Journal of Youth and Adolescence (2020) 49:1503–1516
https://doi.org/10.1007/s10964-019-01187-9

EMPIRICAL RESEARCH

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Peer Support and Role Modelling Predict Physical Activity Change among Adolescents over Twelve Months

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Received: 21 November 2019 / Accepted: 17 December 2019 / Published online: 2 January 2020

Abstract

Physical activity levels decline during adolescence; however, some individuals initiate or maintain physical activity participation during this period of life. Socialisation impacts physical activity participation, yet few studies have explored the role of parental and peer processes concurrently on youth physical activity transitions over time. This study examined whether mother's father's and friends' support, modelling and teasing predicted adolescents' physical activity initiation, drop-off or maintenance over twelve months. In total, 803 adolescents (62.5% females, *M age* = 13.72) from Dublin, Ireland, completed self-report measures of support, modelling, teasing, and physical activity. Participants were classified as physical activity maintainers (17.8%), low active maintainers (58.8%), drop-offs (10.3%) or physical activity initiators (13.1%). The results revealed that parental support and modelling were unrelated to adolescents' physical activity transitions, however mother's and father's support predicted sustained physical activity participation twelve months later. In contrast, peer processes predicted physical activity maintenance, initiation and drop-off at one-year follow-up underscoring the salient role of peers for adolescents' behaviour change. In line with expectancy-value theory, the findings indicate that parents and peers represent distinct socialising agents that impart their influence on adolescents' physical activity maintenance and behaviour change through various mechanisms, highlighting the need to consider both sources of socialisation concurrently in future studies of adolescent behaviour change.

Keywords Parental support · Modelling · Peers · Teasing · Longitudinal study · Sport

Introduction

Young people's participation in organised sport is associated with higher levels of moderate-to-vigorous physical activity (Woods et al. 2018), which is linked to better health, enhanced wellbeing and positive functioning (Strong et al. 2005; Zarret et al. 2007). Despite these benefits, most adolescents in Ireland (where the current study is conducted) and elsewhere, are not sufficiently active to meet recommended guidelines of 60 min of moderate-to-vigorous physical activity daily (Woods et al. 2018; Kalman et al. 2015). Moreover, longitudinal research indicates that physical activity levels decrease across adolescence (Nader et al. 2008). Nonetheless, some teenagers continue to maintain participation in physical activity with a minority initiating involvement during this period of life (Rangul et al. 2011; Zook et al. 2014). Physical activity habits formed during adolescence track into adulthood (Telema et al. 2005), thus identifying factors that support uptake of moderate-to-vigorous physical activity and sustained participation is of key importance for youth outcomes.

Previous studies exploring youth participation in sport and physical activity have focused on the role of motivational beliefs and values (Dawes et al. 2014; Wang et al. 2017). However, most of the values and beliefs that regulate health-related behaviours are learned during adolescence from parents and peers. Substantial evidence points to the role of significant others in predicting young people's physical activity participation, yet the impact of parents and peers on predicting changes in adolescents' physical activity participation over time is less well understood. Guided by expectancy-value theory (Eccles and Wigfield 2002; Wigfield and Eccles 2000), the present study addressed this gap in the literature by examining whether mother's, father's

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and friends' support, modelling and teasing predicted moderate-to-vigorous physical activity initiation, drop-off and maintenance over twelve months among male and female adolescents. Following on from this, a key question of this research is how do peer and parental socialisation jointly predict physical activity behaviour change and maintenance over twelve months?

Theoretical Framework

The present study is framed by expectancy-value theory (Eccles and Wigfield 2002; Wigfield and Eccles 2000) which posits that the immediate predictors of sport and physical activity behaviours are individuals' expectancies for success and subjective task values, which reflect the intrinsic value of activity, utility value (usefulness of task for current and future goals), attainment value of activity (importance of doing well at task), and cost (perceived negative aspects of engaging in task). In addition, expectancy-value theory recognises that these motivational beliefs are shaped by socialising individuals who impact individual's physical activity participation through various mechanisms such as modelling physical activity behaviours themselves, providing young people with messages about their competence and the value of participation, as well as provision of emotional support and positive physical activity experiences (Fredricks and Eccles 2005).

Central to adolescents' principal interactions with parents and peers is social support, which refers to any behaviour that facilitates an individual to be active. Comprising numerous forms, social support includes direct (e.g. partaking in physical activity with adolescent), instrumental (e.g. providing transport to physical activity venue), and emotionally supportive behaviours (e.g. praise and encouragement). Young people also imitate and model behaviours they observe significant others undertake (Bandura, 1986). In addition, role models can impact young people's behaviour indirectly through socialisation of beliefs about one's own abilities, task values, and gender stereotypes (Fredricks and Eccles 2002, 2005). Teasing from peers in contrast, diminishes adolescents' perceptions of competence and physical activity enjoyment which can deter subsequent participation (Casey et al. 2009; Vu et al. 2006).

Parental Support and Modelling

Empirical reviews of physical activity behavioural correlates consistently indicate that parental support is positively related to adolescent physical activity (e.g. Mendonça et al. 2014; Pugliese and Tinsley 2007: Yao and Rhodes 2015), particularly organised physical activity participation (Spink et al. 2006). Longitudinal studies demonstrate that higher perceptions of parental support are associated with sustained adolescent physical activity participation over time (Zook et al. 2014), whilst lower parental support underpins declining physical activity levels (Davison and Jago 2009; Dowda et al. 2007). Inconsistent findings have been evidenced however in relation to parental modelling, with some reviews demonstrating a positive association between parental modelling of physical activity and young people's participation (e.g. Edwardson and Gorely 2010, Yao and Rhodes 2015), whilst other reviews found no association (e.g. Van der Horst et al. 2007) or proved inconclusive (e.g. Biddle et al. 2005). Given the limited number of longitudinal studies investigating parental role models and young people's physical activity it is difficult to draw substantive conclusions regarding this relationship. More research is therefore needed to elucidate the impact of mother's and father's modelling and support on adolescent's physical activity initiation and dropout over time.

Peer Support, Modelling and Teasing

Peer relationships take on greater prominence during adolescence, as teenagers move away from parents as their primary source of support (Beets et al. 2006). It is widely evidenced that peer support including encouragement and engagement in physical activity with friends is positively related to adolescents' overall physical activity levels (e.g. Maturo and Cunningham 2013; Mendonça et al. 2014). Friend's modelling of physical activity has also been identified as a significant correlate of young people's physical activity (Graham et al. 2011; Laird et al. 2016). Qualitative findings indicate that teenagers want to fit in with friends and tend to endorse the behaviours modelled before them. As such adolescents with inactive friends tend to avoid taking part in physical activity, whilst those who engage in sport and physical activities typically have more active friends (Allison et al. 2005; Coleman et al. 2008).

The peer group can also undermine sport and physical activity involvement through teasing directed at one's appearance or athletic ability, which results in negative physical activity experiences that deters subsequent participation (Casey et al. 2009; Storch et al. 2007). To facilitate a greater understanding of the mechanisms through which peers impact adolescent physical activity participation and change over time, it is therefore necessary to take account of both positive and negative interpersonal interactions.

Multiple Social Support Agents

Mendonça et al. (2014) found that adolescents who perceived higher levels of support from both parents and friends reported higher physical activity levels and were more likely to meet recommended levels of moderate-to-vigorous physical activity. Less studied however is the

impact of parental and peer support on adolescents' physical activity participation over time. One of the few longitudinal studies that collectively explored these influences on adolescent girls' physical activity participation over three years found that physical activity maintainers had higher perceptions of friend and parental support at baseline, in addition to more frequent physical activity undertaken with friends (Zook et al. 2014). However, parental and peer support and frequency of physical activity undertaken with peers did not predict physical activity uptake or dropout.

In line with these findings, Duncan et al. (2007) found that male and female adolescents who reported higher perceptions of peer support and peer physical activity at baseline demonstrated lower rates of physical activity decline between 12 and 17 years of age. Conversely, parental support and modelling did not predict physical activity change. The role of parental and peer processes on physical activity uptake was not explored, thus it is unclear how support and modelling from significant others simultaneously impacts young people's initiation of physical activity. Taken together the findings from these studies indicate that peer support represents an important mechanism for continued physical activity participation across adolescence. However, the relationship between peer and parental processes and adolescents' physical activity behaviour change is less clear. The role of mother's, father's, and friends' support, modelling and teasing on young people's moderate-to-vigorous physical activity uptake and dropout therefore requires further investigation.

Controlling for Age and Gender

The present study controlled for gender and age, as robust findings indicate that males are more physically active than girls at all ages, whilst older adolescents report lower levels of physical activity than their younger counterparts (Nader et al. 2008; Borraccino et al. 2009). According to Eccles expectancy-value model, gender differences in physical activity participation result from gender differences in perceived competence, interest and value of sport, which are influenced by socializer's behaviours and beliefs (Fredricks and Eccles 2002; Wigfield and Eccles 2000). Indeed, Fredricks and Eccles (2005) found that parents provided more opportunities and encouragement to support their sons' relative to their daughters' involvement in sport, perceiving sport to be more important for boys, whom they considered more competent, even after controlling for physical ability. Decreased physical activity participation across the teenage years has been attributed to the greater cost of sport involvement owing to increased time-commitment, in addition to other activities such as academic work taking on greater importance (Wang et al. 2017).

The Current Study

In the present study, existing gaps in the literature were addressed by exploring the influence of parental and peer socialising processes on adolescents' moderate-to-vigorous physical activity participation over one-year. This study builds on previous research in the following ways. First, few studies have explored predictors of physical activity change, despite the associated benefits of mobilising low active youth and reducing physical activity drop-off. Expectancy value theory posits that adolescents' expectancies for success and subjective task values, are formulated through socialising agents (Eccles and Wigfield 2002). Previous research has focused on the relationship between motivational beliefs and physical activity participation with less attention directed towards impact of parents and peers, whose interactions constitute salient influences during adolescence (Dawes et al. 2014; Wang et al. 2017). Moreover, few longitudinal studies have explored the role of parental and peer processes concurrently on adolescents' physical activity change over time resulting in a limited understanding of how socialisation processes influence youth physical activity transitions. Identification of the mechanisms through which socialising individuals impact adolescents' physical activity change and maintenance could be used to inform interventions targeting increased physical activity participation.

Therefore, the aim of this study is to examine whether mother's, father's and friends' support, modelling, and teasing predict physical activity change and maintenance among adolescents over a 12-month period. The current study will focus on attainment of moderate-to-vigorous physical activity recommendations derived from volitional participation in extracurricular and community-based organised sport and physical activity that has the potential to positively impact adolescents' social and developmental outcomes (Eime et al. 2013; Strong et al. 2005). Based on prior research it is hypothesised that higher levels of support and higher physical activity role modelling behaviours from mothers, fathers and friends, as well as lower levels of teasing, will predict continued physical activity participation and lower risk of drop-off over twelve months. The role of parental and peer influences on initiation of regular moderate-to-vigorous physical activity has received less attention, thus hypotheses regarding this association are non-directional.

Method

Participants

One thousand and four adolescents were recruited from eight secondary schools comprising six community schools,

one designated disadvantaged school and one fee-paying school in Dublin, Ireland. Students were drawn from 84 classes across Grades 7 to 11 and ranged in age from 12 to 17 years of age ($M = 13.72$, SD = 1.25). Participants were followed-up approximately one-year later. A total of 803 adolescents (37.5% males, 62.5% females) participated in both waves of data collection. Most participants identified as White (81.7%), followed by Black African (7.8%), Asian (5.3%), Mixed (2.4%), and non-identified (2.4%).

Attrition rates ranged from 6.6 to 28.6% across schools due to students having incomplete data ($n = 9$), moving school ($n = 13$), being absent on day of assessment ($n = 165$) and lack of parental consent provided at baseline for participation at follow-up ($n = 14$). Adolescents who participated at both time points ($n = 803$) were compared on baseline variables to those who completed initial survey only ($n = 192$). Participants who dropped out of the study reported significantly lower levels of mother's support ($t(994) = -2.07$, $p = 0.039$), and mother's physical activity role modelling ($t(994) = -2.69$, $p = 0.007$) compared to those retained in the final analyses. No other significant differences were found between groups on baseline predictors.

Procedure

Approval to conduct the study was obtained from the School of Psychology Ethics Committee within the university (equivalent to a Human Subjects review board). Principals of sixteen randomly selected post-primary schools in Dublin, Ireland were informed about the study by post. Eight principals agreed to participate during a follow-up phone call one week later. A suitable date was arranged for the lead researcher to talk to students about the study and invite participation. Parental consent forms requesting permission for students to participate in the study at baseline and follow-up one-year later were distributed to students to take home. Students who returned a signed parental consent form were subsequently assembled during a regularly scheduled class. Participants were informed that participation was voluntary, and their responses were confidential. Willing participants provided written informed consent and completed a paper-and-pencil survey, which took approximately 40 min to complete. The survey was re-administered at follow-up approximately twelve months later.

Measures

Participants completed a self-report survey at baseline and follow-up comprising measures of physical activity and psychosocial variables. The social measures administered at baseline and physical activity survey completed at each time point will be analysed in this paper.

Moderate-to-vigorous physical activity

A Physical Activity Recall Seven Day Diary (PAR-7DD; Lawler et al. 2017) was used to retrospectively record physical activity undertaken over the previous seven days with information elicited on the type of activity engaged in (e.g. soccer), context (organised vs non-organised), length of activity bout (minutes) and perceived difficulty of activity (light, moderate or hard). Participants were instructed to exclude any time spent in physical education, a compulsory class that all students within the present study were required to undertake weekly. At the end of the PAR-7DD, participants were asked to indicate whether the amount of physical activity undertaken over the last seven days reflected a typical week. On average, at baseline and one-year follow-up, 75.7% of adolescents indicated that it was a typical week, 18.8% said they usually do more and 5.5% reported that they usually do less.

The Compendium of Energy Expenditure for Youth (Ridley et al. 2008), which provides estimated energy costs for different activities at various levels of difficulty was used to assign a metabolic equivalent (MET) value to each activity reported in the PAR-7DD. International guidelines recommend that young people achieve at least 60 min daily of moderate-to-vigorous physical activity, which reflects any activity that produces increases in heart rate and breathing. Duration of minutes spent in moderate-to-vigorous physical activity (i.e ≥4 METs) were calculated separately for each day. Participants in this study accumulated a mean of 40 min of moderate-to-vigorous physical activity daily. Thus, in line with previous research, a lower physical activity criterion than the daily recommendation was implemented (Patnode et al. 2011; Zook et al. 2014). In accordance, participants who achieved at least 30 min of moderate-to-vigorous physical activity on five or more days over the past week were classified as high active whilst those below this cut-off were classified as low active, reflecting the fact that adolescents in this group were not sufficiently active to meet recommended moderate-to-vigorous physical activity guidelines.

Adolescents were subsequently grouped longitudinally, into one of four physical activity trajectories reflecting those who were high active at both time points (physical activity maintainers), high active at baseline and low active at follow-up (physical activity drop-offs), low active at both time points (low active maintainers), and low active at baseline and high active at follow-up (physical activity initiators). To facilitate a more meaningful interpretation of the physical activity trajectory groups, intensity of organised physical activity participation was also calculated by summing total hours spent in organised team sport, individual sport, and organised physical activities over the past seven days (Bohnert et al. 2010).

Mother's support and father's support

Five items developed for the Amherst Health and Activity Study were used to evaluate maternal and paternal social support for physical activity (Prochaska et al. 2002; Sallis et al. 2002). Participants were asked to reflect over a typical week and indicate the extent, to which each parent provided encouragement to be active, undertook a physical activity with them, provided transport to a physical activity setting, viewed physical activity practices or praised physical activity participation. Frequency of behaviours was recorded on a five-point scale ranging from not at all (1) to everyday (5). The items were summed together to calculate a total social support score for each parent with higher scores reflecting higher perceptions of social support among adolescents. This measure has previously demonstrated high internal consistency ($\alpha = 0.77$) among secondary school students (Prochaska et al. 2002). Cronbach alpha coefficients in the present study were satisfactory for mother's support (0.77) and father's support (0.85).

Mother's and father's physical activity role modelling

Perceptions of parental physical activity participation during a typical week was assessed using one item (e.g. During a typical week how often has your Mum/Dad done physical activity themselves or with friends, like going for long walks or playing sports?"). Responses ranged on a five-point scale from not at all (1) to every day (5). The question was completed separately for each parent with higher scores representing higher frequency of mother's and father's physical activity role modelling behaviours.

Friends' support

Four items assessed perceived support for physical activity from friends including encouragement, praise, participation in physical activity with peer, and participant encouragement of peer physical activity (Prochaska et al. 2002; Sallis et al. 2002). Participants rated the frequency of support behaviours during a typical week on a five-point Likert-type scale ranging from not at all (1) to every day (5). Higher scores reflected higher perceptions of friend support for physical activity. The four-item peer support scale has evidenced good internal reliability ($\alpha = 0.81$) among adolescents and has been widely used in other studies examining perceived peer support for physical activity participation (e.g. Beets et al. 2006; Beets et al. 2007). This scale demonstrated good internal reliability ($\alpha = 0.74$) in the present study.

Friends' physical activity role modelling

Perceptions of friends' participation in sport and physical activity during a typical week was assessed using one question (i.e. "During a typical week how often do your friends do physical activity or play sports?"). Participants responded on a five-point scale that ranged from 'not at all' (1) to 'every day' (5) with higher scores representing higher levels of friend physical activity role modelling.

Teasing

Slater and Tiggemann (2011) developed four items to measure teasing experiences specific to the physical activity domain (e.g. "Have people made fun of you because of how you look?"). Three additional items were included in the current study to evaluate negative comments targeting one's level of competency in sport and physical activity: "Have people laughed at you or made fun of you for not being fit enough?", "Have people laughed at you because you are not fast enough?" and "Have people made fun of you for not being good at physical activity or sport?". Responses were scored on a five-point scale that varied from 'never' (1) to 'very often' (5). The seven items were summed to provide a total teasing score with higher scores indicative of higher teasing experienced within a physical activity context. The original scale has previously demonstrated adequate internal consistency among a sample of male and female adolescents (Slater and Tiggeman 2011). The seven-item measure demonstrated adequate internal reliability in this study ($\alpha = 0.73$).

Statistical Analysis

Logistic regression analyses were conducted to examine associations between peer and parental predictors at baseline and physical activity behaviour change and maintenance groups at follow-up one-year later. The predictors were mother's support, father's support, mother's physical activity role modelling, father's physical activity modelling, friends' support, friends' physical activity modelling and peer teasing. Odds ratios (with 95% confidence intervals) were calculated to facilitate comparison between physical activity maintainers and drop-offs, physical activity initiators and low active maintainers, and physical activity maintainers and low active maintainers. Multivariable logistic regression models adjusted for age and gender were performed. Findings did not differ for the adjusted and non-adjusted models, therefore results from the non-adjusted models are presented. Data analyses were performed using SPSS, Version 21.0.

Table 1 Baseline descriptive characteristics for each physical activity trajectory group

Variable	Min–Max	Overall $n = 803$ M (SD)	Physical activity maintainers $n = 143$ M (SD)	Physical activity drop-offs $n = 83$ M (SD)	Low active maintainers $n = 472$ M (SD)	Physical activity initiators $n = 105$ M (SD)
Age (years)	12–17	13.71 (1.29)	13.61 (1.29)	13.87 (1.37)	13.80 (1.30)	13.27 (1.09)
Mother's support	5–25	13.17 (4.55)	15.59 (4.39)	14.46 (4.39)	12.09 (4.24)	13.73 (4.65)
Mother's physical activity modelling	1–5	2.81 (1.28)	3.06 (1.21)	2.91 (1.25)	2.73 (1.29)	2.75 (1.30)
Father's support	5–25	12.41 (5.27)	15.39 (5.09)	13.74 (5.42)	11.28 (4.75)	12.41 (5.84)
Father's physical activity modelling	1–5	2.55 (1.34)	2.81 (1.29)	2.67 (1.32)	2.47 (1.34)	2.52 (1.40)
Friends' support	4–20	10.97 (3.60)	13.70 (3.33)	12.84 (2.75)	9.62 (3.24)	11.84 (3.05)
Friends' physical activity modelling	1–5	3.13 (0.92)	3.58 (0.90)	3.22 (0.89)	2.92 (0.86)	3.41 (0.90)
Teasing	7–35	12.59 (4.47)	11.27 (3.84)	12.00 (4.29)	13.13 (4.56)	12.44 (4.62)

Table 2 Mean hours per week of organised team sport, individual sport and non-sport physical activity participation for each physical activity trajectory group at baseline and 12-month follow-up

Variable	Time	Physical activity maintainers M (SD)	Physical activity drop-offs M (SD)	Low active maintainers M (SD)	Physical activity initiators M (SD)
Team sport	Time 1	4.64 (3.72)	3.68 (3.64)	0.65 (1.32)	1.34 (1.90)
	Time 2	4.12 (3.27)	1.94 (2.26)	0.62 (1.30)	2.24 (2.92)
Individual sport	Time 1	1.85 (3.32)	0.70 (1.84)	0.44 (1.10)	0.72 (1.64)
	Time 2	1.44 (2.77)	0.56 (1.55)	0.37 (1.09)	1.15 (2.41)
Non-sport	Time 1	1.32 (2.90)	2.07 (3.57)	0.60 (1.40)	0.58 (1.38)
Physical activity	Time 2	1.49 (3.14)	0.72 (1.51)	0.60 (1.33)	1.23 (2.39)

Results

In total, 803 adolescents (301 Male, 502 Female) aged 12–18 years (Baseline M age = 13.71, SD = 1.29) participated at each time point. At baseline, 28.1% of adolescents ($n = 226$) were classified as high active, whilst 71.9% were low active ($n = 577$). The respective figures at twelve-month follow-up were 30.9% ($n = 248$) and 69.1% ($n = 555$). Mean daily minutes of moderate-to-vigorous physical activity were calculated for the low active and high active groups at each time point. Participants classified as high active achieved recommended amounts of physical activity at baseline ($M = 85.99$; SD = 33.33) and twelve-month follow-up ($M = 78.12$; SD = 30.14) accumulating over 1 h of moderate-to-vigorous physical activity daily. In contrast, adolescents classified as low active averaged just 21 min of moderate-to-vigorous physical activity daily at each time point ($M = 22.35$, SD = 20.35; $M = 21.35$, SD = 19.67).

Participants were grouped into one of four physical activity trajectories based on whether they were classified as high or low active at each time point. The most prevalent physical activity trajectory group was low active maintainers who did not meet recommended levels of moderate-to-vigorous physical activity at either time point (58.8%, $n = 472$ (112 M, 360 F)). In contrast, only 17.8% of adolescents maintained moderate-to-vigorous physical activity participation over one-year (17.8%, $n = 143$ (91 M, 52 F)), whilst 10.3% of those who were high active at baseline became low active at follow-up (drop-offs, $n = 83$ (45 M, 38 F)). Another 13.1% of participants categorised as low active at baseline were classified as high active at follow-up (physical activity initiators, $n = 105$ (53 M, 52 F). Descriptive statistics for physical activity maintainers, drop-offs, low active maintainers and physical activity initiators on baseline variables are presented in Table 1.

Intensity of participation characterised as mean hours per week (Bohnert et al. 2010) spent in organised team sport, individual sport and non-sport physical activity for each physical activity trajectory group is presented in Table 2. Physical activity maintainers reported the highest levels of sport involvement at baseline and twelve-month follow-up relative to the other groups, with most of their time spent in team sport, averaging over 4 h per week. In contrast, participation in team sport and organised physical activities decreased by almost one and a half hours from baseline to follow-up among physical activity drop-offs. Low active

maintainers averaged less than 1 h per week in organised sports and physical activity. Physical activity initiators however, reported an additional 30 min of participation in all organised sports and physical activities at twelve-month follow-up.

Physical Activity Transitions

With respect to physical activity transitions, it was hypothesised that adolescents who reported lower perceptions of support and physical activity role modelling from mothers, fathers and friends and higher levels of teasing would be more likely to drop-off twelve months later relative to those who maintained participation. The results revealed that adolescents who reported higher perceptions of friends' physical activity, which served as a proxy for modelling, were less likely to be categorised as drop-offs at follow-up than those who reported lower levels of friends' physical activity (OR: 0.69, 95% CI: 0.48–0.99, $p = 0.49$). None of the other variables predicted physical activity drop-off (Table 3).

As shown in Table 4, adolescents who reported higher levels of support from friends were more likely to initiate moderate-to-vigorous physical activity than those who perceived lower support from friends (OR: 1.16, 95% CI: 1.07–1.26, $p < 0.001$). Gender and age were also associated with initiating physical activity. Older adolescents were less likely to initiate physical activity levels (OR: 0.76, 95% CI: 0.62–0.93, $p = 0.007$) whilst boys were nearly three times more likely than girls to initiate physical activity participation at one-year follow-up (OR: 2.92; 95% CI: 1.79–4.77, $p < 0.001$).

Table 3 Odds ratio of being a physical activity maintainer in comparison with drop-off, as a function of gender, age and parent and peer variables

Variables	OR	95% CI	*p*
Gender			
Female	1.00	(Reference)	
Male	0.707	0.376–1.328	0.281
Age	1.106	0.883–1.385	0.379
Mother support	0.966	0.893–1.045	0.387
Father support	0.952	0.889–1.020	0.165
Mother PA role model	0.921	0.689–1.232	0.580
Father PA role model	1.061	0.790–1.426	0.693
Friend support	1.011	0.905–1.130	0.844
Friend PA role model	0.691	0.478–0.99	**0.049**
Teasing	1.027	0.955–1.105	0.467

Significant *p* values are shown in bold

PA physical activity

Table 4 Odds ratio of being a physical activity initiator in comparison with low-active maintainer, as a function of gender, age and parent and peer variables

Variables	OR	95% CI	*p*
Gender			
Female	1.00	(Reference)	
Male	2.92	1.79–4.77	**<0.001**
Age	0.76	0.62–0.93	**0.007**
Mother support	1.06	0.98–1.14	0.130
Father support	0.98	0.92–1.04	0.515
Mother PA role model	0.92	0.73–1.16	0.490
Father PA role model	1.08	0.86–1.36	0.523
Friend support	1.16	1.07–1.26	**<0.001**
Friend PA role model	1.33	0.98–1.82	0.068
Teasing	0.99	0.94–1.04	0.662

Significant *p* values are shown in bold

PA physical activity

Table 5 Odds ratio of being a physical activity maintainer in comparison with low-active maintainer, as a function of gender, age and parent and peer variables

Variables	OR	95% CI	*p*
Gender			
Female	1.00	(Reference)	
Male	4.40	2.64–7.34	**<0.001**
Table	1.04	0.86–1.26	0.720
Age			
Mother support	1.09	1.02–1.17	**0.015**
Father support	1.09	1.03–1.16	**0.006**
Mother PA role model	1.08	0.86–1.36	0.501
Father PA role model	0.99	0.78–1.25	0.913
Friend support	1.29	1.18–1.41	**<0.001**
Friend PA role model	1.20	0.87–1.67	0.273
Teasing	0.91	0.86–0.97	**0.003**

Significant *p* values are shown in bold

PA physical activity

Physical Activity Stability

The odds ratios for maintaining physical activity from baseline to follow-up compared to low active maintainers for predictor variables are presented in Table 5. The strongest predictor of maintaining physical activity over one-year was gender, with adolescent boys over 4 times more likely than girls to sustain involvement. Adolescents with higher levels of perceived support from friends (OR: 1.29, 95% CI: 1.18–1.41, $p < 0.001$) mothers (OR: 1.09, 95% CI: 1.02–1.17, $p = 0.015$) and fathers (OR: 1.09, 95% CI: 1.03–1.16, $p = 0.006$) also had higher odds of being a

physical activity maintainer. In contrast, those who reported higher levels of teasing were less likely to sustain physical activity participation over one-year (OR: 0.91, 95% CI: 0.86–0.97, $p = 0.003$).

Discussion

Physical activity habits developed during adolescence track into adulthood and impact young people's health, wellbeing and development (Telama et al. 2005). Despite the salience of peer and parental influences during adolescence, few longitudinal studies have explored the concurrent impact of socialisation processes on young people's physical activity behaviour change and maintenance. Thus, it is unclear how peer and parental processes impact youth's physical activity transitions over time. This gap in the literature was addressed by examining whether mother's, father's and friends' support, modelling and teasing collectively predicted physical activity initiation, drop-off and maintenance among adolescents over a twelve-month period.

In accordance with research undertaken by Wang et al. (2017) on adolescents' sport participation trajectories, most participants in this study were classified into a physical activity group characterised by stable levels of participation (58.8% low active maintainers and 17.8% physical activity maintainers) as opposed to change (10.3% drop-offs, 13.1% physical activity initiators). The current study findings also resonate with results from the longitudinal Young-HUNT study in Norway (Rangul et al. 2011), which comprised a population-level survey that implemented a moderate-to-vigorous physical activity participation threshold of at least four days per week. Rangul et al. (2011) found that 59% of adolescents were classified as inactive maintainers at follow-up, whilst 13% of the sample maintained physical activity participation, 16% decreased involvement and 12% adopted physical activity. Comparable findings were evidenced in the current study demonstrating support for the validity of the physical activity cut-off points adopted in this study.

Physical Activity Drop-Offs versus Physical Activity Maintainers

In support of our hypotheses, adolescents that reported higher perceptions of friend physical activity at baseline were less likely to decrease physical activity twelve months later. Consistent with this finding, Duncan et al. (2007) demonstrated that adolescents that reported higher levels of friend physical activity at baseline evidenced less of a physical activity decline from 12 to 17 years of age. However, the findings from the present study contradict findings from Zook et al. (2014) who found that peer physical activity was unrelated to physical activity transitions among adolescent girls over a three-year period. The divergent findings may be attributed to methodological differences regarding assessment of friend physical activity across studies. Zook et al. (2014) asked girls to identify how often their friends undertook physical activity in addition to the frequency with which they undertook physically together whilst the present study, in line with Duncan et al. (2007), focused on the former question using a mixed sample of adolescent boys and girls. Resonating with the current findings, prior quantitative (Laird et al. 2016) and qualitative research indicates that friend physical activity behaviour influences adolescents' decisions about participation (Allison et al. 2005; Coleman et al. 2008). Physical activity maintainers reported higher organised sport and physical activity participation intensity relative to the other physical activity trajectory groups. Adolescents' organised sport and physical activity typically comprises activities undertaken as part of team, group or alongside peers, which may serve to reinforce social norms and conformity to peers behaviour (Brechwald and Prinstein 2011). Thus, friends served as powerful models of physical activity behaviour that young people sought to emulate by sustaining participation in moderate-to-vigorous physical activity participation over twelve months.

Friend role modelling may have also impacted physical activity maintenance indirectly by shaping adolescents' own value beliefs about the importance of physical activity participation and continued involvement (Maturo and Cunningham 2013; Wigfield and Eccles 2000). In addition, an active friend represents someone with whom one can undertake physical activity, thus it is possible that physical activity maintainers undertook activity alongside their chosen friend, and the associated outcomes of friendship and enjoyment fostered intrinsic and utility values, which contributed to sustained participation at twelve-month follow-up (Allen 2003; Ullrich-French and Smith 2009). It is important to acknowledge however, that individuals' expectancies for success and subjective task values were not measured in this study. Additional research is therefore necessary to confirm the mechanisms through which peer physical activity reduced likelihood of drop-off. Notwithstanding this, the findings indicate that peer modelling exerted a protective influence on adolescents continued physical activity participation over one-year by decreasing risk of dropout.

Conversely, friends' support was unrelated to physical activity drop-off. Encouragement and praise from peers may be of less relevance for adolescents who have already established regular physical activity habits. Rather, young people's motivation to persist in physical activity appears to be guided by friends' actual physical activity participation, which highlights norms of acceptable and expected

behaviour (Smith and Petosa 2016; Telzer et al. 2018). In addition, mother's and father's modelling and support behaviours, did not emerge as significant predictors of physical activity drop-off. The current findings extend past research by identifying peers as more salient models of physical activity behaviour change during adolescence, with teenagers more likely to endorse the behaviours of peers than parents (Smith and Petosa 2016; Zook et al. 2014).

Physical Activity Initiators vs Low Active Maintainers

Higher friend support at baseline predicted moderate-to-vigorous physical uptake among adolescents that were low active, which confirms our hypothesis. Contradicting Zook et al. (2014) who found that peer support was unrelated to adolescent girls' physical activity uptake from grade 8 to 11, the current findings identify peer support as an important mechanism for promoting physical activity initiation at one-year follow-up. The discrepant findings may be attributed to duration of follow-up with perceptions of support more likely to be related to changes in physical activity over the short term.

Provision of emotional support from friends in addition to undertaking physical activity together facilitates feelings of interpersonal relatedness within the peer group, which underpins autonomous motivation to change behaviour (Deci and Ryan 2014; Maturo and Cunningham 2013; Smith and Petosa 2016). Moreover, peer praise and encouragement support individuals' feelings of competence or expectancies for success within the physical domain which, in line with expectancy value theory, will positively impact participation (Fitzgerald et al. 2012; Weiss and Stuntz 2004). In contrast, friend modelling did not predict initiation of physical activity. The findings indicate that simply observing peer physical activity is insufficient to promote uptake of moderate-to-vigorous physical activity, with more direct and emotional forms of friend support necessary to mobilise low active youth.

Parental support and modelling were also found to be unrelated to uptake of moderate-to-vigorous physical activity among adolescents. The results resonate with previous studies that have found that peers play a stronger role in adolescents' physical activity behaviours than parents (Beets et al. 2006; 2007; Edwardson et al. 2013). Moreover, the current study extends cross-sectional literature by highlighting the significance of peer processes for predicting initiation of adolescents' moderate-to-vigorous physical activity over twelve months.

In addition, gender and age emerged as significant predictors of physical activity initiation. Adolescent boys were more likely than girls to adopt physical activity, which is consistent with prior research exploring physical activity change over 10-months among male and female teenagers (Gillison et al. 2011). Physical activity initiators increased overall moderate-to-vigorous physical activity participation through increased hours spent in organised sports and physical activity. Owing to culturally prescribed stereotypes pertaining to sport as a masculine domain, it is plausible that in line with expectancy-value theory boys received higher levels of support which contributed to gender disparities in adoption of physical activity (Frederick and Eccles 2005; Edwardson et al. 2014).

Older adolescents were also less likely to adopt physical activity than their younger counterparts, reflecting widely evidenced age-related disparities in physical activity levels (Borraccino et al. 2009). Adolescence is characterised by many cognitive, social and developmental changes, thus perceived value of physical activity participation may diminish as competing priorities such as academic work, employment or other extracurricular activities take on greater importance (Eccles 1999). This finding further highlights the importance of intervening in early adolescence to promote physical activity uptake and participation.

Physical Activity Maintainers vs Low Active Maintainers

Consistent with our hypothesis, perceived support from friends, mothers and fathers predicted sustained physical activity participation over one-year. In line with the present findings, Zook et al. (2014) found that higher perceptions of family and friend support at baseline predicted continued physical activity behaviour among adolescent girls at three years follow-up but did not predict changes in physical activity participation. The results are consistent with prior research that adolescents perceiving higher levels of parental and peer support reported higher levels of physical activity (Mendonça et al. 2014). The current findings therefore indicate that parental support is more important in predicting physical activity behaviour maintenance relative to low active maintenance rather than actual change. This study extends previous research undertaken by Zook et al. (2014) by focusing on male and female adolescents in addition to examining perceptions of mother's and father's physical activity and peer teasing alongside perceived support from parents and peers.

Contrary to our expectations, mother and father physical activity role modelling behaviours did not emerge as significant predictors of adolescents' physical activity maintenance. Trost et al. (2003) found that the effect of parental role modelling on adolescents' physical activity behaviour was diminished when parental support was examined concurrently. Building on this cross-sectional research, the present findings demonstrate that parental physical activity was insufficient to promote sustained physical activity participation among adolescents at one-year follow-up, with

more direct and instrumental parental behaviours necessary to facilitate continued involvement (Trost et al. 2003). Peer physical activity was also unrelated to physical activity maintenance over time. It is possible that assessment of peer support alongside peer modelling, attenuated the effects of perceived peer activity on adolescents' continued physical activity participation, however these assumptions were not formally tested in the current study thus additional analyses is necessary to explore this possibility further.

With respect to negative interactions, the current findings confirmed our hypothesis that individuals reporting higher levels of teasing were less likely to be classified as physical activity maintainers at follow-up one-year later. This finding resonates with qualitative research undertaken by Vu et al. (2006), which found that negative commentary regarding one's appearance or physical competencies can serve as a barrier to physical activity participation, with individuals refraining from physical activity situations that may incite peer victimisation. In line with expectancy-value theory, peer victimisation can undermine feelings of competence and intrinsic value of activity, resulting in a negative experience of physical activity that ultimately deters participation. The current findings thus demonstrate that peers can impact physical activity maintenance and change across adolescence in both positive and negative ways.

In addition, gender emerged as a predictor of physical activity maintenance. Relative to those who remained low active over twelve months, adolescents who sustained physical activity participation were more likely to be male, reflecting prior longitudinal studies on young people's physical activity participation (Gillison et al. 2011; Rangul et al. 2011). As previously mentioned, physical activity maintainers reported higher sport participation intensity, and sport is a gendered activity, thus socialising agents may impact gendered differences in physical activity maintenance by influencing expectancies and task values (Chalabaev et al. 2013). Consistent with expectancy theory, it may be argued that parents and peers place greater value on male as opposed to female sport participation, providing more support and considering them to be more competent, with such attitudes and behaviours impacting adolescents boys' and girls' expectancies for success and task values, which ultimately results in gender disparities in physical activity participation and maintenance (Fredricks and Eccles 2002, 2005).

Implications

Taken together the findings have relevance for understanding adolescent's development, highlighting the significant role of peers in young people's physical activity behaviour change. Peer participation in physical activity helps to project norms of acceptable behaviour (Fitzgerald et al. 2012), which protects against moderate-to-vigorous physical activity drop-off during adolescence when risk of decline is high. Interactions with peers in the form of encouragement, praise and direct physical activity participation provides adolescents with information about themselves as valued and competent individuals (Laird et al. 2018; Vazou et al. 2005), which serves to support initiation of moderate-to-vigorous physical activity. In short, the findings highlight that peers can serve as agents of physical activity behaviour change and maintenance through mechanisms of support and modelling.

The current findings have implications for interventions targeting youth physical activity behaviour change. Peers have typically been overlooked in physical activity interventions despite the strong influence they exert on young people's behaviour in this domain (Weiss and Phillips 2015). The findings therefore underscore the potential benefit of peer-led interventions for increasing physical activity levels among young people and for preventing drop-off. In accordance, the results of PLAN-A, a feasibility cluster randomised trial, in which peer-nominated students were trained to promote physical activity during informal conversations with friends, revealed a significant increase in weekday moderate-to-vigorous physical activity at follow-up one-year later (Sebire et al. 2018). Peer support in the form of physical activity encouragement and modelling positive attitudes towards physical activity likely contributed to increased participation. In line with the present findings, future interventions could involve active peers as role models to help ameliorate physical activity declines across adolescence.

Limitations and Strengths

The prospective longitudinal design and large sample size is one of the key strengths of this study. However, the limitations of this study must be acknowledged. First, most participants were of white ethnicity, thus generalisability to other races and cultures cannot be assumed. In addition, potential differences in socioeconomic factors were not examined. Adolescents from higher social classes are more likely to meet recommended moderate-to-vigorous physical activity guidelines than those from lower social classes (Borraccino et al. 2009). Thus, social class reflects an important demographic factor to control for in future research given its potential role in young people's physical activity involvement. Another key limitation is that physical activity was assessed using self-report survey, which may be influenced by socially desirable responses and errors in memory recall (Dollman et al. 2009). Objective methods of physical activity would facilitate a more reliable, accurate measure of young people's physical activity. Thus, it is recommended that such methods be employed in future research alongside survey measure to validate the findings.

In addition, prior research indicates that physical activity levels vary with seasonality (Tucker and Gilliland 2007), which was not addressed in the present study. Future studies should incorporate a twelve-month recall-time frame to account for possible seasonal variation in sport and physical activity participation.

It is also important to acknowledge that the current study focused on predictors of recommended levels of moderate-to-vigorous physical activity participation. However, the impact of peer and parental processes on adolescents' physical activity participation may differ dependent on the type of activity undertaken. Accordingly, psychological processes and outcomes have been found to vary across discrete profiles of organised and non-organised physical activity participation, and team and individual sport (Dawes et al. 2014; Lawler et al. 2017). In addition, predictors of young people's sport and physical activity participation may vary dependent on intensity, duration, and breath of participation (Bohnert et al. 2010). While intensity of organised physical activity participation was described in brief in the current study to facilitate contextual insight into physical activity trajectory groups, these dimensions were not adopted as the main outcome of analysis. Conceptualising and evaluating organised physical activity involvement from this perspective may however, facilitate additional insight into adolescent development as outcomes can differ across various dimensions of participation (Bohnert et al. 2010). Thus, one avenue for future research is to implement a person-centred approach to examine whether peer and parental predictors of physical activity transitions differ dependent on pattern of physical activity undertaken. Adopting such an approach may help to determine under what conditions and for whom interventions targeting physical activity participation could be implemented successfully.

Moreover, while it was proposed that peer support and modelling impacted adolescents' physical activity transitions by influencing individuals task values and expectancies, these assumptions were not formally tested within this study. Finally, due to low sample sizes in physical activity initiation and drop-off groups, analyses could not be performed separately by gender. Prior research indicates that gender of both child and parent has been found to moderate the relation between social support and young people's physical activity behaviour (Kirby et al. 2011). Thus, additional research should be conducted to determine whether discrete peer and parental processes differentially impact male and female adolescents' physical activity behaviour change and maintenance over time.

Conclusion

Despite the benefits of recommended moderate-to-vigorous physical activity for youth outcomes, teenagers in Ireland and worldwide demonstrate low rates of physical activity participation with levels declining across adolescence (Woods et al. 2018; Kalman et al. 2015). Previous research has shown that peer and parental processes are associated with youth physical activity participation, yet few studies have examined both sources of socialisation simultaneously with respect to physical activity change over time. The present study addressed this gap by examining the impact of parental and peer support, modelling, and teasing on male and female adolescents' moderate-to-vigorous physical activity initiation, maintenance and drop-off over twelve months.

The findings from this study advance the existing literature by demonstrating that peer socialisation processes are more salient than parental processes for adolescents' physical activity behaviour change. Peers served as agents of behaviour change through mechanisms of support and role modelling. Accordingly, higher perceptions of friend physical activity were associated with a decreased risk of physical activity drop-off, whilst higher levels of friend support predicted initiation of regular moderate-to-vigorous physical activity. Peer socialisation therefore plays a key role in physical activity transitions during adolescence, when risk of dropout is high.

In contrast, parental support and modelling was unrelated to young people's physical activity transitions, which resonates with prior research that parental influence decreases as children enter adolescence. With respect to physical activity stability, higher levels of maternal, paternal and friend support in addition to lower teasing, predicted continued moderate-to-vigorous physical activity participation over one-year, relative to those who remained low active. Consistent with expectancy value theory (Eccles and Wigfield 2002; Wigfield and Eccles 2000), these findings suggest that parents and peers represent distinct socialising agents that impart their influence on adolescents' physical activity maintenance and behaviour change through various mechanisms, highlighting the need to consider both sources of socialisation concurrently in future studies of adolescent behaviour change. Interventions capitalising on existing social processes among young people should be implemented to support moderate-to-vigorous physical activity initiation and sustained participation, in addition to targeting physical activity decline, which could ultimately enhance young people overall health, wellbeing and development.

Acknowledgements The authors thank all the students who participated in the study and the teachers and principals who facilitated this research to take place.

Authors' Contributions All authors participated in the conception and design of the present study; ML performed statistical analysis, interpreted the data and wrote and drafted the manuscript; EN contributed

to data analyses and interpretation, and critically reviewed initial versions of the manuscript; CH performed critical revision of the manuscript. All authors read and approved the final manuscript.

Funding This work was funded by an Irish Research Council Government of Ireland Postgraduate Scholarship and a Noel Hickey Research Bursary supported by the Irish Heart Foundation.

Data Sharing and Declaration The datasets generated and/or analysed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the School of Psychology Research Ethics Committee in the University of Dublin, Trinity College, Ireland, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Parental consent and individual consent were obtained in writing from all participants included in the study.

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