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**Citation** (please note it is advisable to refer to the publisher's version if you intend to cite from this work)

**Whitehead, AE, Umeh, FK, Quayle, L and Morley, D (2017) Mobile Technology Usage Mediates Gender Differences in Physical Activity. International Journal of Sport Psychology, 48 (6). ISSN 0047-0767**

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1           **Mobile Technology Usage Mediates Gender Differences in Physical Activity**

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11       This research was supported by a Sports Coach UK funded tender to Amy E. Whitehead.

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25 **Mobile Technology Usage Mediates Gender Differences in Physical Activity**

26

27 **Abstract**

28 Gender differences in how technology is used to facilitate physical activity engagement was  
29 examined. 578 adults completed a survey assessing gender, mobile device usage, stages of  
30 change in physical activity based on the transtheoretical model of behaviour change (TTM) and  
31 relevant covariates. Data analysis revealed that both cumulative device types and cumulative  
32 reasons for using devices mediated gender differences in stage membership for physical activity.  
33 Females used fewer devices and reported fewer reasons for using such devices than male  
34 participants. These dispositions predicted a reduced probability of achieving action/maintenance  
35 stages for physical activity. Females used fewer mobile devices and perceived fewer incentives  
36 for using such devices. As a result they are less likely to enter the action/maintenance stages of  
37 physical activity. Interventions to promote female participation in physical activity need to  
38 recognise gender differences in the use of mobile technology.

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49           **Mobile Technology Usage Mediates Gender Differences in Physical Activity**

50 Rates of obesity, diabetes, and cardiovascular disease (CVD) have continued to rise across  
51 populations in many Western countries and other parts of the world (Chiu, Maclagan, Tu, &  
52 Shah, 2015; Du et al., 2014; Samaranayaka & Gulliford, 2013; Saydah et al., 2014). Previous  
53 literature reports a higher rate of obesity in females (Kanter & Caballero, 2012) and, therefore,  
54 subsequent research has focused its attention on gender differences in physical activity (Spencer,  
55 Rehman, & Kirk, 2015). Moreover, findings from other research suggests females are less  
56 physically active than males (Brand et al., 2016; Bronikowski, Laudanska-Krzeminska,  
57 Tomaczak, & Morina, 2016; Caperchione, Chau, Walker, Mummery, & Jennings, 2015; Kelly,  
58 Edney, Moran, Srikanth, & Callisaya, 2016; Magoc, Tomaka, Shamaley, & Bridges, 2016;  
59 McLaughlin, Connell, & Janevic, 2016; Viciano, Mayorga-Vega, & Martinez-Baena, 2016). For  
60 example, Brand et al. (2016) found that even amongst adolescents judged to engage in ‘high’  
61 levels of moderate-to-vigorous physical activity (i.e., classified as exercising for 7 hours or 421  
62 minutes per week), males were more physically active, reporting an average of 1091.02  
63 minutes/week of activity, compared to 922.78 minutes/week of activity for females.

64           The reported deficit in physical activity in females has been attributed to a range of social  
65 and cultural factors including the complex relationships between physical activity, feminine  
66 ideals, and body-image factors (Spencer et al., 2015). Further research by Martins, Marques,  
67 Sarmiento, and da Costa (2015) has identified how the majority of studies that have looked at the  
68 perceptions of physical activity have focused on adolescent females. Their systematic review  
69 concluded that the main barriers to physical activity were attitudes toward physical activity;  
70 motivation; perceptions of competence and body image; fun; influence of friends, family and  
71 physical education teachers; and environmental physical activity opportunities. Fun was the most  
72 frequently cited reason for female physical activity enegagement in most studies within the

73 review (Martins et al., 2015) and elsewhere (Yungblut, Schinke, & McGannon, 2012), however,  
74 when searching for further meaning around this variable it is important to consider participants'  
75 perceptions of fun. For example, research has found that fun is related to the specific physical  
76 activity (e.g. yoga) (Azzarito & Hill, 2013). Furthermore, it is important that the activity is  
77 challenging yet not competitive (Brooks & Magnusson, 2007), with autonomy (Yungblut et al.,  
78 2012), social support from family members and a high perception of competence being  
79 important (Azzarito & Hill, 2013).

80 Although recent research has implicated a newly-found barrier to physical activity participation  
81 – the use of electronic devices (Pawlowski, Tjornhoj-Thomsen, Schipperijn, & Troelsen, 2014)  
82 there is uncertainty regarding the role of mobile technology and the extent to which it mediates  
83 gender differences in physical activity. Research has shown gender differences in the use of  
84 mobile devices such as smart phones and tablets (Baron & Campbell, 2012). For example,  
85 researchers exploring the use of video gaming technology have reported technology being  
86 specially designed for the needs of male gamers (Ivory, 2006). Rehbein, Kliem, Baier, Mößle,  
87 and Petry (2015) found significantly higher gender differences amongst a large German  
88 adolescent sample, suggesting that boys were involved in 162 minutes of gaming per day  
89 compared to the girls' gaming time of 27 minutes. Additionally, research suggests mobile devices  
90 can offer incentives that affect levels of physical activity (Pawlowski et al., 2014), whereby  
91 access to particular fitness apps have encouraged an active lifestyle (Direito et al., 2014). By  
92 contrast, excessive dependence on mobile technology (e.g., for gaming, social networking) can  
93 precipitate a sedentary lifestyle (Lepp, Barkley, Sanders, Rebold, & Gates, 2013). Therefore,  
94 device use may operate as both a barrier (e.g. encouraging sedentary living through gaming) and a  
95 facilitator (e.g. through sharing exercise results with others). Given that previous research has

96 found more males use technological devices in comparison to females, there does seem to be a  
97 potential gender barrier.

98         Despite evidence linking mobile technology to variable usage related to both gender and  
99 physical activity, no study has examined the extent to which the use of mobile technology  
100 mediates (i.e., explains) the physical activity deficit in females, using appropriate analytic  
101 protocols (e.g., bootstrapping) (Hayes, 2013). Research in this area will have implications for the  
102 development of interventions to promote physical activity in females. Previous research has used  
103 behaviour change models such as the transtheoretical model (TTM) proposed by Prochaska and  
104 Velicer (1997) to understand gender differences in physical activity and possible mediating  
105 factors. According to this model, behaviour change unfolds through five distinct stages:  
106 precontemplation (no intention to engage in physical activity), contemplation (the intention to  
107 engage in activity within the next 6 months), preparation (preparing to engage in the next 6  
108 months), action (engaging in physical activity but for less than 6 months) and maintenance  
109 (engaging in physical activity for 30 or more minutes a day on 5 or more days per week for more  
110 than 6 months). Studies have found significant gender differences in stages of change for  
111 physical activity (Garber, Allsworth, Marcus, Hesser, & Lapane, 2008).

112         The aim of this study was to assess the direct relationship between gender and stages of  
113 change in physical activity, and also the extent to which this association is *indirect*, mediated by  
114 the use of mobile devices. The following hypotheses were tested:

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116         a) There are gender differences in stages of change for physical activity, with males more  
117         likely to achieve action/maintenance stages

118

119 b) Gender differences in stages of change for physical activity are mediated by individual  
120 differences in the use of mobile devices.

121

## 122 **Methods**

### 123 **Participants**

124 Surveys were completed by a range of participants (n=578, 301 males and 277 females) from  
125 across the United Kingdom. The age of respondents was 16-25 years (n=140), 26-34 years  
126 (n=101), 35-44 years (n=136), 45-54 years (n=127), 55-64 years (n=56), 65+ years (n=18). The  
127 only eligibility criteria specified was that all respondents had to be over the age of 16 years.

128

### 129 **Materials and Procedure**

130 The web-based survey was created using Bristol Online Survey (BOS) software (BOS, 2016)  
131 and captured data related to stages of change in technology use, physical activity participation,  
132 type of device used and perceived benefits of the device. The survey was disseminated via local  
133 sports networks and web-based social media for a period of eight weeks (December – January,  
134 2015). The host institution granted ethical approval and participants gave informed consent on-  
135 line prior to completing the questions.

136

### 137 **Stages of Change**

138 The Transtheoretical model of behaviour change (Prochaska & Velicer, 1997) uses 5 stages to  
139 represent an individual's behaviour in a given domain; these stages are (i) pre-contemplation, (ii)  
140 contemplation, (iii) preparation, (iv) action and (v) maintenance. Using National Health Service  
141 (2015) guidelines, respondents were classified into one of these stages of change, based on their

142 response to the following question: 'Do you currently engage in any form of sport or physical  
143 activity?':

144 *'I do not participate in sport or physical activity in any way and I do not intend to do so in the  
145 future'* (Pre-contemplation)

146 *'I have been thinking about participating in sport and physical activity but I have not done any  
147 yet'* (Contemplation)

148 *'I have started preparing to engage in sport or physical activity but I am not yet active'  
149 (Preparation)*

150 *'I am engaging in sport or physical activity on a regular basis (30 or more minutes a day on 5 or  
151 more days per week) and have been doing so for less than six months'* (Action)

152 *'I am engaging in sport or physical activity on a regular basis (30 or more minutes a day on 5 or  
153 more days per week) and have done so for the last six months or more'* (Maintenance)

154 Consistent with previous research using this model, in which progression into the  
155 Action/Maintenance for physical activity (and other behaviours) depicts successful behaviour  
156 change (Johnson et al., 2008; Prochaska et al., 2005), participants in the present study were  
157 dichotomised into two stages: pre-Action/Maintenance (coded 0) and post-Action/Maintenance  
158 (coded 1).

159

#### 160 **Type of device**

161 The type of device being used by participants was assessed by asking respondents what sort of  
162 technology they used (sports coach UK, 2016). Participants responded by ticking one or more  
163 items from a list of up to six items: *Applications downloaded onto a smart phone or tablet,*  
164 *Online web-based information, GPS-enabled devices, Social media, wearable technology, and*  
165 *'other'* (please specify). Each ticked item was coded as '1'. The total number of items ticked was



166 then summed to generate an index, with scores ranging from 0 to 6; the higher the score, the  
167 greater the number of device types used.

168

### 169 **Reasons for device use**

170 Following the question about technology types, participants were asked to identify their  
171 motivations (i.e., reasons) for device use, using a previously used conceptual framework (op den  
172 Akker, et al., 2013). In response to the question ‘What do you use the technology for?’, a list of  
173 items was provided, including ‘*Collect physical data on myself*’ Yes(1)/No(0) , ‘*Compare my*  
174 *results with others*’ Yes(1)/No(0), ‘*As a tool to motivate myself*’ Yes(1)/No(0), ‘*As a group*  
175 *training tool*’ Yes(1)/No(0), ‘*For fitness purposes*’ Yes(1)/No(0), ‘*Communicate with a*  
176 *coach/instructor*’ Yes(1)/No(0), ‘*Other*’ Yes(1)/No(0). Responses to these items were summed  
177 to generate a ‘reasons for tech use’ index (scores ranging from 0 to 7 – a higher scored indicated  
178 more reasons or greater motivation for technology use).

179

### 180 **Covariates**

181 A number of factors may confound gender differences in physical activity including age  
182 (Molanorouzi, Khoo, & Morris, 2015), perceived incentives in use of technology use (Yau &  
183 Cheng, 2012), coaching (Etnier, 2011), and participation in organised sporting activity (e.g.,  
184 club-based events) (Vilhjalmsson & Kristjansdottir, 2003). Thus, the following variables were  
185 treated as potential confounding factors in this study: age, exposure or access to a coach (‘Are  
186 you currently being coached either individually or in a team setting?’ ‘Yes – I’m being coached’  
187 (1) or ‘No – I’m not being coached’ (0)), and organising participation in sporting activities  
188 (‘Please indicate who organises this [list of various sporting events provided] and whether it is  
189 competitive or recreational?’ ‘Club’ Yes(1)/No(0), ‘Another organisation but not a sports club’

190 Yes(1)/No(0), 'Gym or other health/fitness centre' Yes(1)/No(0), 'Myself (I do it on my own)'  
191 Yes(1)/No(0), 'With friends' Yes(1)/No(0). Responses to these organisational items were  
192 totalled to give an 'organisation' index (scores ranging from 0 to 4, with a higher score denoting  
193 more organising activity). Another covariate was the perceived benefits of technology use  
194 ('What do you perceive to be the benefits of using technology to support participation in sports  
195 and physical activity? Please select any applicable terms' – 'Enhance performance'  
196 Yes(1)/No(0), 'Provide useful data on performance' Yes(1)/No(0), 'Helps with motivation'  
197 Yes(1)/No(0), 'None', 'Other'. Responses to the first three benefit items were summed to  
198 produce a 'perceived benefits' index (scores ranged from 0 to 3 – the higher the score, the  
199 greater the perceived benefits of technology use.

200

## 201 **Statistical analysis**

202 The direct and indirect effects of gender on stages of change for physical activity were assessed  
203 using a bootstrapping SPSS dialogue (Hayes, 2009; Hayes, 2013). Mediation analysis involves  
204 testing the significance of three key regression pathways (see *Figures 1 & 2*); (i) relationship  
205 between variable X (predictor) and variable M (mediator), known as *path a*; (ii) relationship  
206 between variable M (mediator) and variable Y (outcome), called *path b*; (iii) direct relationship  
207 between variable X (predictor) and variable Y (outcome), or *path c*.

208 Gender was treated as variable X (predictor), while stage membership (pre- versus post  
209 action/maintenance) for physical activity was evaluated as variable Y (outcome). Cumulative  
210 (i.e., total number of) device types used and cumulative reasons (i.e., total number of incentives  
211 or motivations) for using mobile devices were both treated as variables M (mediators).

212 Additionally, age, receiving coaching, organisation of sporting events, and perceived benefits of  
213 technology use, were treated as covariates. The bootstrapping strapping SPSS dialogue allowed

214 for the inclusion. Unadjusted bootstrapping models were first generated, in which covariates  
215 were excluded. Bootstrapping was then repeated adjusting for the various covariates.

216

## 217 **Results**

### 218 **Descriptive statistics**

219 The vast majority of respondents (72.3%) were in the Maintenance stage of change for physical  
220 activity, followed by Action (1.9%), Preparation (2.7%), Contemplation (2.1%), and Pre-  
221 contemplation (0.5%). The remaining 20.5% participants were categorised as non-responders  
222 (i.e., missing data) and excluded from subsequent data analysis. On average, respondents used  
223 about two ( $M = 1.75$ ,  $SD = 1.65$ ) different types of technological devices, with a maximum of 6  
224 and a minimum of zero. The most frequently cited reasons or motivations for device use were to  
225 collect physical or performance data (36.9%) and compare results with others (36.7%), followed  
226 by motivating oneself (31.6%), physical fitness (24.8%), communication with coach (10.7%),  
227 training tool (9.7%), and finally ‘other’ (3.6%). Of three possible benefits of using technology,  
228 respondents cited an average of two ( $M = 1.98$ ,  $SD = 1.05$ ). The most commonly cited benefit  
229 was receiving ‘useful feedback’ (74.4%), followed by ‘motivates me’ (66.4%), and finally  
230 ‘enhance performance’ (57.8%). The most frequently used specified technology was mobile apps  
231 (44.9%), followed by GPS (41%), wearable devices (32.5%), online websites (30%), and finally  
232 social media (24.6%). Just under 3% of respondents used ‘other’ (i.e., unspecified) forms of  
233 technology.

234 .....

235 **Insert Table 1 about here**

236 .....

### 237 **Mediating effect of cumulative device types used**

238 Results are shown in *Table 1*. Gender predicted cumulative device use, with females using fewer  
239 device types. Cumulative device type, in turn, predicted stage membership for physical activity,  
240 with use of more device types predicting a higher probability of action/maintenance stage  
241 membership. Contrary to what was hypothesised, gender did not directly predict stage  
242 membership for physical activity. However, as hypothesised, there was a significant indirect  
243 effect, whereby cumulative device use mediated the effects of gender on stage membership;  
244 females used fewer technological devices, which in turn meant a reduced likelihood of being in  
245 the action/maintenance stages of physical activity (*Figure 1*). This indirect effect persisted after  
246 controlling for age (older respondents were less likely to be in the action/maintenance stages for  
247 physical activity), but was no longer significant after accounting for coaching, followed by other  
248 covariates.

249 .....  
250 Insert Table 2 about here  
251 .....

252  
253 **Mediating effect of cumulative reasons for device use**

254 Results are shown in *Table 2*. In the initial bootstrapping model, prior to accounting for  
255 covariates, gender showed a near-significant association with cumulative perceived benefits for  
256 using mobile devices ( $p = 0.05$ ), with females reporting fewer reasons for using mobile devices  
257 in the context of physical activity. In turn, cumulative reasons for using devices predicted stage  
258 membership for physical activity, with a higher number of reasons denoting an increased  
259 probably of action/maintenance stage membership. Gender did not directly predict stage  
260 membership. As expected, a significant indirect effect emerged (*Figure 2*), whereby cumulative  
261 reasons for using technological devices mediated the relationship between gender and stage

262 membership; females reported fewer reasons for using mobile devices in the context of physical  
263 activity, a disposition that in turn denoted a reduced probability of action/maintenance stage  
264 membership. This mediator effect remained significant after adjusting for age differences in  
265 stage membership, but was nullified after adjusting for coaching, and other covariates.

266 .....

267 Insert Figure 1 about here

268 .....

269 .....

270 Insert Figure 2 about here

271 .....

272 **Discussion**

273 This study aimed to assess the direct relationship between gender and stages of change in  
274 physical activity, and also the extent to which this association is indirect, mediated by the use of  
275 mobile devices. Interestingly, and in contravention of our first hypothesis, gender did not predict  
276 stage membership. This finding contradicts much of the literature surrounding physical activity  
277 and gender differences, however the majority of this research has been focussed on adolescent  
278 females (Martins et al., 2015). The majority of the participants within this study were over the  
279 age of twenty five and our understanding of the factors associated with physical activity in this  
280 specific population is limited (Booth, Owen, Bauman, Clavisi, & Leslie, 2000). Furthermore,  
281 within the present study those who may have completed the survey may have had an interest in  
282 physical activity (Berry & Spence, 2006), leading to bias and the potential reason why gender  
283 difference was not found. Whilst gender did not predict stage membership, males used more  
284 device types than females and had more reasons for using technology, which in turn may have  
285 had a positive impact on male physical activity, as demonstrated by the prominent positioning of

286 males in the action/maintenance stage of the TTM (DiClemente & Prochaska, 1998; Prochaska  
287 & Velicer, 1997). Females used technology less than their male counterparts and this could have  
288 a negative consequence on their physical activity levels. Given the proliferation of technology in  
289 everyday life (Walshaw, 2015; Wang, Xiang, & Fesenmaier, 2016), it is interesting to note that  
290 gender differences in technology use may affect the physical activity behaviours of individuals.  
291 Whilst previous research has highlighted both negative (Lepp et al., 2013) and positive effects  
292 (Direito et al., 2014) of technology on physical activity and lifestyles, results from this study  
293 suggest the patterns of behaviour are more complex and gender differentiated.

294         The finding that technology positively mediates physical activity is an indication that the  
295 use of technology could play a critical part in the way that interventions are established to  
296 motivate participants to become, and remain, physically active. It is, perhaps, not surprising that  
297 technology may affect male participation in this way, as the majority of technology is situated in  
298 male dominated environments (Garber et al., 2008; Johnson et al., 2008). Therefore, this  
299 provides an explanation as to why males may be more confident in the use of technology, which  
300 may be transferring into physical activity app based technology use.

301         Results within the current study suggest that technology may positively influence male  
302 physical activity, due to males using a larger range of devices and having more reasons for using  
303 technology in comparison to females. Females are motivated differently than males, in relation to  
304 physical activity. Generally speaking, females are less ego and mastery-oriented than males,  
305 therefore caring less about their performance in relation to others (Egli, Bland, Melton, & Czech,  
306 2011; Su, McBride, & Xiang, 2015). Their goals in relation to physical activity are more aligned  
307 to overall health, appearance and physical attractiveness (Chowdhury, 2012; Molanorouzi et al.,  
308 2015; Morris, Clayton, Power, & Han, 1995). Therefore, as the majority of mobile technology is  
309 predominantly geared towards incentivising participants through demonstrating individual

310 standing in relation to peers, vis-a-vie enhancement of performance, females may be less likely  
311 than males to be motivated by this function. Subsequently, there is a need for technology  
312 designers to further personalise and provide incentives for individual progress, particularly for  
313 females, irrespective of peer-performance.

314 Wider evidence suggests that early structured physical activity experiences for girls, such  
315 as school-based Physical Education, fails to provide adequate levels of PA, or develop self-  
316 regulatory skills and habits that would enable them to continue physical activity through their  
317 transition into adulthood (Hobbs, Daly-Smith, Morley, & McKenna, 2014; Knuth & Hallal,  
318 2009). When research has evidenced the link between intrinsic motivation and self-regulation in  
319 physical activity in general (Teixeira, Carraça, Markland, Silva, & Ryan, 2012), and specifically  
320 female physical activity (Lauderdale, Yli-Piipari, Irwin, & Layne, 2015), it is crucial that mobile  
321 technology is tailored effectively to meet the gender-specific demands of its users. op den Akker,  
322 Jones, and Hermens (2014) provide a series of tailoring concepts for designing physical activity  
323 apps that could readily be used, as one such solution.

324 It is interesting that age predicted stage membership for physical activity, but  
325 nevertheless failed to negate the direct or indirect contribution of gender (albeit noting that  
326 gender did not directly predict stage membership in the context of perceived benefits). It follows  
327 that although younger respondents were more likely to achieve the action/maintenance for  
328 physical activity (Dumith, Gigante, & Domingues, 2007; Garber et al., 2008) female respondents  
329 were nevertheless still less likely than males to have achieved such stage membership, which  
330 may be due to the underlying technology-related mediating factors (e.g., females used fewer  
331 devices). In other words, the role of mobile technology in explaining gender differences in  
332 physical activity isn't necessarily diminished by age; older adults, who presumably are less  
333 active, may still potentially achieve action/maintenance for physical activity if they perceive

334 sufficient reasons for using mobile technology. If so, this may have significant implications for  
335 the use of mobile technology to boost activity levels in (otherwise less active) older adults;  
336 particularly males.

337         It is important to acknowledge the limitations within this study. Firstly, the sample  
338 consisted of a small number of participants in the pre-contemplation, contemplation and  
339 preparation stages of change. Over 70% of respondents had achieved Action/Maintenance,  
340 suggesting, as a sample, an existing motivation to the use of technology to facilitate an active  
341 lifestyle. A problem with survey research design is the possible non-response bias, which may  
342 have occurred within this study, where there are different rates of responses between study  
343 participants and some of those who were invited to complete the survey but did not respond  
344 (Drivsholm et al., 2006; Grotzinger, Stuart, & Ahern, 1994; Holle et al., 2006). More  
345 specifically, those who may have completed the survey may have an interest in physical activity,  
346 which could result in bias. Non-response bias within physical activity research should be  
347 acknowledged as a limitation, reducing the final sample size and generalisability of a population  
348 through potential under-reporting of a specific group (Berry & Spence, 2006; Lahaut, Jansen,  
349 Van de Mheen, & Garretsen, 2002). Furthermore, the study did not control for previous history  
350 of technology use or other variables such as current BMI, health status or body image and it is  
351 plausible to suggest that these factors had an influence on the use of health and sport apps. It is  
352 therefore suggested that future research takes into account these variables, to provide a wider  
353 understanding of the motives behind health and sport technology engagement.

354         Another limitation that should be acknowledged is the terminology for those participants  
355 in the action and maintenance stage. When answering this question participants were guided by  
356 the sentence which specified that they are to select the action stage if they engage in physical  
357 activity for 30 or more minutes a day on 5 or more days per week for less than six months and



358 the maintenance stage if they engage in physical activity for 30 or more minutes a day on 5 or  
359 more days per week and have done so for the last six months or more. This definition was taken  
360 from NHS (2015) guidelines, however it is important to state that there are alternative guidelines  
361 provided by both the NHS (NHS, 2015) and the American physical activity guidelines advisory  
362 committee report (US Department of Health and Human Services, 2008). These guidelines also  
363 offer more detail and different alternatives to the recommended physical activity guidelines  
364 based around individuals participating in 150 minutes of physical activity per week but in  
365 different forms (e.g. different levels of intensity, strength exercises and a mix of moderate and  
366 vigorous aerobic activity). For simplicity, this study chose to use 30 minutes, five times per  
367 week; future research should take these guidelines and the implications of asking these questions  
368 in a certain manner into consideration. Finally, the measure of perceived benefits of technology  
369 use was arguably perfunctory. It focused on generic concepts, notably ‘enhancing performance’,  
370 ‘providing useful feedback’, and ‘motivating me’. These domains may exclude other  
371 perceived advantages of technology use, such as goal setting.

372         The fact that the majority of participants in the present study were physically activity  
373 seems to support the premise that new technologies may facilitate physical activity behaviours in  
374 a variety of settings and environments. However, gender differences are clearly evident in  
375 behaviours associated with technology use and physical activity. Males see more reasons or  
376 motivations for using this type of technology, which may explain why they use more types of  
377 devices and are more physically active. Females use fewer technological devices and see fewer  
378 reasons or incentives in technology use than their male counterparts. This study is the first step in  
379 probing the use of technology to facilitate physical activity behaviour and gender differences  
380 associated with this. Further research, therefore, needs to develop this work by understanding the  
381 mechanisms and the sociocultural factors that cause these gender differences. Understanding this

382 could support technology manufacturers and national initiatives to improve physical activity  
383 levels and, in turn, create a healthier population.

384

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Table 1 – *Mediating effect of cumulative device types on gender differences in stages of change for physical activity, before and after adjusting for selected covariates.*

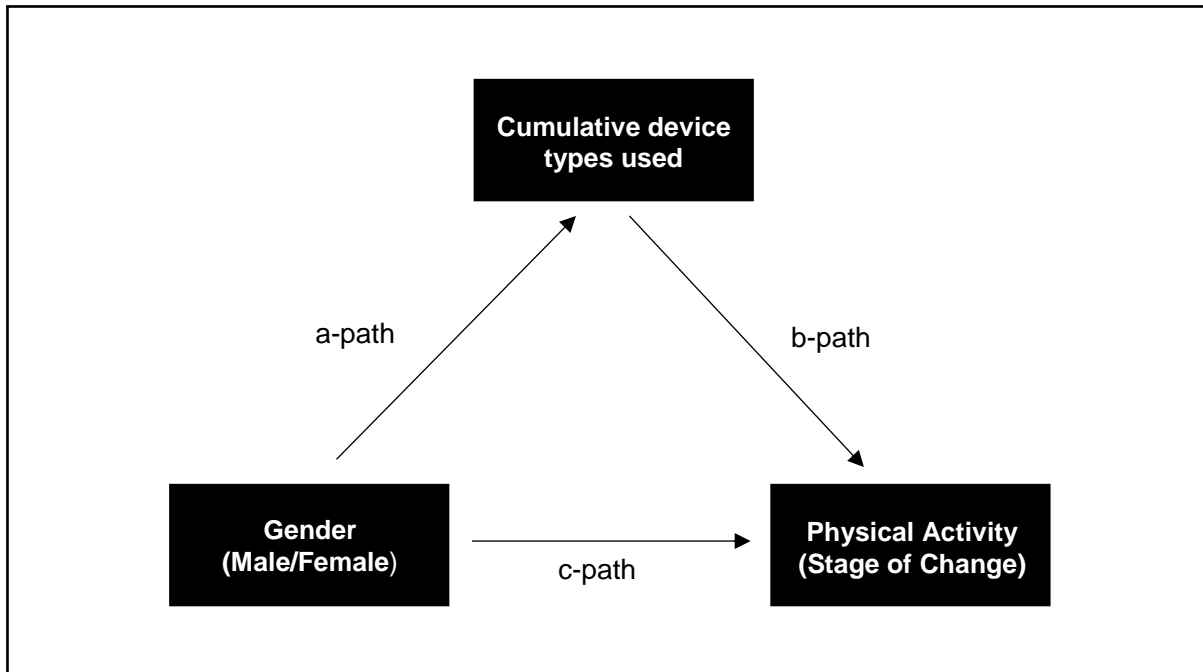
<b>Variables</b>	<b>Path a (Gender → Cumulative device types)</b>	<b>Path b (Cumulative device types → A/M Stages for Physical Activity)</b>	<b>Path c (Gender → A/M Stages for Physical Activity)</b>	<b>Path a*b or Indirect effect (Gender → Cumulative device types → A/M Stages for Physical Activity)</b>
Unadjusted	-0.36 (-0.63, -0.09) <sup>a</sup>	0.43 (0.17, 0.68) <sup>a</sup>	0.06 (-0.59, 0.72)	-0.15 (-0.39, -0.042) <sup>a</sup>
Adjusted for age range	-0.36 (-0.64, -0.09) <sup>a</sup>	0.43 (0.17, 0.70) <sup>a</sup>	-0.03 (-0.70, 0.63)	-0.16 (-0.39, -0.03) <sup>a</sup>
Adjusted for Age range, and Coaching ( <i>Yes/No</i> )	-0.38 (-0.66, -0.09) <sup>a</sup>	-0.05 (-0.57, 0.45)	-1.05 (-2.79, 0.69)	0.02 (-0.43, 0.37)
Adjusted for Age range, and Coaching ( <i>Yes/No</i> ), Organising index score ( <i>Organising Myself + With my friends + Club + Gym</i> )	-0.36 (-0.64, -0.07) <sup>a</sup>	-0.07 (-0.58, 0.44)	-1.07 (-2.84, 0.68)	0.02 (-0.42, 0.56)
Adjusted for Age range, and Coaching ( <i>Yes/No</i> ), Organising index score ( <i>Organising Myself + With my friends + Club + Gym</i> ), Perceived benefits ( <i>Enhance performance + Provides useful feedback + Motivates me</i> )	-0.20 (-0.47, 0.05)	-0.14 (-0.72, 0.44)	-1.05 (-2.83, 0.71)	0.03 (-0.16, 0.53)

<sup>a</sup> $p < 0.05$  or CI range excludes '0'. The table does not include the *direct* effect of variable X (gender) on variable Y (stages of change for physical activity), unadjusted for variance attributable to the mediator variable (cumulative device types).

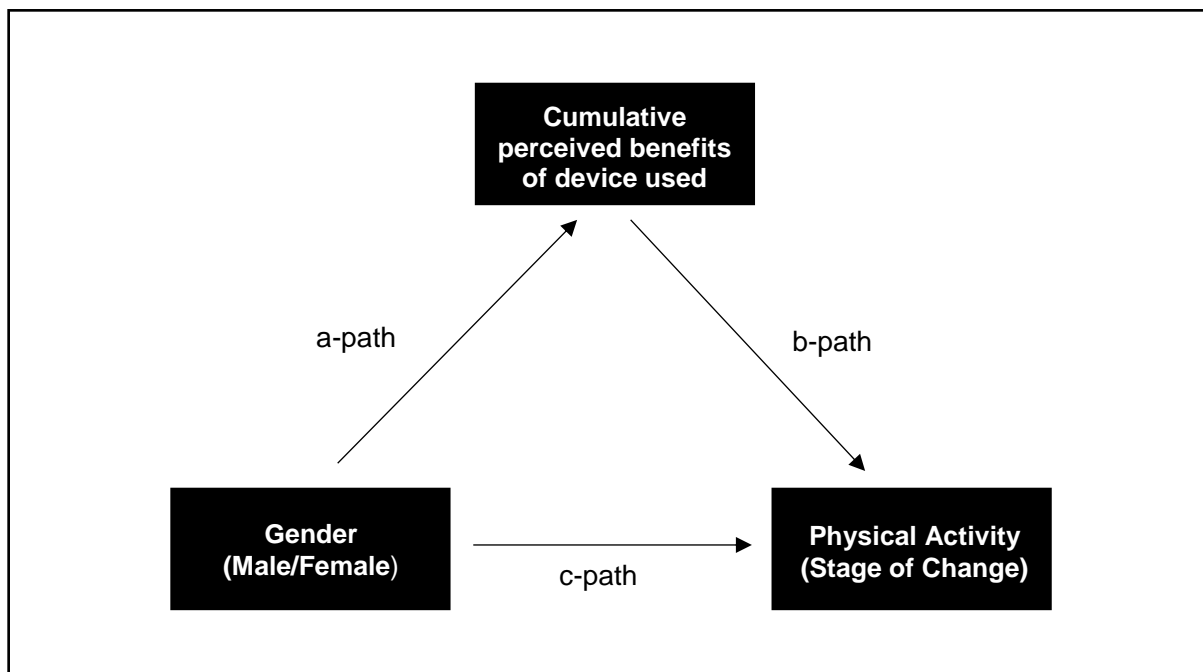
Table 2 – *Mediating effect of cumulative reasons for device use on gender differences in stages of change for physical activity, before and after adjusting for selected covariates.*

<b>Variables</b>	<b>Path a (Gender → Cumulative perceived reasons for device use)</b>	<b>Path b (Cumulative perceived reasons for device use → A/M Stages for Physical Activity)</b>	<b>Path c (Gender → A/M Stages for Physical Activity)</b>	<b>Path a*b or Indirect effect (Gender → perceived reasons for device use → A/M Stages for Physical Activity)</b>
Unadjusted	-0.27 (-0.54, 0.00)	0.57 (0.29, 0.84) <sup>a</sup>	0.07 (-0.59, 0.73)	-0.15 (-0.39, -0.02) <sup>a</sup>
Adjusted for age range	-0.28 (-0.55, -0.00) <sup>a</sup>	0.57 (0.29, 0.85) <sup>a</sup>	-0.02 (-0.69, 0.65)	-0.16 (-0.38, -0.01) <sup>a</sup>
Adjusted for Age range, and Coaching ( <i>Yes/No</i> )	-0.33 (-0.62, -0.04) <sup>a</sup>	0.14 (-0.37, 0.66)	-0.97 (-2.71, 0.76)	-0.04 (-0.99, 0.05)
Adjusted for Age range, and Coaching ( <i>Yes/No</i> ), Organising index score ( <i>Organising Myself + With my friends + Club + Gym</i> )	-0.30 (-0.59, -0.01) <sup>a</sup>	0.13 (-0.39, 0.66)	-0.99 (-2.74, 0.76)	-0.04 (-0.81, 0.06)
Adjusted for Age range, and Coaching ( <i>Yes/No</i> ), Organising index score ( <i>Organising Myself + With my friends + Club + Gym</i> ), Perceived benefits ( <i>Enhance performance + Provides useful feedback + Motivates me</i> )	-0.16 (-0.44, 0.10)	0.11 (-0.44, 0.68)	-0.97 (-2.73, 0.78)	-0.02 (-0.79, 0.04)

<sup>a</sup> $p < 0.05$  or CI range excludes '0'. The table does not include the *direct* effect of variable *X* (gender) on variable *Y* (stages of change for physical activity), unadjusted for variance attributable to the mediator variable (cumulative reasons for using technology).



**Figure 1:** Mediating effect of cumulative device types on relations between gender and stages of change in physical activity (Pre/Post Action & Maintenance)



**Figure 2** Mediating effect of cumulative perceived benefits for device use on relations between gender and stages of change in physical activity (Pre/Post Action & Maintenance)