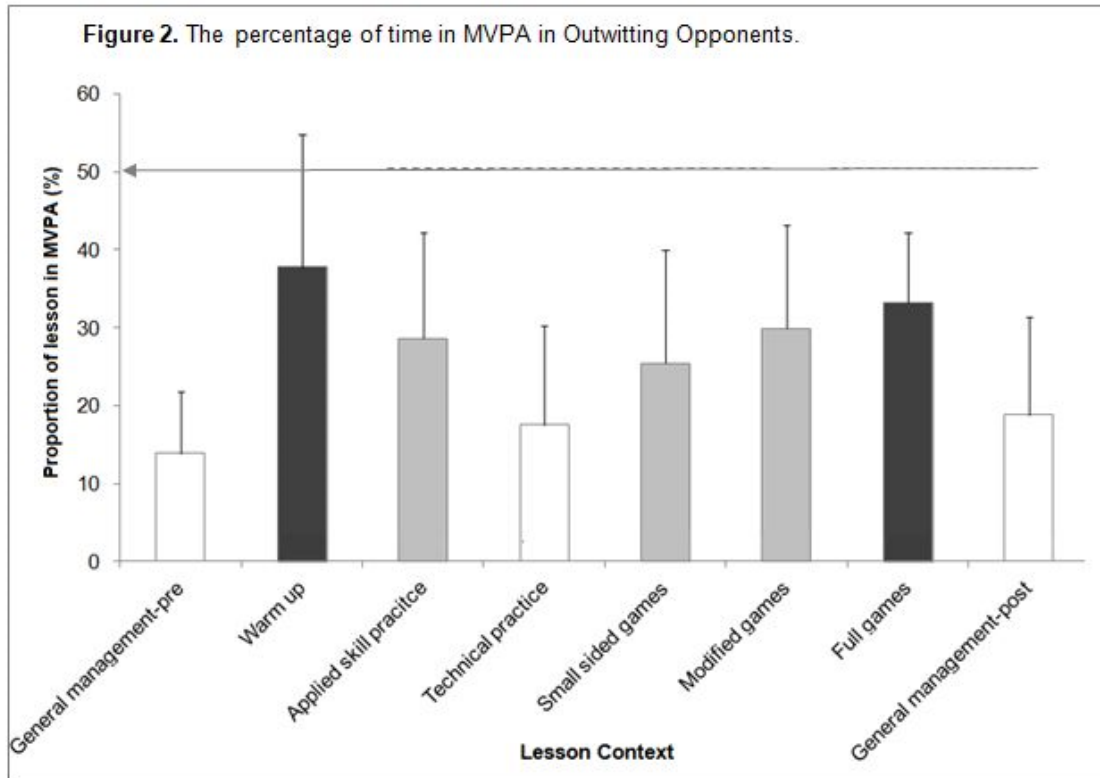
Table 1. Coding criteria of the eight observed lesson contexts in Outwitting Opponents and Accurate Replication.

Lesson context	Outwitting Opponents Description	Accurate Replication Description
General management-pre	Pupils were not involved in any PE content such as the register being taken or setting up equipment.	
Warm-up	Activities such as aerobic activity or stretches.	
Technical practice	Practicing a technique in a de-contextualised environment for example, static drills.	Practicing a technique in a de-contextualised environment for example, isolated movements.
Applied skill practice	Practice activity involving pressure, decision making and uneven numbers, for instance one vs. two.	Practice activity involving pressure, decision making such as a gymnastics routine
Modified games	Includes modification of the rules, conditions and equipment with even numbers in teams.	Not Applicable
Small-sided games	No additional conditions such as rule or equipment changes. Only the playing area and numbers in each team are reduced.	Not Applicable
Full game	Incorporates full version of game including numbers per team and area of play size.	Not Applicable
General management-post	At the end of the lesson and included changing time and plenaries.	

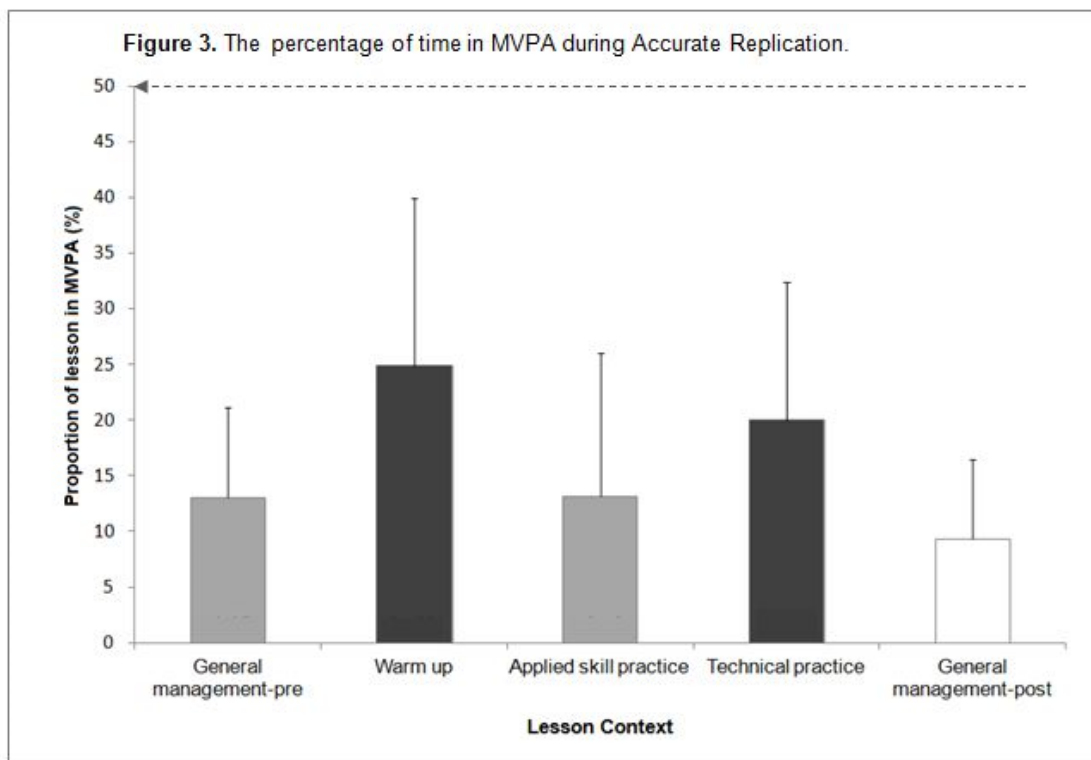
Table 2. Pupils within each physical activity threshold of physical activity during accurate replication and outwitting opponents

Available learning time spent in MVPA	Pupils within threshold during AR	Pupils within threshold during OO
5-9%	12.90%	7.40%
10-19%	67.74%	30.80%
20-29%	12.90%	45.60%
30-39%	6.45%	13.50%
40-49%	0.00%	2.46%
>50%	0.00%	0.00%





Note: Outwitting Opponents is taught through the medium of netball and field hockey



Note: Accurate Replication is taught through the medium of gymnastics