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**Auditing the socio-environmental determinants of motivation towards physically
activity or sedentariness in work-aged adults: A qualitative study**

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Abstract

28 **Background:** There is a lack of understanding of ~~working-aged adults~~ work aged adults' (30-
29 60 years old) perspectives on the motivation of physical activity versus sedentariness. This
30 study aims to: (1) identify which socio-environmental factors motivate physical activity
31 and/or sedentary behavior, in adults aged 30-60 years; and (2) explore how these motivators
32 interact and combine. **Method:** Fifteen work-aged adults who were able to engage in physical
33 activity (Mean age = 43.9 years; SD 9.6, range 31-59) participated in semi-structured
34 interviews. Inductive content analysis was used to generate an inventory of socio-
35 environmental factors and their specific influences on motivation towards physical activity or
36 sedentariness. **Results:** Key socio-environmental agents found to influence motivation
37 included: Spouse/partner, parents, children, siblings, whole family, grandchildren, friends,
38 work-mates, neighbors, strangers, team-mates and class-mates, instructors, health care
39 professionals, employers, gyms and health companies, governments, media and social media,
40 cultural norms, and the physical environment. Mechanisms fell into five broad themes of
41 socio-environmental motivation for both physical activity and sedentariness: (1) competence
42 and progress; (2) informational influences, (3) emotional influences, (4) pragmatics and
43 logistics, and (5) relationships. Similar socio-environmental factors were frequently reported
44 as able to motivate both activity and sedentariness. Likewise, individual categories of
45 influence could also motivate both behaviors, depending on context. **Conclusion:** The
46 findings of this paper 'unpack' theoretical concepts into specific and targeted behavioral
47 recommendations. The data suggested no simple solutions for promoting physical activity or
48 reducing sedentariness, but rather complex and interacting systems surrounding work-aged
49 adults~~The data suggested no individual 'ideal' solution for promoting physical activity or~~
50 ~~reducing sedentariness, but rather complex and interacting systems surrounding work aged~~
51 ~~adults. Findings also suggest that health professionals should be encouraged to support~~
52 adults' health by examining the socio-environmental motivational influences, or 'motivational
53 atmosphere'~~Instead, findings suggested health professionals should support adults health by~~

54 ~~carefully managing the socio-environmental motivational influences, or “motivational~~
55 ~~atmosphere”.~~

56

57

58 **Key words:** Motivational climate, determinants, ecological, behavioral etiology, interviews,

59 health behavior

86 movements, occupations, living arrangements and lifestyle choices [22, 23]. As a result, the
87 population of ~~working aged adults~~work aged adults receives significantly less research
88 attention. Nonetheless, research is needed to enable the generation of evidence-based
89 guidelines to promote physical activity in this group. Such guidelines would help to both
90 prevent inactivity related morbidity and mortality, as well as increasing quality of life, for a
91 very large portion of a country's economically productive population.

92 One core issue in overcoming this health burden is motivating busy work aged adults
93 (30-60 years of age) to choose physical activity, when their work, homes and family life often
94 readily facilitate sedentariness [24, 25]. Motivation has been defined as: "the hypothetical
95 construct used to describe the internal and/or external forces that produce the initiation,
96 direction, intensity and persistence of behavior" [26]. As such, motivation researchers
97 frequently focus on the regulation of motivated behavior, as opposed to the observable
98 outcomes such as effort, persistence, or task choice [27]. The motivational influence exerted
99 by key social agents is referred to as the motivational climate [28], or motivational
100 atmosphere [29]. Recent research has emphasized the benefits of concurrently examining
101 influences from multiple socio-environmental agents, leading to a richer understanding of
102 how these factors interact and combine to influence motivation [30, 31]. Additionally, these
103 papers have illustrated the importance of resisting using a familiar and simplistic theoretical
104 perspective *a priori* when viewing complex social phenomena [31].[32–34]. By adopting
105 such a theoretically agnostic approach [35] it is then possible to reflect back on compatibility
106 with existing theories *a posteriori*, rather than allowing theory to determine what is
107 examined, how, and how data is interpreted [35, 36]. This approach involves declining to
108 adopt a single guiding explanatory framework *a priori*; instead engaging with the data in the
109 full knowledge of existing theories (i.e. not naïve) but critically and effortfully seeking to
110 avoid allowing one theory to steer data collection or interpretation: an open mind but not an
111 empty head [37]. As such, inductive research is appropriately informed by existing theory but

112 can also inform the development of new understanding [31, 38, 39]. This argument can be
113 expressed as follows: theoretical frameworks can become simple classification systems for
114 interpreting a complex phenomenon, undermining the emergence of new understanding.
115 Rather, we may more fruitfully study the phenomena by capturing meaning that emerges
116 from the data. Finally, since the social environment can simultaneously motivate physical
117 activity and sedentariness, research is needed to assess these simultaneous influences [40,
118 41]. Recent research has recognized that individual participants are regularly exposed to
119 concurrent motivational influences, and that decisions regarding health behaviors are made in
120 these ‘relativistic’ terms, as opposed to ‘absolute’ terms (i.e., choosing one behavior over
121 another, not in isolation [42–44]). Recognition of this approach necessitates seeking a range
122 of participants and experiences, as opposed to groups that might be representative of either
123 high or low physical activity (i.e., maximum variability sampling - [45]).

124 In light of the preceding considerations, the current study was designed to audit the
125 sources and types of socio-environmental influences on motivation towards both physical
126 activity and sedentariness in working age adults. Further, the study set out to organize these
127 influences into a coherent framework. As such, the research questions for this study were:

- 128 1. Which socio-environmental influences and social interactions motivate physical
129 activity and/or sedentary behavior, in work-aged adults (30-60 years old)?
- 130 2. How can these socio-environmental influences be organized and understood, in order
131 to enable future research and practical intervention?

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Method

Participants Sampling Strategy

134 Stratified sampling sought participants to create even/representative samples from
135 activity levels (low, moderate, high), age, and occupation (unemployed, low skilled, high
136 skilled/professional). Emails and intranet invitations were distributed through one UK
137

138 university, one city council, and the exercise referral scheme operated by one primary
139 healthcare trust (letter included in the 'joining instructions' for the scheme). Inclusion criteria
140 were as follows: age between 30-60 years of age; and being physically able to engage in
141 moderate to vigorous physical activity (MVPA). Of the 20 people who responded to the
142 invitation to participate, two were excluded as they were unable to participate in physical
143 activity. A further three were unable to arrange a convenient time for interview. Reflecting
144 the geographical locale in the North-East of England, 14 of the participants were white
145 European and one was Hispanic. As demonstrated in Table 1, the stratified sampling ensured a
146 range of activity levels, ages and occupations, and the screening interview also ensured that
147 participants were 'information rich' [46–48]. The sampling of a relatively wide range of activity
148 levels and backgrounds – relative to the geographical area – was deliberate, and informed by
149 the 'maximum variability sampling' strategy for qualitative research [45]. Achieving a range of
150 ages, backgrounds and physical activity levels was one consideration that informed the decision
151 to end recruitment (along with data 'saturation' – see below).[46–48].

152 **Design**

153 A qualitative exploration of factors that motivate either physical activity or sedentary
154 behaviors was undertaken using in-depth one-to-one interviews with ~~working aged~~
155 ~~adults~~work aged adults. Interviews were deployed to encourage participants to explore issues
156 in-depth, and in their own language [49, 50]. A critical realist philosophical stance was
157 adopted [29, 33, 38, 39], based on the assumption that the underlying intransitive 'reality'
158 being studied is complex, but contains some consistencies that may be perceived by different
159 observers (i.e., the participants). In light of this attempt to examine common or recurring
160 socio-environmental influences, methodologies that would prioritize the individual's unique
161 lived experience (such as phenomenology and ethnography) were not the focus of this study
162 [51–54]. That is not to say, however, that such approaches would be irrelevant or unhelpful
163 for different research questions or philosophical assumptions. Consequently, participants

164 were asked to describe lived experiences of real events, as they recalled them, and to expand
165 on their explanations of how particular behaviors or attributes affected their motivation. In
166 line with the assumption that all participant's lives contained: (i) multiple concurrent
167 experiences; that could motivate (ii) both physical activity and/or sedentariness; all
168 participant were asked to discuss both outcomes [43, 44]. Interviews took place at the
169 university campus, at participants' offices, or over the telephone for those where face-to-face
170 meetings were impractical. A semi-structured interview guide was deployed, based on those
171 used in recent similar studies [29, 38]. After a brief introduction, the main questions assessed
172 the influences of socio-environmental influences on motivated behaviors: defined as effort,
173 persistence, task choice, focus, and enjoyment [55].

174 **Ethics.**

175 The study obtained ethical clearance from the University of Lincoln, College of Social
176 Sciences ethics committee. Prior to beginning the interview, each participant gave full
177 informed consent – in writing - for their data to be collected (audio recorded), stored
178 (electronically), and published in any subsequent reports. There were no competing interests.

179 **Procedure**

180 A single interviewer who had been specifically trained for this study contacted
181 respondents to perform the screening interview and, if suitable, the full interview. Interviews
182 were conducted face-to-face (n=11), and by phone (n=4), at which point the research team
183 were in agreement that saturation was occurring in the data (i.e., key themes were being
184 repeated and very few new concepts were being reported [56]). All interviews were conducted
185 by the same interviewer, trained in qualitative methods (fourth author) and supported by an
186 experienced qualitative researcher (first author). The interviewer was required to ask the same
187 questions to each participant, but not always in the same order, to reduce the influences of
188 question order or fatigue (See Interview Guide; Figure 1). ~~Prior to beginning the interview,~~
189 ~~each participant gave full informed consent for their data to be collected (audio recorded),~~

190 ~~stored (electronically), and published in any subsequent reports. There were no competing~~
191 ~~interests.~~

192 At the beginning of each interview, the interviewer defined motivation, physical
193 activity and sedentary behavior as follows (See Figure 1 - Interview Guide). The definition of
194 motivation provided in the introduction was also explained. The interview questions centered
195 around: (i) current levels of physical activity; (ii) who/what are the socio-environmental
196 influences on motivation towards your physical activity, or sedentariness?; (iii) in relation to
197 each socio-environmental influence, what have they done to facilitate/enhance your
198 motivation towards physical activity, or sedentariness?; and (iv) what would need to change
199 to significantly increase (or decrease) your motivation towards physical activity? The
200 interview proceeded differently every time in response to the topics raised by participants.
201 Participants were allowed to respond freely and if questions intended for later in the interview
202 were discussed, this was permitted. Impromptu probes were generated to explore themes and
203 new questions that arose during interviews. Thus, while the interview was structured, there
204 was flexibility within it to allow greater depth of exploration.

205 The interviewer audio transcribed interviews verbatim as soon as possible after they
206 occurred, and the lead analyst began the analysis process immediately, in order to feed any
207 new insights into subsequent interviews. This immediate transcription and analysis also
208 informed the decision regarding when saturation was reached. Two qualified health
209 researchers (second and third authors) assisted in the recruitment process by connecting the
210 research team to important networks (local council, local exercise referral scheme). They also
211 played a key role as critical friends in the consensus validation and peer debriefing aspects of
212 the analysis [57].

213 **Data Analysis**

214 An eight-step analytic procedure [39] was implemented to prepare and analyze the data:
215 (a) transcribe interviews verbatim (yielding 134 pages of single-spaced text, 58,200 words); (b)

216 read and re-read transcripts for familiarization; (c) tag each quote as either concerning physical
217 activity versus sedentary behavior – for the purpose of this analysis quotes that discouraged
218 physical activity were classified under motivating sedentariness; (d) perform a thorough
219 inductive content analysis, moving recursively between creating tags (“open coding”), creating
220 categories (“focused coding”), and organizing categories into higher themes, using constant
221 comparison and critical reflection to guide analysis [58]. This analysis was approached using
222 QSR NVivo qualitative analysis software [59]; (e) inter-rater checking of the coding was
223 completed using a sample of transcripts. The research team compared the independent codings
224 of three randomly selected manuscripts, concluding that codings were semantically consistent
225 in 88% of the cases, which is deemed acceptable [60]; (f) member checking - which consisted
226 of returning manuscripts and analysis outcomes to original participants for checking (six
227 responses). This process did not suggest any modifications to the study findings or analysis,
228 although participants did express strong agreement with the study findings and expressed
229 interest in seeing future studies; (g) an iterative consensus validation process was conducted
230 with two members of the research team to ensure the integration of codings into particular
231 categories made the most analytic sense (which particularly focused on the labeling of themes
232 and the suitability of quotes/codes for being coded into those themes); and (h) a peer debrief
233 was conducted with an expert researcher throughout the analysis as well as in review of the
234 final analysis. This structured use of multiple sources of data, investigators and theoretical
235 viewpoints is proposed to facilitate a triangulation of the subject matter, which is less
236 susceptible to individual bias [61]. Within the analysis process, all identified codes represented
237 the interpreted meanings of the participants’ responses, focusing on specific behaviors and
238 attributes of socio-environmental influences. Some codes were directly named after the
239 participants’ own words, whilst others were named after concepts existing in the literature that
240 were representative. In the latter case, processes of private reflection, consensus validation and
241 peer review were utilized to ensure that these codes and categories were represented in the data

242 and no 'forcing' occurred during the coding [34]. Using constant comparison processes [45], the
243 recursive coding of properties, interactions and contexts/situations was carried out until no new
244 information about a category seemed to emerge [56]. Space considerations prevent the full
245 presentation of quotes and illustrations, but in an attempt to demonstrate the transparency and
246 authenticity of the research, and numerous quotes ~~are presented to~~ offer the reader a sense of
247 personally experiencing the phenomenon being studied and presented [62].

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Results

250 The analysis identified 308 raw themes coded into 38 categories and 5 higher
251 dimensions. Two-hundred and one raw themes (37 categories) pertained to motivating
252 physical activity, while 107 raw themes (23 categories) pertained to motivating sedentariness.
253 Mirrored categories were also identified that motivated both physical activity and/or
254 sedentariness in similar ways. These mirrored themes are highlighted in the below analysis.
255 Five higher-order themes of socio-environmental motivators emerged: (a) competence and
256 progress; (b) informational influences; (c) emotional influences; (d) pragmatics and logistics;
257 and (e) relatedness and belonging. The following presentation of results is organized to
258 reflect these five higher-order themes. Where quotations are provided, the participant's
259 reference and source of influence are indicated as follows [Gender-Age-Occupation-SOURCE]

260

Competence and progress

261 Within this higher-order theme, there were 12 categories identified, containing 41 raw
262 themes. There were three instances of categories mirroring across both physical activity and
263 sedentariness. Overall, this higher-order theme reflects the way that competence within tasks
264 is evaluated and recognized.

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Mirrored categories. Categories pertaining to social judgments motivated both
physical activity and sedentariness. Fear of negative social judgments could motivate
physical activity (e.g., fearing the nurse's judgment):

268 When it was just me and I was trying to lose weight on my own I was like ‘Yeah
269 whatever’. However, seeing her I’m like ‘You know what I’d better lose something
270 because she’s a right battle-axe!’... She’s just her general demeanor she’s quiet
271 mean.... just going to somebody whose expecting me to lose that weight and not
272 doing it: I don’t like the thought of that. [M-31-Sport-Centre-Manager-PRACTICE-NURSE]

273 Alternatively, this fear could also demotivate physical activity (e.g., fearing the
274 judgment of new team-mates):

275 I think there’s also a fear factor as well. Say if you joined a five a side football team
276 there’s the unknown and the fact that they would all be fit and very physically active
277 and your all unfit and out-of-breath... the fear factor of looking a fool in front of your
278 peers... which I know is a catch 22 because the longer you don’t do it the worse its
279 going to get, but it probably is a de-motivating factor. [M-37-Warehouse-Supervisor-TEAMMATES]

280 Likewise, social comparisons could either motivate physical activity or sedentariness,
281 depending whether once compared well or badly. For example: “We went along [to
282 badminton] thinking it would be ok to have a knock around, and it was just full of these
283 ultra-fit ultra-talented people who were really going for it... It was far too competitive there
284 really” [M-37-Warehouse-Supervisor-TEAMMATES]. Finally, the suitability of the activities could either
285 motivate PA or sedentariness, such that lack of enjoyable activities could lead to
286 sedentariness, or having desirable opportunities available could motivate physical activity.

287 **Non-mirrored categories.** Six categories that motivated physical activity were not
288 mirrored under promoting sedentariness. These included: (i) healthy competition (e.g., versus
289 team-mates/opponents, siblings, the instructor etc.). An example would include: “She used to
290 get me to race her and I mean I never won but it’s good... she needed to get her times
291 down... and I did get better and better at it, and I do really miss it” [M-34-Office-Worker-PERSONAL
292 TRAINER]; (ii) noticing and recording progress (e.g., phone apps, workmates, family etc.); for
293 example: “I think the little thing I have on my phone, that tells me ‘You have burned this

294 amount of calories'. It's like, you know 'Yeah I did this amount yesterday, I can be at least
295 the same today'" [F-47-Novellist-PHONE-APP]; (iii) activities individualized to me (e.g., gym
296 instructor, personal trainer); for example: "I'm actually still on week one because I've not
297 been very well, but the trainer says you can stay on week one as long as you like. I'm
298 planning to move to week two next week" [F-45-Nurse-GYM INSTRUCTOR]; (iv) public accountability
299 (e.g., phone apps, social media); (v) realistic pace of progress (e.g., gym instructor, personal
300 trainer, phone app); and (vi) showing me how to do it properly (e.g., gym instructor, personal
301 trainer; sister).

302 **Informational influences**

303 Within this higher-order theme, there were 15 categories identified, containing 82 raw
304 themes. There were five instances of categories mirroring across both physical activity and
305 sedentariness. Overall, this higher-order theme pertained to the nature, content, consistency
306 and packaging of information that motivates either physical activity or sedentariness.

307 **Mirrored categories.** Categories pertaining to consistency of messages could motivate
308 either physical activity (if consistent) or sedentariness (if contradictory). Likewise, role
309 models could either motivate physical activity or sedentariness (e.g., "He lost three stone in a
310 year, and I was still fat and he was thin, and I got a bit jealous. And it suddenly clicked and I
311 decided I wasn't a lost cause" [F-56-Offier-worker-PARTNER], *versus* "I've got a teenage son who's 14,
312 and his idea of being motivated is sitting on the laptop all day. It doesn't matter what you say
313 to him. Going to shops, getting out of the house... it's like pulling your hair out" [F-35-Carer-
314 SON]). Social norms could be created that would either motivate physical activity (e.g., "I think
315 because of experiences and how I was brought up as a child... if I notice I'm getting out of
316 breath going up stairs or playing in the park... I would make a real conscious effort [to get fit
317 again]" [M-34-Office-Worker-PARENTS], or sedentariness (e.g., "I's just nice and warm, isn't it? ...TV,
318 computer... cooking and those sorts of things... it's just what we do as a family" [F-49-Sales-
319 assistant-FAMILY]). Likewise, shocking images in the media (or government campaigns) could

320 motivate those who wish to avoid ill health, but were also described as desensitizing people,
 321 or causing feelings of hopelessness. For example: “To be honest with you I do take them with
 322 a pinch of salt. . . . The message seems to change week-by-week, so I think there’s a kind of
 323 filtering [out] mechanism in my mind’ [M-37-Warehouse-manager-MEDIA]. Finally, health professionals
 324 could either motivate physical activity by offering specific and personally relevant ‘warnings
 325 and alarms’ regarding health, or reinforce sedentariness by not mentioning health at a
 326 consultation. For example: “Well my father’s got high blood pressure, but the doctor
 327 highlighted it to me. . . . The initial doctor I saw suggested I needed to lose weight. . . I lost
 328 half a stone. . . then I went on and lost another couple of stone” [M-49-Manager-GENERAL
 329 PRACTITIONER], *versus* “No, the doctor never said anything. Last time I went my blood pressure
 330 was fine” [F-43-Teaching-Assistant-GENERAL PRACTITIONER].

331 **Non-mirrored categories.** Four categories that motivated physical activity were not
 332 mirrored under promoting sedentariness. These included: (i) ‘my job gives me an awareness’
 333 (e.g., those who worked in health promotion etc.); (ii) personal assessment opened my eyes
 334 (e.g., exercise referral worker or personal trainers) – for example: “The first week I saw her
 335 she just said write down everything you eat and do, don’t change anything, and I did. And I
 336 was quite shocked really. . . Er, it sort of come from there and then” [F-57-Retired-EXERCISE-
 337 REFERRAL-WORKER]; (iii) raising awareness and making me think (e.g., media campaigns,
 338 posters in health centers) – which can be illustrated by the following quote: “Well there are a
 339 lot of programs on [TV] about obesity. . . I went to the doctor and she told me I was
 340 borderline obese. . . so yes it wasn’t quite ideal” [M-49-Manager-MEDIA + GENERAL PRACTITIONER]; and
 341 (iv) referrals and recommendations (e.g., between healthcare providers, or by friends to
 342 attend a specific activity) – for example: “I was talking to the nurse who was doing the
 343 checking my blood pressure, and before she said anything I said ‘Look ok is there anything [I
 344 can do]. . . any programs?’ and she said yes. So she referred me.” [F-47-Novelist-PRACTICE-NURSE].
 345 One category was listed as motivating sedentariness only, which was labeled ‘too many

346 temptations'. In this category, participants discussed the wide range of easily accessible
347 opportunities to be sedentary, and the attention-grabbing, immediately rewarding nature of
348 these sedentary activities. The following quote illustrates the theme:

349 Just too many temptations. It's too easy just to stay in and game. It's too easy just to go
350 home, put the heating on and get comfy, have a couple of drinks... alcoholic drinks.

351 You get used to it and you get in that kind of mindset. [M-34-Office-Worker-PHYSICAL
352 ENVIRONMENT + NORMS]

353 **Emotional influences**

354 Within this higher-order theme, there were nine categories identified, containing 55 raw
355 themes. There were four instances of categories being mirrored across both physical activity
356 and sedentariness. Overall, this higher-order theme pertains to the ways that the provision of
357 emotional and moral support can motivate either physical activity or sedentariness.

358 **Mirrored categories.** Categories pertaining to doing a specific activity together could
359 motivate either physical activity or sedentariness. For example, "Cycling with my husband,
360 I'm not just cycling, I'm getting to chat to him: 'This is what I've done today...' For me, if it
361 was just running for running's sake then it wouldn't happen" [F-45-Nurse-HUSBAND], versus "I get
362 up in the morning and watch [TV] with a cup of coffee, and he'll spend some time on the
363 computer and I spend a lot of time with him watching TV" [F-57-Retired-HUSBAND]. Likewise,
364 constant prompting and reminding could motivate physical activity or, if viewed as too much,
365 sedentary behaviors (e.g., "My partner bless her, soul, she might say 'Oh let's go and do
366 something' and I'm at the crossroads like 'walk, do something...' you know? I think it
367 pushes me to [do it]" [F-47-Novelist-PARTNER], versus "It would completely demotivate me. By
368 going on and on... The amount of times we've had arguments and I've had to sleep
369 downstairs..." [M-31-Sport-Centre-Manager-WIFE]). Notably this 'prompting' could come from
370 husbands/wives/partners, as well as children and parents, and even teammates missing a key
371 player. Moral support and encouragement could motivate physical activity or its absence

372 could steer towards sedentariness. For example where spouses, children or friends took an
373 interest and showed approval, physical activity could be encouraged. In contrast, where these
374 social agents showed disinterest or disapproval towards physically active pursuits,
375 sedentariness was encouraged. Finally, altruistic behaviors such as looking after friends or
376 family could both motivate physical activity (for example, taking grand-children to the park)
377 or motivate sedentariness (for example, spending time with a depressed or immobile friend).
378 An example of caring for another leading to sedentariness is illustrated in the following
379 quote:

380 I knew him [friend] and he seemed quite jolly but underneath it he's absolutely not...
381 He was becoming a bit like a lost cause... He was spending a great deal of time at my
382 house, but he's extremely lethargic, he is very obese... and he loves watching TV, so
383 you know, we would. It was just too much inactivity. Lots of nights watching loads of
384 TV.[F-59-Retired-FRIEND]

385 Hence, high quality relationships could both motivate physical activity and
386 sedentariness depending on the context.

387 **Non-mirrored categories.** One category - allowing 'me time' - was listed as promoting
388 physical activity but not sedentariness. Where spouses and family were willing to 'release' a
389 parent to be active, or where teammates understood that a colleague wanted to be quiet and
390 alone, this category was used to capture the behavior. This can be illustrated as follows:

391 In terms of pressures of running a home and sorting the children out... sometimes
392 there's not much time in the day to do exercise... If I can go running in the morning
393 that means I can do it at times when there's not a lot else going on, and the kids aren't
394 usually awake. By the time I get back and I'm done I'm ready to take on my
395 responsibilities as a parent, and husband..."[M-49-Manager-WIFE]

396

397 **Pragmatics and logistics**

398 This higher order theme contained 13 categories and 84 raw themes. There were four
399 instances of categories being mirrored to motivate both physical activity and sedentariness.
400 Overall, this higher-order-theme pertained to social interactions and relationships that directly
401 facilitated/enabled, or restricted/prevented, physical activity.

402 **Mirrored categories.** Categories pertaining to the geography and the physical
403 environment motivated both physical activity and sedentariness. Close proximity to facilities
404 that were affordable and well-maintained were described as motivating physical activity,
405 whereas lack of access – either by distance, price or other accessibility issues – and poor
406 maintenance were described as discouraging activity and promoting sedentariness. Examples
407 of these themes include:

408 I now work around 1.7 miles from where I live, so it's just easier. And I mean it's the
409 bonus of not having to pay for parking as well. I just get out my door: no traffic, no
410 ridiculous prices for parking... plus you get the health benefits [M-37-Warehouse-Supervisor-
411 PROXIMITY]

412 I live in a country [rural] area where it's just dangerous to go out [cycling or walking]
413 in the dark. You've got cars, they're not going to see you, you could have a severe
414 accident. [M-34-Office-worker-RURAL LOCATION]

415 We live out in the country, probably ten miles away from the nearest town, so, it's just
416 not the cheapest thing. We would do it for a little while but I know that very quickly we
417 would be, you know, 'Oh we can't be bothered with the driving to and from'. There's
418 no question that because we live out in the country we lose out. If it was just around the
419 corner I think it would be different. [M-49-Manager-RURAL-LOCATION]

420 Logistical/pragmatic support could either facilitate physical activity (e.g., "He looks
421 after the kids while I go to the gym" [F-35-Carer-HUSBAND]), or its removal/absence could
422 undermine it (e.g., "My partner could be more encouraging in terms of running the home and
423 sorting the children out... I can't go off and do gardening, if I wanted to I'd have to negotiate

424 that” [M-49-Manager-WIFE]). Likewise special projects and initiatives could either motivate
425 physical activity (when present) or sedentariness (when absent or ended). For example: “The
426 NHS influenced me... with their campaign ‘Couch-to-5K’... I would have thought that
427 influenced me a lot” [F-35-Carer-GOVERNMENT] versus “SureStart did do a good job, we went on a
428 woodland walk and went out into nature; the children liked it too. But they don’t do it
429 anymore. It’s to do with funding... it’s all to do with funding” [F-35-Carer-GOVERNMENT]. Finally,
430 participants made it extremely clear that ‘workload directly relates to physical activity’, such
431 that increased work volumes or high work stress could easily undermine being active. In
432 contrast, flexible working arrangements or self-employment were viewed as conducive to
433 physical activity. As an example, the most active participant responded to the question ‘what
434 would it take to make you sedentary, to stop you being active?’ as follows: “I suppose if my
435 work hours increased then I couldn’t continue in the same way, or if I changed to a different
436 type of work... I’d probably just be working hard and reading and watching television: more
437 sedentary things” [M-49-Manager-WORKLOAD]. Another described how worked dominated his life:

438 It takes up the majority of my time. I commute for an hour and a half... it’s just *time*...
439 Wake up: seven o’clock in the morning. Leave the house: ten to eight. Get to work
440 around nine. Finish at 6, seven o’clock. By the time I get home it’s eight. Spend half an
441 hour with my daughter. Cook tea or watch TV. Do the pots. Watch TV. Spend a bit of
442 time with my missus. Then it’s off to bed. [M-31-Sport-Centre-Manager-WORK-LIFE BALANCE]

443 **Non-mirrored categories.** One category that motivated physical activity was not
444 mirrored under promoting sedentariness: ‘happy coincidences’ reflected the possibility for
445 unintended pathways into physical activity, such as a daughter wanting a dog then not taking
446 it for walks. Four categories only motivated sedentariness: (i) Family and work always come
447 first – which reflected the idea that any problem with family or work would immediately
448 supplant physical activity (e.g., “I mean God forbid but if something happened and one of my
449 children were ill, or seriously injured... then everything else goes out the window: my one

450 single priority is my family”^[M-36-Warehouse-Supervisor-FAMILY], and “I would rather spend an hour-
451 and-a-half with my daughter than doing exercise... even if it’s just sitting on the sofa
452 cuddling her, I would rather do that because I haven’t seen her all day”^{[M31-Sport-Centre-Manager-}
453 DAUGHTER]) (ii) provision of facilities / opportunities – no gym/pool nearby, no crèche at gym,
454 gym too expensive or memberships too long/inflexible; (iii) social events can undermine
455 physical activity – such as one-off dinners or the visits of friends from out-of-town; and (iv)
456 lack of targeted provisions (e.g., failure to target new mothers or parents of children with
457 special needs).

458 **Relatedness and belonging**

459 This higher order theme contained eight categories and 37 raw themes. There were
460 three instances of categories being mirrored to motivate both physical activity and
461 sedentariness. Overall, this higher-order-theme captured the co-dependency of physical
462 activity and social relationships: either through one-to-one relationships or group
463 membership.

464 **Mirrored categories.** Categories pertaining to ‘group membership’ motivated both
465 physical activity and sedentariness. Being a member of a social group could motivate
466 physical activity (e.g., “You’re motivated to go if there’s a group of you. It’s easier to say no
467 if you’re on your own. It’s the social side as well, isn’t it? Not just in a gym pounding my
468 legs”^[F-49-Sales-Assistant-EXERCISE CLASSMATES], and “I guess it’s just the commitment you make,
469 and it’s not wanting to let other people down”^[M-31-Office-Worker-TEAMMATES]). In contrast, this
470 group membership could also motivate sedentariness (e.g., “There’s a group online saying
471 ‘Oh come on, one more hour’ and that turns into two... then six hours can easily get to quite
472 a few more hours. There’s a lot of people on it”^[M-34-Office-worker-ONLINE GAMING PEERS]).
473 Likewise, ‘opportunities to improve/expand social bonds’ could either motivate physical
474 activity or sedentariness, depending whether those being bonded with were active or
475 sedentary. Examples of these influences include: “It’s the social aspect as well, isn’t it? And I

476 suppose keeping fit. Meeting other people... because I don't know them... and then working
477 as a team... team efforts"^[F-43-Teaching-Assistant-CLASSMATES] versus "But I met a lot of people on it
478 [online gaming], and earlier on this year I actually met three of them. Thats also given me
479 things to do because I can go across... go and see them."^[M-34-Office-Worker-ONLINE-GAMING-PEERS].

480 Finally, the relationship with the instructor could either motivate physical activity or
481 sedentariness, such that a poor relationship could lead to sedentariness, or a good relationship
482 could motivate physical activity. The following quotes illustrate this influence: "It was
483 mainly the way she spoke to the group, at the front, she was just quite comical and she'd have
484 us in... she was good!"^[F-56-Office-Worker-INSTRUCTOR]; *versus* "I didn't look forwards to the abuse
485 that personal trainers can dispense.... I'd probably start fighting... or start swearing..."^{[F-47-}
486 Novelist-PERSONAL TRAINER].

487 **Non-mirrored categories.** Two categories that motivated physical activity were not
488 mirrored under promoting sedentariness. These included: (i) "Do it for your family" –
489 wherein family became a sufficient reason to pursue good health (e.g., "I'm a father and I
490 want to be fit and healthy to provide for them"^[M-36-Warehouse-Supervisor-CHILDREN]); and (ii) mutual
491 pushing (e.g., "Well it's like you support each other really, because I'm sort of keen, but he
492 definitely pushes me, my colleague"^[F-45-Nurse-WORK COLLEAGUE]).

493 **Commentary on socio-environmental influences**

494 On reviewing Table 2 it is clear that the majority of the socio-environmental influences
495 that were identified in the analysis could motivate either activity or sedentariness. Close
496 family (wife, husband, partner, daughter, son, mother, father); friends, workmates, team and
497 classmates, employers, strangers, personal trainers, general practitioners, media, governments
498 and the physical environment could all motivate both forms of behavior. In contrast, social
499 media, websites apps and podcasts, exercise referral workers and nurses, class instructors and
500 siblings were only listed as motivating physical activity in this study. Likewise, online
501 gaming peers and gym/companies were only listed as motivating sedentariness – perhaps

502 because the services offered by gyms have certain assumptions and standards expected, and
503 so only perceived faults/problems were noted by participants in this study. It is possible,
504 indeed likely, that each type of socio-environmental influence can motivate both physical
505 activity and sedentariness at different times, in different ways, as the data from this paper is
506 unlikely to be exhaustive. Overall, the observed pattern suggests that – pending future
507 investigations - there are unlikely to be any exclusive ‘angels’ or ‘devils’ amongst these
508 socio-environmental influences, when it comes to motivating physical activity or sedentary
509 behavior.

510 **Commentary on mirrored themes**

511 On reviewing Table 3, it is clear that many broad categories of behavior can motivate
512 either physical activity or sedentariness (all the themes highlighted in *italic*). Thus we reach
513 the finding that, for example, social relationships can form around pastimes that are either
514 active or sedentary, or that simple approval and moral support in relation to certain tasks
515 makes it easier for a close family member to pursue them (be they active or sedentary).
516 Overall, it appears that the context, intention behind, and perceptions of specific behaviors
517 are important. There are clearly instances of categories that exclusively motivated either
518 physical activity or sedentariness, but focusing on these (e.g., reinforcing the former and
519 extinguishing the latter) may be misguided. The majority of categories in these data were
520 mirrored, suggested that the key is in using these existing mechanisms to motivate physical
521 activity *instead of* sedentariness.

522 **Discussion**

523 This study employed qualitative methods with working age adults to establish: (i) the
524 socio-environmental influences motivating either physical activity or sedentary behavior; and
525 (ii) specific behaviors and attributes that were perceived to influence motivation. Additionally
526 we set out to develop a framework to analyze and interpret those motivationally relevant
527 behaviors, which may inform future research and practice. Findings focused on five broad

528 themes of motivational influence: (a) competence and progress; (b) informational influences;
529 (c) emotional influences; (d) pragmatics and logistics; and (e) relatedness and belonging.
530 Each of these themes related to the motivation of both physical activity and sedentary
531 behaviors, with many categories within the analysis reported to motivate both types of
532 behavior. Likewise, almost all the socio-environmental influences identified in the study were
533 reported to motivate both physical activity and sedentariness in different instances. A
534 comprehensive list of socio-environmental factors was generated, and these sources-of-
535 influence were associated with particular motivationally relevant behaviors.

536 **Comparison to existing theory and research**

537 While attempts were made to minimize the influence of existing theories in
538 determining what to study, how, and how to interpret results (see Introduction), it is still
539 important to reconcile the current findings with existing knowledge. The categories and
540 themes identified in this study are consistent with existing theoretical and empirical
541 knowledge, as well as offering new insights. For example, self-determination theory [63]
542 posits that ‘optimally’ motivating social environments support the psychological needs to
543 experience competence, autonomy and relatedness. The five high-order themes identified in
544 this study can be readily aligned to this theory. Supporting competence is addressed in the
545 theme of ‘competence and progress’. Supporting autonomy is addressed by the themes of
546 informational influences, emotional influences, and pragmatics and logistics – particularly
547 when exploring the categories and raw themes. Likewise, supporting feelings of relatedness
548 can be achieved by examining the themes from ‘relatedness and belonging’. Separately,
549 social support theory describes the degree to which people have assistance available from
550 other others, and that they are part of a supportive social network [64]. Key dimensions of
551 social support are: (1) emotional support (e.g. comfort, validation, ‘there for you’); (2)
552 informational support (e.g. advice and guidance); (3) tangible support (also known as
553 material or instrumental support - e.g. concrete assistance such as purchasing equipment and

554 providing transport); and (4) esteem support (bolstering self-confidence and providing
555 reassurance [65, 66]. The findings of this study can be mapped onto social support theory:
556 with competence and progress reflecting ‘esteem support’; informational influences reflecting
557 ‘informational support’, emotional influences reflecting emotional support, and pragmatics
558 and logistics reflecting ‘tangible support’. Only the theme of ‘relatedness and belonging’ is
559 less immediately reconciled to social support theory. As such, the findings of the current
560 study are credible in relation to existing literature, but also expand current knowledge by
561 identifying specific socio-environmental factors and the specific behaviors that influence
562 motivation towards physical activity. Hence, for example, where perceptions of ‘information
563 social support’ are shown to predict behavior change or intervention adherence, the current
564 findings offer specific behavioral recommendations to create those perceptions. Such
565 informational support may include: personal assessments and individual health advice from
566 doctors and nurses; awareness-raising, education, and (in some instances) shocking
567 stories/images in the media; referrals between health practitioners, and role-modeling of ideal
568 behaviors (friends, family, work colleagues). On this issue of warnings (from health
569 professionals) and shocking images in the media, a review of intervention studies
570 demonstrated equivocal findings [67]. Specifically, significant interactions have been shown
571 between threatening communications and efficacy, such that threats were only effective when
572 the recipient felt able to change their behavior or lifestyle. This finding is consistent with the
573 message of this study that socio-environmental motivators of physical activity (and sedentary
574 behavior) are complex and interactive. Thus if it were decided to use a health professional or
575 the media to introduce a threatening message, the recipient should also be supported and
576 enabled to pursue behavior change.

577 In relation to the trans-theoretical model of behavior change [68], and its application
578 to physical activity and/or sedentary behavior, the findings of this paper also offer practical
579 insights. In this approach to behavior change, participants are classified into a ‘stage-of-

580 change' in relation to reaching and maintaining the desired behavior (i.e., pre-contemplation,
581 contemplation, preparation, action and maintenance). Different processes-of-change are
582 associated with each stage, and the current finding offer insights as to which social agents can
583 perform which specific behaviors for each process. For example: (i) *consciousness-raising*
584 was reflected in the themes of 'informational influences' such as media campaigns,
585 assessment by health practitioners, and role-modeling by family and friends; (ii) *dramatic*
586 *relief* would also be closely aligned to media and primary health practitioners (for the initial
587 'bad news') followed by friends, family and health/fitness providers to provide the relief; (iii)
588 *self-re-evaluation* could be prompted by general practitioners and nurses as well as wearable
589 devices and web-apps, and also friends or family 'leading by example'; (iv) *environmental*
590 *re-evaluation* - realizing one's effects and dependence on others – would require reasonably
591 close connections with family or friends to form the frame of reference, and is well
592 represented under the themes of 'relatedness and belonging' (e.g., support for being active or
593 sedentary) as well as 'informational influences' (norms and expectations around activity or
594 sedentariness); (v) *social liberation* - realizing that society is more supportive of the healthy
595 behavior – appears to be well supported by both team- and class-mates, as well as gym-
596 instructors, exercise leaders and family members (note here that primary health professionals
597 and media appear less well-suited to these categories); (vi) *self-liberation* appears to be
598 closely aligned to themes under 'pragmatics and logistics' in the current data, and may be
599 provided chiefly by family, friends, employers, local government and the organizers of local
600 activities or groups; (vii) *helping relationships* are well addressed under 'relationships and
601 belonging', once again with family, team- and class-mates, and instructors/trainers being key
602 sources of influence. (viii) *Counter-conditioning* (vsubstituting unhealthy ways of acting and
603 thinking for healthy ways) and (ix) *reinforcement management* (increasing the rewards that
604 come from positive behavior and reducing those that come from negative behavior) are two
605 themes that were not well-discussed by participants – perhaps because these may apply more

606 at the personal level (especially of the aims of these stages is to increase intrinsic motivation
607 rather than extrinsic rewards - [69]). (x) *Stimulus control* - using reminders and cues that
608 encourage physical activity – appeared to be managed either by close family and friends
609 (including team- and class-mates), or personal devices and web-apps. Perhaps outside the
610 stage-of-change model, the physical environment – built and natural – as well as government
611 policies, are arguably some of the most pervasive and influential stimulus control influences.
612 The counterpoint to all of the above is that similar sources and forms of motivational
613 influence were described in regard to sedentary behavior. This indicates the possibility of a
614 less readily detected (and thus resisted), pathway into sedentary behavior; where none of the
615 ‘stages-of-change’ – towards the undesirable outcome of sedentariness - are deliberate or
616 conscious (see also [70]). If such influences were to prove less readily recognized and
617 resisted, it would require a different methodology, as interviews only permit the reporting of
618 phenomena that can be noticed and articulated by participants. Nonetheless, in the mean time
619 our findings offer traction to those seeking to implement a specific process of change:
620 offering both potential behaviors as well as appropriate agents to enact those behaviors.
621 Finally, these findings may be helpful in reference to the Theory of Reasoned Action [71,
622 72], specifically in relation to the ‘elicitation’ procedure prescribed for successfully applying
623 the theory. Kok and Ruiter [72; p.62] noted that “It is... surprising how many authors apply
624 [this theory] without the careful elicitation of beliefs through adequate qualitative and
625 quantitative research, a procedure which Fishbein and Ajzen proscribe as an essential
626 prerequisite for application”. The findings of the present study may inform the elicitation of
627 social norms/values as well as their influences/sources – i.e., what to look for, and from
628 whom. Where such beliefs and intentions are modifiable, the present findings may offer
629 added insight into how to approach this. Hence, despite adopting a theoretically agnostic
630 inductive approach [35, 36], the findings of this study are reconcilable with several existing
631 and relevant theories: self-determination theory, social support theory, the trans-theoretical

632 model and the theory of reasoned action. The present study worked on the assumption that
633 using a particular theory as a guide, prescribing what to look for, how to look and how to
634 interpret the findings may generate data that are only reconcilable with, and aligned to, the
635 tenets of one theory. One benefit of this approach is that researchers working to apply or
636 evaluate any one of these theories could draw on the current findings to inform their
637 interventions.

638 **Comparison to other populations**

639 ~~Working aged adults~~Work aged adults are a relatively under-studied population
640 precisely because their social influences are unpredictable. Workplaces, family arrangements,
641 and lifestyle choices can vary substantially between working adults. In contrast, children
642 almost universally attend school and older adults are more frequently engaged in the
643 healthcare system. Hence, for example, Brustad's review [74] on the social influence on
644 children's motivation towards physical activity identified only parents, school and the
645 physical environment (access/opportunity) as core sources of influence. In contrast, ~~working-~~
646 ~~aged adults~~work aged adults experienced a significantly more diverse range of socio-
647 environmental influences. As such studying this population in the first place is a strength of
648 the current study. Despite the more diverse sources of influence, when compared against the
649 broad categories of influence in children (i) promoting competence; (ii) supporting autonomy
650 through social support (pragmatic, emotional and informational); and (iii) the importance of
651 relationships and group membership, are all clearly echoed in recent reviews of motivational
652 climate/atmosphere for children [29, 31, 39].

653 On the basis of these findings, and other recent papers, methodologies based on realist
654 assumptions and acknowledging complexity, may hold promise for the study of motivational
655 climates. Much of our current understanding of motivational climates is based on the *a priori*
656 adoption of theory-derived questionnaires, which assess relatively broad perceptions of the
657 social environment [30]. These studies are valuable in demonstrating that when people

658 perceive their social environment supports particular concepts, such as autonomy, their
659 motivation benefits. The question of precisely how these perceptions are generated, however,
660 cannot be readily answered by assessing such generalized subjective perceptions, and this
661 was a central consideration in adopting critical realist assumptions for this study [33, 62]. By
662 generating a list of the raw ingredients in adults' social-motivational eco-system, this study
663 informs future research that seeks to motivate physical activity and reduce sedentariness.
664 Additionally, while valuable findings this area have come from focusing on the social
665 influences of specific social agents (e.g., parents [75], grandparents [76], physical
666 environment [77, 78]), there may be additional insight available from examining concurrent
667 motivational influences. By studying multiple sources-of-influence concurrently, it becomes
668 possible to identify interactions, co-dependencies and recurring themes. For example, the
669 concurrent role of children and partners in the family, referrals between health professionals,
670 and the importance of consistent messaging between the media, government and health
671 professionals were all emphasized in these data.

672 **Limitations:** It is important to remain cognizant that this study merely sought to
673 generate a list of the key socio-environmental influences on motivation towards physical
674 activity, and then explore how this occurs. The broad scope of the study meant that it was not
675 possible to establish the specific ways that large groups/categories of behaviors combine to
676 influence motivation, and this should be addressed in future studies adopting a tighter focus
677 and perhaps a different methodology. Likewise, the study was limited as the sample
678 contained many more white/British participants than other ethnicities and nationalities,
679 specifically focusing on the North East of England. As such these findings may not be
680 generalizable across all contexts. However, differences between genders, ethnicities and
681 nationalities were not a focus of this study, and future large-scale or quantitative studies may
682 be able to explore any such differences. Other limitations of the study include reliance on the
683 qualitative methodology of participants' recall and ability to articulate their experiences

684 effectively. For example, the results of this type of study reflect what people themselves see
685 as influencing their motivation, which may overlook any influences that participants were
686 unable to perceive or articulate (on reflection, we would speculate that this phenomenon is
687 more applicable to the factors promoting sedentariness than activity, as people were often less
688 fluent and eloquent in response to those questions). Whilst the quality and depth of the
689 responses provided would suggest these were not serious problems, they must be considered
690 in evaluating the findings of the study. Additionally, on reflection, there may still be
691 examples of motivationally relevant social influence that were not explicitly specified by
692 participants in this study. The existence of non-mirrored themes and the sampling of data
693 from one geographical region both suggest that the resulting model still has space for
694 additional clarification (i.e., a substantive model as opposed to a formal theory [79, 80]).
695 Future replications, for example in different contexts or cultures, may identify additional raw
696 themes and lead to a model that may be generalized across contexts and cultures. The higher-
697 order themes may be less likely to require updating than raw themes, and it seems reasonable
698 to expect counter-instances of some non-mirrored themes. Thus when interpreting these
699 findings, absence of evidence should not be interpreted as evidence of absence.

700 **Implications for applied practice.** The finding of this paper may inform the intake
701 and needs analysis processes of health practitioners, on the occasions they assess the physical
702 activity profiles of ~~working aged adults~~ work aged adults. Indeed, one participant reported that
703 the ‘lifestyle audit’ performed by the practice nurse formed the touchstone around which her
704 lifestyle changes could be planned and monitored [F-57-Retired-EXERCISE-REFERRAL-WORKER]. We
705 know from previous questionnaire-based research that, for example, perceiving one’s
706 psychological needs are being supported consistently predicts subsequent motivation and
707 behavior [81]. The current study enables such finding to be translated into practice, detailing
708 both the places to look for such support and interventions that might be recommended. In
709 light of the findings of this study, practitioners may be able to direct patients to specific

710 sources of competence evaluation, information and education, emotional support,
711 pragmatic/material support, or social relatedness. For example, the general practitioner is a
712 good source of information regarding diagnoses, management and prognoses, but may not be
713 a typical source of friendship or logistical influences. Immediate family (spouse, children,
714 parents) and friends (including team-mates or class-mates) appear to be more typical sources
715 of emotional and logistical influences. It may even be possible to create a new role, not
716 currently captured in the social network, of physical activity advocate. These specialists could
717 receive referrals from primary health-care and perform the above audit of social influences,
718 offer guidance, counseling and planning support, and connect patients directly to the most
719 appropriate local opportunities/organizations. One final conclusion from this study emerges
720 as a result of examining the specific behaviors, from specific socio-environmental agents, in
721 determining motivation towards important lifestyle choices. Upon adopting this
722 methodology, it become clear that we are dealing with a complex system, as opposed to a
723 complicated one [31, 82, 83]. As such, our methods – both in research and in practice - may
724 need to adapt to accommodate this complexity. With the emerging availability of wearable
725 technology, constant connection to the Internet, and new analytic tools such as agent-based
726 modeling and neural networks, the required adaptations are increasingly within our reach.
727

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932 Table 1 – Summary of the participants recruited into the study
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Participant number	Age (yrs)	Gender (F/M)	Occupation	Diagnosed Health Issues	Unique-Identifier	Estimated minutes of MVPA per week in last month (>5 METs)	Self-reported PA participation
1	45	F	Registered Nurse (senior)		F-45-Nurse	120	Gym, 3x/week - Treadmill walking, stationary cycling
2	35	F	Unemployed FT carer to disabled son		F-35-Carer	180	Gym, 3x/week – 30 min cardio plus resistance weight training
3	59	F	Unemployed	Myalgic Encephalomyelitis (ME)	F-59-Retired	50	Gym 2x/week – Yoga, Treadmill, cycle, swim
4	57	F	Retired. Volunteers in a hospice		F-57-Retired	90	Swimming once per week (1 hour), looking after grandson once per week
5	43	F	Teaching Assistant and Foster Carer		F-43-Teaching-Assistant	120	Walking to work, participating in 2 PE lessons per week
6	47	F	Novel writer		F-47-Novellist	120	Walking to shops, housework, gardening
7	31	M	Sport Centre Manager.	Sprained Ankle	M-31-Sport-Centre-Manager	0	Badminton, Basketball (120 / 210 pre injury)
8	31	M	Office worker		M-31-Office-worker	240	2 games of rugby per week, 1 hour of training
9	34	M	Technical Officer		M-34-Office-worker	0	Long walks at weekends
10	49	F	Sales Assistant		F-49-Sales-Assistant	0	Walking to and from work, approx. 2 hrs/wk total
11	49	M	Office Manager		M-49-Manager	240	Cycling, 3-6 times per week, 20-25 miles each time
12	57	F	Office Worker		F-56-Office-worker	0	Dog Walking
13	49	M	Office Manager		M-49-Manager	150	Jogging twice per week, 8-10 miles, 75 mins each
14	36	M	Warehouse Supervisor		M-36-Warehouse-supervisor	180	Jogging twice per week, 12 miles 90 mins per run
15	37	M	Warehouse Supervisor		M-37-Warehouse-supervisor	0	Walking 3-4 times per week, approx. 60 mins each

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939 Table 2 – Summary of the motivational influences towards either physical activity or sedentariness from each social agent
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Social Agent	Behaviors and attributes reported to motivate physical activity	Behaviors and attributes reported to motivate sedentary behavior
Husband / wife / partner	Allowing me time to be active, constantly prompting me to be active, role modeling PA behavior, doing activities together, encouraging me, reminds me of friends made through PA, looks after kids while I go.	Disinterested, does not approve, begrudges time spent away being active, is very sedentary him/herself, we are sedentary together (TV), works too much/late. Reminders can be demotivating. Reminders needed/appreciated. Could help by looking after kids while I am active.
Parents / father / mother	Setting a good example, prompting/asking, preferring to be outdoors, taking an interest and supporting, "showing my future".	Prefer to take car which means I have to too.
Brother / Sister	Accompanying me, teaching me new skills, sibling rivalry	
Children / son / daughter	Helping him/her ends up making me active too, taking an interest in my PA, noticing my achievements, accompanying parent to gym, prompting/pushing parent to be active.	Looking after kids leaves me exhausted, being sick / requiring care prevents PA opportunities, I would rather spend time with them, insisting on sedentary activities (video games)
Family	Doing everything together (inc. PA), making PA our norm, letting me fit PA around them, being a reason to stay healthy.	Our routine is to watch TV in an evening, family comes before 'personal' activities, having children takes over your life, having no help to run household reduces PA opportunities, any illness/problem would have to come before PA.
Grand children	Requiring a lot of activity to look after	After caring for them I can't face any PA.
Friend / Friends	Introducing me, recommending activities, being 'sporty', being another reason for me to attend, group membership/belonging, allowing me time alone too.	Being lethargic /sedentary meant I had to be if I wanted to be with them, being unable to walk far means parking closer, no friend to help/support me, we became friends through sedentary activities (gaming, drinking), socializing trumps PA (rarer/more important)
Online gaming peers		I made friends through online gaming, encouraging me to stay online (sed.) a bit longer.
Work-mates or study colleagues	Being active themselves, insisting on taking the stairs, recommending classes/activities, agreeing to do activities together, identifying a person as 'active/sporty', being in poor health as an example to avoid.	Not interested in PA.
Neighbors	Going for regular walks	
Strangers (adults, older, younger)	Showing me what is possible, building relationships during active commuting.	Being rude during PA – at gym or in sport, appearing to have negative attitude towards those who exercise.
Team-mates or opponents (sport)	Group membership / belongingness, asking me to return after I quit, using sport for social time, building friendships through sport, allowing quiet time when I need it. Boasting so I want to beat them.	Attaching social events (drinking) to training/games, quitting can scupper a team/group (e.g., if 4 needed); being too good, or appearing intolerant of beginners, making negative comments.
Gym Colleagues	Going as a pair creates commitment, leaving me alone when I need it.	
Gym Instructor	Helping find right equipment, teaching me the right technique, challenging me to races / goals	
Class Instructor	A great teacher, differentiates tasks, seeks gradual improvement not step changes	
Personal Trainer	Tailoring program to specific needs, personalizing program to disability, structuring program so progress is self-evident, challenging me to races/goals.	Shouting or using negative motivation
Exercise referral worker / health worker	Performing (and following up) lifestyle audit, referring me for extra treatment, helping me find and take opportunities to be active.	
General Practitioner	Diagnosing illness and detailing consequences, highlighting risk factors and detailing consequences, advising me to lose weight or reduce blood pressure, informing me of warning signs to avoid/manage, referring me for specialist help	No advice given implies I must be ok.
Practice Nurse	Referrals to exercise or weight management groups, being a bit stern so I fear negative judgment.	
Exercise class-mates	Creating a social bond and sense of belonging, needing my help to motivate them, pushing me – by sheer presence or deliberate/vocal	
Employer	Jobs that involve promoting PA and health, workplace schemes to be active, reducing workload or allowing flexible hours	High workload prevents PA, long hours prevent PA, workload direct inverse relationship to PA, work is more important than PA, Stress makes me not feel like PA, job involves being sedentary, design of workplace undermines PA, inconsistent work patterns so cannot join class/team; work plus family leaves no time for PA, no schemes or initiatives, long commute leaves no time.
Event organizers and community groups	Publicizing event details, allowing me to get involved by organizing sparked interest	
Gyms / companies		Too expensive, need flexible membership options, high expectations of beginners, over-crowded gym, no entry level activities, need a crèche, need classes targeting new mums.
Government	Incentives and schemes, information campaigns, parking charges	Restricting access to certain locations (reservoirs), poor public transport, removing funding from schemes that were working.
Media	Educating and informing, reinforcing advice from doctors (or good advice), bringing the issue straight into our home, showing extreme images and worst cases, promoting local events and initiatives, prompting me to see GP, providing a constant 'nudge'	Inconsistent / contradictory messages, attention grabbing so I sit and read/watch, "so many opportunities", shock tactics can desensitize me, promoting particular body image demotivates me, targeting certain groups over others. "TV is the main threat"
Cultural norms	"Slim women", "muscular men", "overweight=bad"	Its "just normal" to curl up in and evening and put the heating on, need to look smart for job (cannot get rained on or sweaty), simple gender roles dictate wife stays indoors.
Social media		
Websites, apps and podcasts	Information is helpful, recording calories, announces/publicizes my achievements	
Available activities	Suited to individual preferences (group/individual, competitive/classes)	Everything seems expensive, too far away = unable to travel, changing format of sessions put me off, pace was too high / low.
Physical Environment	Facilities are close by, converting disused land/facilities into PA opportunities.	No facilities in my area, transport costs too high, need to be within walking distance, not safe to cycle on these roads, quality of facilities is poor

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Table 3 – Analysis of categories of behavior and their organization into five higher order themes.

Mirrored themes are highlighted with italic font and a (**) symbol. Social agents are paired with the categories of behavior for illustration. Each category may contain between 2-20 raw themes.

Motivating Physical Activity			Motivating Sedentariness				
Category of behaviors / attributes	→ Social Agents	→ Overall Higher Theme	← Social Agents	← Category of behaviors / attributes			
Healthy competition	Team-mate, opposition, siblings, instructors, son/daughter	Competence and progress	Strangers, Team-mates, class-mates	<i>**Fear of negative social judgments</i>			
<i>**Fear of negative social judgments</i>	Nurse			<i>**Fear of negative social judgments</i>			
Noticing / recording progress	Son/daughter, Website/App, work colleagues			Available activities, gyms/companies, government	<i>**Nothing that suits me, that I want to do</i>		
Activities individualized to me	Website/app/podcast, personal trainer, gym instructor						
Public accountability	Website/app, social media, work colleagues						
Realistic pace of progress	Health worker, class instructor						
Showing me how to do it properly	Gym instructor						
<i>**Social comparisons (I compare well)</i>	Work colleagues, friends					Team-mates / class-mates	<i>**Social comparisons (I compare badly)</i>
<i>**The nature of the activity on offer has to suit me</i>	Available activities						
"Happy coincidences" – facilitating PA by accident or shared interest	Social media, employer, family, work colleagues, event organizers						
<i>**Beneficial geography or local area</i>	Physical environment, government	Pragmatics and logistics	Husband/wife/partner, Daughter/son, child, Grand-children, Family, Employer			Family and work always come above exercise/PA	
<i>**Logistical / pragmatic support</i>	Husband/wife/partner, family, gym instructor					Physical environment, government	<i>**Geographical and local issues</i>
				Wife/husband/partner, Team-mates	<i>**Not supporting, or removing support</i>		
<i>**Special projects and initiatives</i>	Government, physical environment, employer			Gyms/companies, physical environment, available activities	<i>**Poor provision of facilities / opportunities</i>		
				Friends	Social events can undermine PA		
				Government, Employer	<i>**Lack of special projects and initiatives</i>		
<i>**Workload directly relates to PA</i>	Employer, physical environment (commute)			Available activities, gyms/companies, government	<i>**Lack of targeted/specialist provision</i>		
				Employer, Family, Physical Environment (commute)	<i>**Workload directly relates to PA</i>		

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Motivating Physical Activity			Motivating Sedentariness		
Category of behaviors / attributes	→ Social Agents	→ Overall Higher Theme	← Social Agents	← Category of behaviors / attributes	
**Consistency of messages between sources	Media, General Practitioner	Informational influences	Media, physical environment, available activities, family, friends, cultural norms	"Too many temptations" towards sedentariness	
My job gives me awareness of key issues	Employers, work colleagues		Media	**Inconsistency of messages between sources	
Personal assessments opened my eyes	Exercise referral worker		Media	**Demotivating, desensitizing, and making me feel hopeless	
Raising awareness and 'making me think'	Media, government		Employers (and clients), cultural norms, Media	**Norms promoting sedentariness	
Referrals and recommendations	General practitioner, nurse, work colleagues		General practitioner	**Failing to raise the issue with me	
**Role models and leading by example	Husband/wife/spouse, Parents, Brother/Sister, Strangers, neighbors, work colleagues, media				
**Shocking images/stories scare me	Media, government				
**Norms promoting physical activity	Friends, work/study colleagues, society/culture		Husband/wife/partner, Parent/father/mother, Family, Friend	**Their sedentariness limits what I can do	
**Warning signs and alarm bells	GPs, media, family (e.g., older), friends getting sick				
Allowing "me time" – to do it, or during	Husband/wife, friends, Team-mates, gym colleagues		Emotional influences	Friends	**Looking after (or spending time) with sedentary friends
**Altruism – supporting each other	Exercise class-mates, daughter/son/child	Husband/wife/partner		**Lack of support / encouragement	
**Moral support, encouragement, interest	Husband/wife/spouse, son/daughter/child, Parents, Website/App,	Husband/wife/partner, Parent/father/mother		**Constant reminders can demotivate	
**Prompting / reminding - of PA or health	Daughter, Wife/partner, Father/mother, friends, team-mates				
**We do activity together	Husband/wife/spouse, son/daughter/child, Parents, Brother/Sister, Friends, Classmates/Team-mates	Husband/wife/partner, Parent/father/mother, family, Friend, online gaming peers		**We engage in sedentary behavior together	
"Do it for your family" – being a reason to stay healthy	Children, family	Work colleagues, Family, Team-mates, Online gaming peers		**Group membership motivates sedentariness	
"Mutual pushing" – doing it together and pushing each other	Wife/Husband/partner, Son/Daughter, Work colleague, team-mate	Relatedness and belonging	Personal trainer, gym instructor, class instructor	**Poor relationship with instructor	
**Group membership in relation to PA fosters commitment	Team-mates, class mates, friends, strangers, husband/wife/partner				
**PA provides opportunities to improve/expand social bonds	Parent/father/mother, husband/wife/partner, team-mates, class-mates		Online gaming peers, Husband/wife/partner, Family, Friends	**Social network supports sedentariness	
**Good relationship with instructor	Personal trainer, gym instructor, class instructor				

948 Figure 1– Interview guide that was used in this study. Note that questions 3-6 could be asked in a flexible order at the
 949 discretion of the interviewer
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(1) Background and Demographic Questions

(a) Name: (b) Age:
 (c) Occupation: (d) Injuries / illnesses (prevent PA?)
 (e) Type and estimated mins of PA on a typical week:

(2) Define Key Terms: *Motivation - the reason/reasons for acting or behaving a particular way; motivation refers to the reasons behind a behaviour, or absence of behaviour. It often reflects: (a) what you chose to do; (b) enjoyment; (c) persistence against difficulty; and (d) seeking challenge and development*

Physical activity- Physical activity is anything you do where your body is moving – walking, running, riding a bike, dancing, playing sport: any kind of physical movement. This includes any activities that make you breath hard, make you sweat, or make your muscles tired.

Sedentary behaviour is when you are awake but expending almost no energy, and so you are in a sitting or reclining position. Common sedentary behaviors include TV viewing, video game playing, computer use, driving a car, or reading.

NB: Repeat questions (3) and (4) until no new themes are offered

(3) Motivating Physical Activity - Can you tell me about the social influences you have in your life that influence any physical activity/ exercise/sporting activities that you participate in? (people, organisations, media etc.)

(4) Motivating Sedentariness - Can you tell me about the social influences you have in your life that influence your being physically inactive and leading a sedentary lifestyle (watching tv, using computer, playing computer games etc.)

Probes to follow up

- who (or what) did the thing
- what did they do
- how did it makes you feel
- how did it effect motivation and why
- check it is related to choices, enjoyment, persistence and challenge

Summarising and reflecting back: Could you please describe to me what you consider to be your 'dream list' for what would influence (or change your intentions) you to be **(5) more physically active** or

(6) more sedentary (and less active) (ideal social influences, specific traits/qualities, why they are ideal, why they are important, what do they do...)

(7) Closing: (a) Review and summarise what has been covered/said
 (b) Any questions for the interviewer (c) Anything to add?

Thank them for participating

952 **Competing interests**

953 The author(s) declare that they have no competing interests.

954

955 **Authors' contributions**

956 RK was the lead researcher in this project: applying for funding, designing the methodology,
957 analyzing the data and leading in the writing of the manuscript. GM and HH both provided
958 vital links to local health networks, and provided vital assistance in the analysis of the data.

959 Likewise, both GM and HH assisted in the drafting of the final manuscript. MG was the
960 research assistant employed to arrange interviews, collect the interview data, transcribe the
961 sound recordings, and collate the member checking. All authors have read and approved the
962 final manuscript.

963

964 **Availability of Data and Materials**

965 We acknowledge the importance of making data available. The ethical approval
966 requirements, and thus the consent forms for this study, did not require participants to agree
967 to full transcripts being publically available. As such, anonymised data can be obtained from
968 the first author by agreement.

969

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