

Aberystwyth University

A qualitative study of physical activity drivers in autistic individuals using COM-B

Parsons, Katherine; Payne, Simon; Holt, Nigel; Wallace, Joanne

Published in:

Research in Autism Spectrum Disorder

DOI:

[10.1016/j.rasd.2024.102331](https://doi.org/10.1016/j.rasd.2024.102331)

Publication date:

2024

Citation for published version (APA):

Parsons, K., Payne, S., Holt, N., & Wallace, J. (2024). A qualitative study of physical activity drivers in autistic individuals using COM-B: Autistic and non-autistic perspectives. *Research in Autism Spectrum Disorder, 111*, Article 102331. <https://doi.org/10.1016/j.rasd.2024.102331>

Document License

CC BY

General rights

Copyright and moral rights for the publications made accessible in the Aberystwyth Research Portal (the Institutional Repository) are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Aberystwyth Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Aberystwyth Research Portal

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

tel: +44 1970 62 2400
email: is@aber.ac.uk



ELSEVIER

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

journal homepage: www.elsevier.com/locate/rasd

A qualitative study of physical activity drivers in autistic individuals using COM-B. Autistic and non-autistic perspectives

Katherine Parsons^{*}, Simon Payne, Nigel Holt, Joanne Wallace

Aberystwyth University, Aberystwyth, Ceredigion, Wales, UK

ARTICLE INFO

Keywords:

Physical activity
Health behaviour
Behaviour change
Exercise
Implementation science

ABSTRACT

Background: Despite evidence of the health benefits of physical activity in non-autistic populations and the additional benefits for autistic populations, physical activity levels remain stubbornly low in autistic individuals. Understanding the determinants of physical activity is essential in order to support intervention development.

Methods: The current research applied the Theoretical Domains Framework (TDF) and Capability Opportunity Motivation, Behaviour (COM-B) model of behaviour to identify determinants of physical activity behaviour, mechanisms of action, and potentially efficacious behaviour change techniques. Fifteen semi-structured interviews were conducted with autistic adults (N = 4) and children (N = 2), parents of autistic children (N = 4), and stakeholders in autism care and support (N = 5). A deductive approach was taken to map themes onto TDF and COM-B.

Results: Participants identified three overarching themes: *Discordance between autistic and non-autistic perspectives*; *physically active environments*; and *autonomy and choice*. Eight subthemes were identified and mapped onto COM-B and TDF. Recommendations for intervention development are made and potential behaviour change techniques are identified.

Conclusions: Given the important role of care providers, future research should focus on the attitudes and behaviours of individuals who care for and support autistic individuals to identify barriers and drivers of physical activity promotion, particularly for individuals with high support needs. An argument is made for co-design in future intervention development.

1. Introduction

Autism spectrum disorder (hereafter ‘autism’) is a neurodevelopmental condition diagnosed in ~700,000 people in the UK (British Medical Association, 2020) and 1/10 children worldwide (Zeidan et al., 2022). It is defined in the Diagnostics and Statistical Manual of Mental Disorders-5 (DSM-5; American Psychiatric Association, 2013) as differences in social and communication skills, and the manifestation of repeated patterns of behaviours, interests or activities (RRBI).

Autistic people present with diverse comorbid health conditions, some of which can be mitigated through changing health behaviours such as physical activity (Gehricke et al., 2020). For example, autistic adults are between 1.6 and 3.4 times more likely to carry a diagnosis of diabetes compared to non-autistic adults, and hypertension is more common in autistic individuals than non-autistic individuals (Flygare Wallén et al., 2018; Shedlock et al., 2016). 19.4% of autistic youth are overweight and 23.05% are obese, compared to 14.9% and 15.91% respectively in non-autistic youth (Healy & Garcia., 2019). Further, a recent systematic review

^{*} Corresponding author.

E-mail address: kap34@aber.ac.uk (K. Parsons).

<https://doi.org/10.1016/j.rasd.2024.102331>

Received 11 July 2023; Received in revised form 17 December 2023; Accepted 10 January 2024

Available online 18 January 2024

1750-9467/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

and meta-analysis highlighted the prevalence of co-occurring psychiatric disorders, including bipolar, depressive, anxiety, and mood disorders (Hossain et al., 2020). Physical activity not only has the potential to decrease all-cause mortality, type II diabetes, and cardiovascular disease risk by ~35% in all populations, but there is also a growing body of evidence to suggest that physical activity mediates wellbeing and mental health variables (Brown et al., 2013; UK Government chief medical officer, 2019; Ussher et al., 2007). Despite the evidenced benefits of physical activity in all populations and, specifically in autistic populations (e.g., Sorensen et al., 2014), there are high rates of inactivity in autistic populations through the lifespan (Gehricke et al., 2020; Pan & Frey, 2006; Pan, 2014; Srinivasan et al., 2014; Stanish et al., 2017).

Translating behavioural determinants into intervention design has proven more impactful when underpinned by theory (Michie & Prestwich, 2010). Thus, the determinants of behaviour in specific populations must be identified then an appropriate theoretical framework determined in order to facilitate intervention development (Arnell et al., 2018; Michie & Johnston, 2012). To this end, the Behaviour Change Wheel (BCW) is a multi-level model which provides intervention functions and policy categories for application to intervention development following the analysis of behavioural drivers (Michie, Van Stralen, and West, 2011). At the centre of the BCW is the COM-B model (capability, opportunity, motivation- behaviour; Fig. 1), which uses existing theoretical knowledge of human behaviour to identify constructs or ‘mechanisms of action’ (MoAs) that need to change to elicit behavioural change (for example, knowledge or self-efficacy; Connell et al., 2019). Constructs of COM-B are broken down further into physical and psychological capability, physical and social opportunity, and reflective and automatic motivation. The COM-B model has been shown as an appropriate model to explain physical (in)activity in typical populations, but it is currently under-utilised in autistic populations (Howlett et al., 2019). The COM-B model and BCW have been chosen because of their ability to flex between individual and systems level behavioural diagnoses (McDermott et al., 2022), which is important when considering the perspectives of autistic individuals and key stakeholders who might drive behaviour change.

Rehabilitation professionals, care and healthcare providers, physical activity professionals and parents all play a role in the promotion of health behaviours in autistic individuals and are potential targets for changing policy, guidelines, and practice (NICE, 2015). Physiotherapists, for example, play a key role in not only providing therapeutic exercises for autistic individuals (Cynthia et al., 2019), but also in recommending lifestyle modifications. Equally, formal carers and other healthcare professionals have regular contact with autistic individuals and are well positioned to broach subjects relating to health behaviours unrelated to autism itself (Milton et al., 2021; Weiler et al., 2012). These agents are likely to act as drivers of behaviour change, particularly for autistic individuals who are in receipt of a high level of care and support (Tiner et al., 2021). The COM-B model and BCW support intervention design through policy categories such as ‘guidelines’ and ‘communication/marketing’, making it an appropriate model to identify behavioural drivers for both the individual and the systems around them. For practitioners, the COM-B model is a straightforward behaviour change model to apply in practice without the need for behavioural science expertise (Michie, Atkins & West, 2014; Whittal et al., 2021).

Simultaneous use of the Theoretical Domains Framework (TDF; Cane, O’Connor & Michie, 2012) enables users to trace a construct back to its theoretical origin. It features 14 domains which are moderators and mediators of behaviour. These are ‘Behavioural regulation’, ‘Beliefs about capabilities’, ‘Beliefs about consequences’, ‘Emotions’, ‘Environmental context and resources’, ‘Goals’, ‘Intentions’, ‘Memory, attention and decision processes’, ‘Knowledge’, ‘Optimism’, ‘Reinforcement’, ‘Social influences’, ‘Social/-professional role and identity’, and ‘Skills’. The use of the TDF in conjunction with the COM-B model has supported the understanding

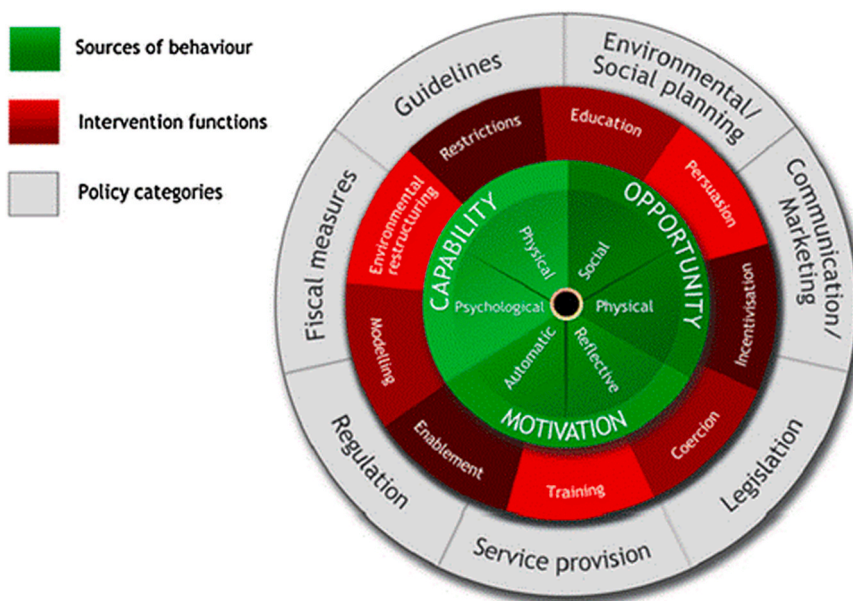


Fig. 1. Behaviour change wheel (Michie, Strallen, & West, 2011). Used under CC BY-NC 4.0 (<https://creativecommons.org/licenses/by-nc/4.0/>) /no modifications.

of probable determinants of behaviours such as oral care, antibiotic prescribing, and workplace sedentarism (Buchanan et al., 2021; Courtenay et al., 2019; Ojo et al., 2019).

A recent systematic review (Parsons et al., under review) of intervention components in autistic populations highlighted, firstly, that evidence for successful or promising physical activity behaviour change is sparse and, secondly, that interventions make scant use of the theoretical understanding of human behaviour that exists to support intervention development. It is probable that interventions showed poor efficacy in autistic populations because they were not tailored to the population's specific needs.

Previous qualitative physical activity research with autistic individuals has focused on parental perspectives of the socio-behavioural factors that contribute to physical activity behaviours (Gregor et al., 2018), impacts of the recent coronavirus pandemic on physical activity behaviours in autistic youth (Esentürk, 2021), and parental perceptions of barriers and facilitators of participation in specific exercise settings (e.g., Gürkan & Kocak, 2020). Healthcare professionals have also provided insight into the barriers and drivers of promoting physical activity in autistic people (McPherson et al., 2022; Tiner, Cunningham, & Pittman, 2021). Where qualitative studies have supported an understanding of the intra-personal, interpersonal, and community-level determinants of physical activity (cf. Jachyra et al., 2021; Obrusnikova and Cavalier, 2011), none have adopted a model which enables the identification of specific techniques that are evidenced to elicit behaviour change via those determinants (Michie et al., 2020). Thus, the aim of the current study is to provide actionable recommendations for policy and practice for agents who have the potential to drive physical activity behaviour change in autistic individuals.

The current study aims to qualitatively identify barriers and enablers of physical activity in autistic individuals through the lens of COM-B and TDF. Interventions are only likely to be fit for purpose if the views of professionals who design and deliver interventions align with those of autistic beneficiaries (Gürkan & Kocak, 2020). Previous research has highlighted that the discordance between autistic and non-autistic perspectives has led to the development of interventions that potentially do more harm than good (cf. Pellicano & den Houting, 2022). Hence, the current study gathers and compares insight from both autistic and non-autistic stakeholders. The research is guided by three research questions:

What are the self-reported barriers and drivers of physical activity for autistic individuals?

Do the views of stakeholders align with views of autistic people in respect to physical activity?

Through employment of implementation science frameworks (COM-B and BCW), what actionable recommendations can be made for interventions design, policy, and practice for those at the frontline of autism health and care?

2. Methods

2.1. Participants

Participants were recruited via social media platforms and autism support networks including registered charity Autistica, who connect autistic participants with relevant research. Local sub-group of the Mencap charity (Mencap Ceredigion) supported with the recruitment of participants with higher support needs. Sampling was both purposive and convenient. The nature of online interviewing determined that all participants used verbal communication. Interviews were conducted online via conferencing platform Microsoft

Table 1
Participant characteristics. (MVPA- moderate to vigorous physical activity).

Pseudonym	Age bracket	Disclosure of autism or relationship to autistic person	Self-report PA level (no. times/week of MVPA)	Location
Ella	35-40 years	Adult parent of an autistic child (aged 11)	Somewhat active (1-3 times/week)	UK
Lizzie	30-35 years	Adult parent of an autistic child (aged 12)	Somewhat active (1-3 times/week)	UK
Gwenda	45-50 years	Adult parent of an autistic child (aged 17)	Mostly inactive (Less than 1 times/week)	UK
Sarah	30-35 years	Adults parent of an autistic child (aged 10)	Somewhat active (1-3 times/week)	UK
Mark	11 years	Autistic young person	Somewhat active (1-3 times/week)	UK
James	10 years	Autistic young person	Somewhat active (1-3 times/week)	UK
Bob	24 years	Autistic young person	Active (3-5 times per week)	UK
Terry	21 years	Autistic young person	Somewhat active (1-3 times/week)	USA
Jemma	18 years	Autistic young person	Mostly inactive (Less than 1 times/week)	USA
Naomi	34 years	Autistic parent of an autistic child (aged 9)	Very active (5 + times per week)	UK
Anthony	30-35 years	Non autistic sports coach for autistic young people and parent to autistic son (aged 14)	Very active (5 + times per week)	UK
Jane	45-50 years	Non-autistic private care provider	Mostly inactive (Less than 1 times/week)	UK
Derrick	25-30 years	Non-autistic support worker	Mostly inactive (Less than 1 times/week)	UK
Greg	30-35 years	Non-autistic boxing coach for autistic young people	Active (3-5 times per week)	UK
Sally	20-25 years	Lead support worker for young autistic people	Mostly inactive (Less than 1 times/week)	UK

Teams. Thematic analysis suggests that sample size is responsive to themes as they are identified, so recruitment ceased when sufficient data was collected to reach saturation (Marshall et al., 2013). Participants were able to take part in the study with their usual support.

2.2. Characteristics of participants

N = 15 participants were interviewed. Four of the 15 were non-autistic parents of autistic children and one autistic parent of an autistic child. Two were autistic young people aged 10–16, and three were autistic young people aged 16–24 years. Four were non-autistic professionals in the care of autistic people, and one was an autistic professional and a parent to an autistic child (Table 1). All participants who were eligible for interview volunteered to be interviewed, with no dropouts, withdrawals, or refusals.

2.3. Procedure

Research procedures were reviewed and approved by Aberystwyth University (AU) Research Ethics Committee, guided by the principles of the accreditation body of the department, the British Psychological Society.

Participants were given participant information sheets and signed a consent or assent form a week before taking part. In the spirit of participatory research, a steering group guided the research. The steering group was made up of two autistic adults, a parent of an autistic child, a parent of two autistic adults, a professional in physical activity delivery who had worked with populations with additional needs, and a carer for young autistic people. The steering group communicated via email, and supported with refining the research question, determining language preference, and proofing materials. The semi-structured interview protocol questions (Table 2) were presented to members of the steering group individually for their comments, to ensure good readability for autistic participants (i.e., use of clear and concise language with no use of metaphors). Questions centred on the lived experiences of autistic people and explored motivation and habit formation in health behaviours and strong interests. Open-ended questions were adapted based on the participants’ engagement with each topic, and a semi-structured approach was chosen to allow focus on motivation and habit formation without being restrictive about sub-topics. Questions were added iteratively as interviews progressed and themes were identified. A further set of open-ended questions was developed for non-autistic stakeholders in autism. Again, the interview guide was appraised by the steering group.

Interviews took between 40 and 60 min to complete and were delivered online because of the COVID-19 pandemic restrictions at the time. Participants under the age of 16 attended interviews with their parent or guardian within easy reach. Parents or guardians were offered the option of being interviewed separately and alone or alongside their child. In all cases, the parent/guardian opted to take part in a joint interview with their child. This was managed by interviewing the child first, then the adult and offering an open discussion at the end for both parties to contribute. No participants over the age of 16-years wished to be interviewed with a parent or carers, so were interviewed alone.

2.4. Interview Structure

Interviews were conducted in an “intensive interview” style, as described by Charmaz (2014). The researcher (KP) followed an

Table 2
COM-B and TDF constructs, sub-constructs and associated questions.

COM-B construct	COM-B sub-construct	TDF domain	Example associated question
Capability	Psychological Physical	Knowledge	<i>Can you tell me what you think the government guidelines for physical activity are for someone your age?</i>
		Memory, attention, and decision processes	<i>What are the health risks associated with being physically inactive?</i>
		Behavioural regulation	<i>Compared to the gov. guidelines, how do your physical activity levels compare?</i>
		Skills	<i>You’ve described some barriers to being active- what have you done in the past to overcome these barriers?</i> <i>What do you think you could do?</i> <i>What do you think might prevent you from being physically active? What might support you to be physically active? What skills do you need to be more active?</i>
Opportunity	Social Physical	Social influences	<i>In what way, if any, do friends and family support you to be physically active? Prevent you?</i>
		Environmental context and resources	<i>How might your friends/family/school/college support physical activity in the future?</i> <i>How does the area you live in support or prevent you from being active? Can you describe some of the facilities or groups that you know of that might support you to be physically active?</i>
Motivation	Reflective Automatic	Beliefs about capabilities	<i>How confident do you feel that you can be physically active? How able do you feel to be physically active?</i>
		Beliefs about consequences	<i>How do you think being physically active might benefit you?</i>
		Social/professional role and identity	<i>How do you think being physically active might support you in other aspects of your life such as work, school, social engagement?</i>
		Optimism	<i>What sort of benefits do you see to increasing physical activity?</i>
		Goals	<i>Have you done anything recently to increase your physical activity levels?</i>
		Emotion	<i>How much, if at all, would you like to increase physical activity levels?</i>
		Reinforcement	<i>How do you think your emotions and feelings impact how active you are day-to-day?</i>

Table 3
COM-B and TDF mapping.

COM-B construct	COM-B sub-construct	TDF domains	Theme and whether barrier (-), facilitator (+) or both (+/-)	Overarching theme	Associated quote
Capability	Psychological	<p>Knowledge Processes (including procedural knowledge, knowledge of task environment)</p> <p>Behavioural regulation (including self-monitoring, breaking habit, action planning)</p> <p>Memory, attention, and decision (including attention control, decision making, cognitive overload/tiredness)</p>	<p>Understanding and disjuncting exercise (+/-)</p> <p>Habits, routines, and uncertainty (+/-)</p> <p>Strong interests as a bridge (+)</p>	<p>Discordance between autistic and non-autistic perspectives</p> <p>Discordance between autistic and non-autistic perspectives</p> <p>Autonomy and choice</p>	<p>“If you said to him, “why are you exercising?” he couldn’t tell you why, or why it’s healthy, whereas my daughter could. So, with our son, it’s disguising it. We were sand sledging, for example, the other day. And he was up and down more than I was. I was worn out. I can say why we’re doing it, but he couldn’t. As long as it’s disguised. And we do- we add little things to try, and as much as he might be taking it in or he might be. But disguise it with my son, massively.” - Anthony.</p> <p>“When I was younger or before I moved here, I would put music on and dance. Not really for the purpose of exercise, more for getting out some of the movement that you need.” - Terry.</p> <p>“I know there are a lot of autistic people, it’s not that we need things necessary to be a certain way, it’s just that we need to know in advance exactly what something is.” - Naomi.</p> <p>“I think it would help if it was done like, slowly, like starting like with like, one day or two days, and then building its way up might be easier than just trying to go from zero to 100. Um, I use a paper planner, so I would probably write it in there...It’s easier for me to kind of introduce it gradually. Because I if I say like, Oh, I’m gonna start going to the gym three times every week, then it produces like a lot of pressure. Which I don’t know if that’s more of an optional thing or morning anxiety thing, because I have both. But yeah. The whole COVID thing where everything was just completely unfamiliar and strange, wasn’t it? So if, for example, obviously, when I’m trying to develop exercise habits, it does tend to have to be almost ritualised or routine.” - Terry.</p> <p>“I would watch a bit of Thomas with him, I’d ask him questions about Thomas every so often. I got into darts and started watching darts so I could have that conversation with him, and I think it really helped with our relationship and helped him build trust.” - Derrick.</p> <p>“I used the cars and the legos to move him on. So, even though we were using the cars, we were doing something different. So, art would be draw the car. Maths would be how many red cars do I have if I took this away. Writing was we’ll write about these cars as well. And that’s what I’d do with him. The repetitiveness was there because it was still the car,</p>

(continued on next page)

Table 3 (continued)

COM-B construct	COM-B sub-construct	TDF domains	Theme and whether barrier (-), facilitator (+) or both (+/-)	Overarching theme	Associated quote
	Physical	Skills (including skills development, competence, ability, interpersonal skills, practice, skills assessment)	Negative past experience (-)	Physically active environments	<p>but it was something different. And that's worked now he's got older." – Anthony.</p> <p>"I'm weak...I'm also short." – Mark.</p> <p>"So, if someone like me did want to join, then I'd be at a level very much lower than them. So that would, like lead to a lot of like feelings of inferiority compared to them. And then like, since they're so competitive, and I'm not very competitive person, that would not make it very easy for me to also join in and also like the socialising part." – Jemma.</p> <p>"Like compared to other kids, maybe of a similar age, they move past their skill level very quickly and then you just get left out because, um, you know, it's difficult, you know, to, to sort of do routines and stuff." – Lizzie</p> <p>"The problem with fitness is it's quite intensive and you get that massive discomfort level where you're hot, you're sweating, you're aching, you're in pain- like, to get someone to that nice calm post-workout tiredness, they have to go through this massive mountain of feelings. If you don't respond well to that- I don't respond well to it, and I have an understanding of why it's happening and how to fix it to an extent, but when you're asking someone with no understanding, 'we're gonna get really hot and really sweaty which we know is going to make you hurt and not like what you're doing'- I don't know how you can motivate someone to go through that." – Derrick</p>
Opportunity	Social	Social influences (including social norms, group conformity, social comparisons, group norms, social support, power, inter-group conflict, alienation, group identity, modelling)	<p>Importance of exercise in others (+/-)</p> <p>Social comparison (+/-)</p>	<p>Physically active environments</p> <p>Physically active environments and Discordance between autistic and non-autistic perspectives</p>	<p>"But then you tend to have half the staff who aren't confident with fitness themselves or are very self-conscious about their own appearance and maybe they don't want to do it and a good way of motivating someone in care is you do it yourself." – Derrick.</p> <p>"We've got another support worker who is very much into walking, running, and what-have-you, and is encouraging and inspiring her key client to go walking on the South Downs, take a packed lunch and, you know, just get out and enjoy nature and see the animals, engage with animals that they come across and what-have-you." – Jane.</p> <p>"I guess for some other people, like, I know, a few like, like, classmates, or just people I've known who like, take pictures of themselves at the gym. And they're like, showing off their body. Which like, I guess for some</p> <p>(continued on next page)</p>

Table 3 (continued)

COM-B construct	COM-B sub-construct	TDF domains	Theme and whether barrier (-), facilitator (+) or both (+/-)	Overarching theme	Associated quote
	Physical	Environmental context and resources (including material resources, organisational culture/climate, salient events/critical incidents, person x environment interaction)	Working in partnership (+/-)	Physically active environments	<p>people, their motivation for you to go into the gym, or some of it at least is like to show off their body. So they wear like very tight clothes, or like, stuff like that. So like the thought of like men seeing my body, which is really like, I don't want to go to the gym." – Jemma.</p> <p>"Um, when I was younger I kind of struggled a little bit with body image because um, I've got a different dad to my siblings and my siblings all look like my mum so very naturally skinny and I always felt like really huge and ungainly and then like with exercise I'm appreciating like my body type because I'm not skinny but I think I look strong and I love having nice muscles and so it's really helped me change how I look at myself instead of being like oh I don't look like how my family's supposed to kind of thing and that's been very empowering." – Naomi.</p> <p>"Yes, definitely. I actually am in a neurodivergent student group at my college, it's been really nice to have those interactions. So, I think if it were geared towards autistic people, it would make me feel a lot more comfortable. And I feel like there just be less pressure. I guess everybody's dealing with similar challenges. They're not they kind of the social, the social difficulties and things like that. And there's an understanding." – Terry.</p> <p>"We work with the parents quite quite, quite heavily. And you know, obviously, the parents are the people who see them 24 h a day, we get them for 45 min, you know, three times a week. So you know, they will tell us if they're having a good week after having a bad week have something else happened if the stressed out in school, if the you know, you've had bad time, there we encourage that communication between the parents and the coaches." – Greg.</p>
Motivation	Reflective	<p>Goals (including goal priority, target setting, action planning, implementation intention)</p> <p>Intentions (including stages of change, stability of intention)</p> <p>Beliefs about consequences (including outcome expectancies, anticipated regret, consequents)</p> <p>Beliefs about capabilities (including perceived competence, self-efficacy, perceived behavioural control, self-esteem, beliefs, empowerment, professional confidence)</p>	Positive past experience (-)	Autonomy and choice	<p>"When I'm running like if I'm running really well like it feels like flying it's amazing it just feels like nothing else really matters in that moment and it's very I'd call it a sensory break." – Naomi.</p> <p>"I get to go outside and like, look at nature, which is really helpful for calming down. I guess it's also it forces me to like, take a break from doing schoolwork, or what I'm working on at the moment." – Jemma.</p> <p>"And the more they do, they better they feel, the more they want to do it. It's just doing it that first time, isn't</p>

(continued on next page)

Table 3 (continued)

COM-B construct	COM-B sub-construct	TDF domains	Theme and whether barrier (-), facilitator (+) or both (+/-)	Overarching theme	Associated quote
	Automatic	<p>Optimism (including pessimism, unrealistic optimism, identity)</p> <p>Social/professional role and identity (including professional identity, professional role, social identity, professional confidence, groups identity, leadership, organisational commitment)</p> <p>Reinforcement (including rewards, incentives, punishment, reinforcement, contingencies, sanctions)</p> <p>Emotions (including fear, anxiety, affect, stress, depression, positive/negative affect, burnout)</p>	<p>Strong interests as a bridge (+)</p> <p>Habits, routines, and uncertainty (+/-)</p>	<p>Autonomy and choice</p> <p>Discordance between autistic and non-autistic perspectives</p>	<p>it?" – Lizzie.</p> <p>"The feeling of water and the way the light hits it and I'm lucky I personally like the chlorine-e smell." – Naomi</p> <p>"Football. If I, I was out with him this morning playing football down the local, so in terms of sport, he's obsessed with football." – Gwenda.</p> <p>"I go to gym quite a lot ... I'm missing rugby a lot, missing people down there that is that yeah...Yes, I have actual book of all the exercises. I have to keep my record anyway because I don't want to like forget about it. Yes, I keep track of it." Bob.</p>

open-ended interview protocol, whereby questions were mapped onto the TDF domains and the COM-B model constructs (Table 2). No incentive was offered for participation.

2.5. Analysis

Thematic analysis, as described by Braun and Clarke (2006), fits with the current researcher's pragmatic theoretical and philosophical position, which recognises that a large body of evidence supports the application of COM-B and TDF while also acknowledging the unique experiences of autistic individuals. Having worked closely with autistic individuals for many years, the primary researcher acknowledges some preconceived ideas relating to autistic experience, thus a second researchers cross-referenced codes and themes.

Thematic analysis is a flexible approach that allows researchers to take both an inductive and deductive approach (Braun and Clarke, 2019). Extensive research has previously been undertaken in the fields of physical activity habit formation and motivation. Therefore, a primarily deductive approach is taken through the mapping onto COM-B and TDF, following a six-step guide, developed by Braun and Clarke (2019). However, researchers identified novel overarching themes and sub-themes which can stand alone without COM-B and TDF. The term 'overarching themes' is used to describe 'central organising concepts' which unifies linked ideas (Braun and Clarke, 2019). Guidance relating to the application of the TDF and COM-B was taken from Atkins et al. (2017); One researcher (KP) analysed all data for codes and themes and a second researcher (SP, whose expertise is in behaviour change science and implementation science) cross-referenced the codebook produced with the interview transcripts to ensure agreement with themes. Coding was carried out using Nvivo 1.7.1 software (2020). Disagreements were settled through verbal debate. Interviewing ceased once data saturation was reached (where no new themes were identified during analysis). Reporting of results was guided by the consolidated criteria for reporting qualitative research (COREQ; Tong, Sainsbury, & Craig, 2007). The 32-item checklist is available in the appendix. When reporting, all participants were assigned a pseudonym to preserve anonymity.

2.6. Reflexivity

First author (KP), a PhD candidate at AU, received training in qualitative methodology before carrying out any interviews. KP identifies as neurodivergent and views autism as one variation of neurodiversity (e.g., ADHD, dyslexia, dyspraxia, OCD). KP acknowledges that, having worked with autistic individuals for many years and as a proponent of the neurodiversity paradigm, her analysis is likely to be informed by these preconceived beliefs. However, this also supported the building of good rapport with participants during interviews.

3. Results

A total of eight sub-themes were identified from the data (Table 3). These themes are described in the order of Capability, Opportunity and Motivation and the TDF domains which they align with in Table 3. Note that the subthemes *Strong interests as a bridge* and *Habits, routines and uncertainty* are repeated in Table 3, spanning both psychological capability and automatic motivation constructs. Three overarching themes were identified. These were *Discordance between autistic and non-autistic perspectives*, *Physically active environments*, and *Autonomy and choice*. The three overarching themes are described below followed by the sub-themes which fit within them:

3.1. Overarching themes

Discordance between autistic and non-autistic perspectives. It was identified through thematic analysis that there was a disconnect between the views of autistic and non-autistic participants. This was particularly evident when autistic participants described an intolerance of uncertainty versus the non-autistic perspective which described a resistance to change. This miscommunication was also evident in the challenges non-autistic stakeholders faced in translating the health benefits of physical activity to autistic people in their care. Understanding the health benefits of physical activity was not a strong driver in autistic participants. Rather, they were more likely to engage and remain engaged through intrinsic motives such as enjoyment and fulfilment. Further, while autistic individuals described ‘stimming’ as a positive movement experience (e.g., release of stress or tension), non-autistic participants often viewed ‘stimming’ as potentially distracting from engagement with activities. Finally, body image issues relating to physical activity (contained in the Social comparison sub-theme) were *only* cited by autistic individuals but never mentioned by non-autistic stakeholders.

Physically active environments was the second over-arching theme and describes the importance of a physically active environment, both social and physical. Participants who experienced physical activity as the ‘norm’ were more likely to engage in physical activity behaviours themselves. Similarly, professionals expressed that their own attitudes to physical activity impacted the attitudes of those in their care. *Positive/ negative past experiences* were a prevalent sub-theme within this overarching theme, and highlighted the importance of positive experiences, positive behavioural modelling, and positive attitudes towards autism in physical activity settings.

Autonomy and choice was the third overarching theme. Autonomy is defined as a psychological driver of behaviour which is intrinsic, rather than controlled by external factors (Deci and Ryan, 1987). For example, through internal rewards such as pleasure or enjoyment rather than external reward such as social approval. Deci and Ryan (1987) explain that “Autonomy connotes an inner endorsement of one’s actions, the sense that emanate from oneself and are one’s own...The more autonomous the behaviour, the more it is endorsed by the whole self and is experienced as action for which one is responsible.” (p.1025). Autistic participants described internalised and intrinsically motivating drivers of physical activity such as experiencing fun, enjoyment, self-determination, and a sense of competence. Often, this sense of autonomy and choice did not come via traditional physical activity routes. In fact, many autistic individuals described their experiences of attending gyms and physical education as damaging to motivation. Many found enjoyment in choosing solo activities that appeared to be both optimally challenging and appealing to specific autistic needs. Swimming, dancing, and running, for example, were described as meeting sensory needs. Exercise was often experienced by autistic people as a sensory experience, while stimming was often in the form of physical movement.

3.2. Sub-themes

The following sub-themes were identified and mapped onto COM-B and TDF. They are also described by their relationship to the overarching themes above.

Understanding and disguising exercise was identified as both a barrier and a facilitator. Firstly, poor understanding of the benefits of physical activity or, more specifically, the risks of inactivity was evidenced by professionals and parents as a barrier. Equally, this was cited as a barrier by autistic people themselves, in that there was a gap between understanding the risks associated with sedentarism and being able to act on that awareness.

Conversely, this sub-theme was identified as a facilitator because many participants, both autistic and non-autistic, cited having engaged with and enjoyed physical activity when it was ‘disguised’. For example, Sally, a lead support worker, described disguising exercise as “dance challenges”. Jemma, an autistic young person, described engaging in physical activity for the sake of movement itself, without acknowledging that she was engaging with exercise as a health behaviour.

This sub-theme fits within the overarching theme *Discordance between autistic and non-autistic perspectives* because it highlighted the challenges that care providers faced in translating the health benefits of physical activity to those they care for. Findings suggested that understanding the health benefits was unlikely to act as a driver for autistic individuals, in any case.

Habits, routines, and uncertainty sub-theme was considered both a barrier and a facilitator. Professionals expressed that routine and structure were important in the lives of the autistic people they supported, particularly in health-related behaviours such as medication adherence and personal care. Similarly, autistic people themselves expressed a preference for routine and structure. This sub-theme fell into the overarching theme *Discordance between autistic and non-autistic perspectives* because non-autistic participants often described autistic people in their care as “disliking change” or being “rigid in their routines”. Conversely, in autistic participants this sub-theme manifest as a need for *certainty* rather than a need for rigid routines; routines could be changed and disrupted with sufficient warning, but new behaviours were challenging to implement if there was any element of uncertainty or unpredictability. Autistic participants expressed that they were not *unwilling* to disrupt routines but that they coped better with change or novel events if they were prepared in advance. In fact, the structure of exercise, once implemented, was considered a driver of behaviour maintenance by autistic participants.

In addition, a once familiar situation could become challenging for autistic participants if elements of uncertainty were introduced or if the environment was not predictable. Naomi described attending a running event and encountering unexpected noise from the supporting crowd. Along with discomfort caused by new running shoes and a flat mobile phone battery, meaning she could not pace herself as usual, she experienced a sensory overload that left her with a negative memory of what would usually be a positive experience for her. However, this experience meant that she was willing to participate in a similar event in future but with better preparation for such eventualities. Within this same sub-theme, many autistic participants expressed frustration when rules and etiquette were not correctly observed by other participants in group or team sports.

Strong interests as a bridge sub-theme was considered a driver of physical activity. This was often driven through trust; an individual

was more likely to accept change if they were supported to do so by someone they trusted, and this trust was often formed between autistic and non-autistic people through sharing strong interests. Both autistic and non-autistic participants described challenges with redirecting attention away from strong interests toward other activities, but this could often be accomplished by *using* those strong interests. Parents, in particular, described creative ways that they had capitalised on strong interests to encourage engagement with education, health behaviours, and other activities of daily living. This sub-theme fell into the overarching theme *Autonomy and choice* because a strong sense of autonomy was associated with engagement with strong interests. Incorporating strong interests into other activities fostered a sense of autonomy in the new activity.

Importance of exercise in others acted primarily as a driver but also as a barrier where exercise was not important to those around the individual. Individuals who supported autistic people acknowledged that physical activity was often only promoted when it was considered a priority behaviour by the person delivering support. This was prominent in those who worked with autistic individuals with higher support needs and less autonomy in their own care. There was contention over what behaviours ought to be prioritised in the care and support of autistic people, with health-related behaviours such as personal care and medication adherence taking priority over preventative behaviours such as physical activity and nutrition. Carers indicated that they were simply 'doing what they were told to do' so, where exercise was not prioritised by care managers, they did not feel empowered to promote it themselves. In addition, some autistic participants felt that they lacked independence to take part in exercise sessions, and this thwarted their sense of autonomy, thus attenuating motivation for exercise. Physical activity behaviours were often only prioritised when there was already an identified need such as existing overweight or obesity. Formal carers also spoke of emotional and behavioural challenges they faced when trying to promote physical activity. Sally and Derrick, for example, both spoke about being aggressively and verbally confronted by the people they supported in response to attempts made to change their routines. This often led to the avoidance of new routines or habits in order to avoid confrontation, particularly in the workplace (i.e., care settings and supported living) where staff might be less equipped to manage such behaviour. This sub-theme fell into the overarching theme of *Physically active environments* because the attitudes of carers towards physical activity directly impacted the potential for physical activity uptake in autistic people in their care.

Social comparison was identified as both a barrier and a driver. Young autistic people cited feeling self-conscious and negative body image as a reason for not attending exercise venues such as gyms, while others were motivated to exercise in order to improve their physical appearance. Jemma described feeling pressure to conform to physical standards that are expected in the gym environment; she did not feel comfortable having to wear potentially revealing gym clothes while not meeting these standards. Naomi, on the other hand, described how identifying as an exerciser had enabled her to embrace her physique which had previously distinguished her from her peers and siblings. Although body image concerns were prevalent amongst autistic participants, they were not identified as a determinant by non-autistic participants.

Similarly, poor self-efficacy to meet the expectations within structured exercise sessions meant that competitive elements acted as barriers. Autistic participants felt that they were unable to 'keep up' with their peers. Autistic participants and their parents spoke about their challenges with motor skills which meant they experienced poor self-efficacy when engaging with physical activity or sport. This was more pronounced when there was perceived social comparison- many had previous experiences of falling behind compared to peer progress. Conversely, feeling capable, strong, and accomplished were all drivers of physical activity. While this did not appear to act as a driver of uptake, it certainly drove maintenance of physical activity behaviours once they had been initiated. Feeling capable seemed to be a driver that afforded protection against barriers such as negative body image and challenges with overcoming uncertainty.

Lack of self-efficacy seemed only to be acknowledged by non-autistic participants who were parents of autistic children and was not cited by other non-autistic stakeholders. For this reason, the sub-theme sits in two overarching themes: *Physically active environments* because the inability to meet perceived physical and social standards acted as a barrier to engagement, while developing an "exerciser identity" and a strong sense of self-efficacy acted as a driver; and *Discordance between autistic and non-autistic perspectives* because elements of this sub-theme (such as body image concerns) were frequently cited by autistic participants but were not considered as a determinant by non-autistic participants, suggesting that it may not be a consideration in intervention development or communication relating to physical activity.

Working in partnership as a sub-theme was both a driver and a barrier. It fit within the overarching theme *Physically active environments* because it showed that a joined-up approach between autistic individuals and the various stakeholders in physical activity promotion can lead to the provision of services that are fit for purpose. To this end, most participants recognised the need to communicate effectively with all parties involved to understand the individual needs of autistic people. Physical activity professionals discussed the need to communicate with parents to understand their child's needs and care providers cited communication with the people they cared for to find ways to promote physical activity that is acceptable to the individual. This communication approach supported the promotion of autism awareness and acceptance within physical activity settings. Parents of autistic children, in particular, expressed that an environment of acceptance encouraged both them and their children to engage with new activities. Lizzie described feeling welcome amongst a group of parents who did not react when her son had a 'meltdown'. Instead, there was a sense of solidarity and shared experience. This was echoed in Greg's narrative who described educating the non-autistic young people in his boxing club about the seemingly unusual stimming behaviour of an autistic child in the group. Other children appeared keen to embrace this difference. Interestingly, most autistic participants said that they would be willing to partake in a group that was made up of other autistic people only but would not like to stand out or be ostracised by doing so. Terry expressed wanting to be around others who could understand her challenges without being identified as different from her peers. Many cited that there were not enough exercise provisions specifically catering to the needs of autistic individuals, or that available services were not sufficiently trained in autism awareness,

Positive past experience was identified as a driver of physical activity. The sub-theme fit within the overarching theme of *Autonomy*

and choice because participants described experiences with physical activity which are autonomy supportive. For example, several autistic people, carers, and parents stated that, following positive past experience with physical activity or sport, it had become a 'special or strong interest.' Naomi and Bob, in particular, described feeling anxious and dissatisfied if they were unable to engage with their chosen physical activity. Even through injury and illness, they persisted with exercise. Autistic participants who considered themselves to be physically active cited intrinsic motives such as freedom of movement, enjoyment of learning specific exercises, and love of a sport. Naomi described a feeling of 'flying' when she runs, Gwenda describes her son's 'obsession' with football, and Bob talks about the amount of time he spends planning his workout routine and perfecting his lifting techniques. Enjoyment of the activity itself appears to promote strong motivation to continue.

This sub-theme appeared to explain physical activity maintenance, rather than uptake. Autistic participants also indicated that physical activity engagement, whether structured or unstructured, afforded them emotional respite and support. James, Terry, Bob and Gemma all spoke about the 'calming' influence of movement. While this appeared to be a driver of physical activity, it did not appear to offer a protective role against some of the stronger barriers such as poor self-efficacy and body image. Non-autistic exercise professionals and parents agreed that physical activity played a therapeutic role in the lives of the people they supported.

Negative past experience was identified as a barrier to physical activity and fit within the overarching theme of *physically active environments*. Social and physical environments which resulted in boredom, under stimulation, physical discomfort, being physically unable to meet demands, and feeling ostracised or shame resulted in a reluctance to make further attempts to be physically active. Non-autistic stakeholders expressed that, for some autistic individuals, it was challenging to understand that discomfort will cease once exercise is ceased, or shortly after. There were challenges with explaining the exchange of short-term discomfort for long-term gains, particularly in autistic individuals who had associated learning disabilities.

4. Discussion

The current study aimed to qualitatively explore the physical activity behaviours of autistic people from their own and stakeholder perspectives using a novel COM-B and TDF mapping approach. Three overarching themes were identified: *Discordance between autistic and non-autistic perspectives*, *Physically active environments*, and *Autonomy and choice*. Within these overarching themes eight sub-themes were mapped onto 14 TDF domains and the 6 constructs of COM-B.

The overarching theme *Discordance between autistic and non-autistic perspectives* identifies a novel concept which has not previously been established in the field of physical activity behaviour change in this population. This research calls attention to the need for co-design and patient and participant involvement in both research and intervention development (Milton, 2020; Slattery et al., 2020). Without involvement of beneficiaries, it is probable that factors which are important to autistic individuals will be omitted or misinterpreted. For example, misinterpreting autistic individuals' needs as stubbornness or rigidity has the potential to lead to the development of ineffective interventions (Kinnaird et al., 2019; Mitchell et al., 2021). It is possible that such assumptions are based on the diagnostic criteria for autism, one of which is an insistence on sameness (APA, 2013.) The current research highlighted that autistic individuals are accepting of change when their need for certainty is met. In practice, this might mean that physical activity programmes are designed with this in mind, or that carers or parents allow for repeated visits to exercise venues before encouraging engagement. Ensuring that care staff and physical activity professionals understand the need for certainty that many autistic people express has the potential to close the gap between the way autistic and non-autistic people conceptualise this phenomenon. This was corroborated in the sub-theme *Working in partnership* - when physical activity professionals and support staff were able to invest time to understand individual needs, they experienced successful engagement.

There was a similar discordance of perspectives relating to strong interests. Strong interests have often been conceived of as maladaptive and obstructive to activities of daily living (Raulston et al., 2019). This has historically caused contention between autistic and research communities (Mercier et al., 2000), with autistic individuals viewing strong interests and repetitive behaviours, both classified under the umbrella of *rigid and repetitive behaviours and interests* (RRBIs), as motivating, beneficial to the individual's wellbeing, and meaningful (Grove et al., 2018; Mercier et al., 2000; Sasson et al., 2012). The current study indicated that, while some stakeholders identified that RRBIs were a potential distraction from alternative activities, they also found that they were a potential vehicle for change. There is a need for consistency in the approach to RRBIs in care settings and the findings of the current research point to their potential positive contribution. Practitioners might benefit from training in methods to incorporate strong interests into interventions to promote engagement. However, practitioners should be mindful that strong interests are used as a bridge to build trust and motivation, not merely a reward for engagement.

In a similar vein, the theme of 'habits, routines, and uncertainty' suggested that the autistic ability to maintain route, both an autistic strength and part of the autism diagnostic criteria (APA, 2013), might be capitalised on through behavioural cueing to support the initiation of new habits (Harrop et al., 2019; Wood, 2021). Ensuring that there is sufficient warning of the change and social support to motivate the behaviour, new habits are likely to be incorporated into existing routines, particularly for individuals who require additional support.

Frequently cited themes were related to the 'social opportunity' domain of COM-B, which fits with research in non-autistic populations, suggesting that social influences are a strong driver of behaviour (Rhodes et al., 2017, 2020; Sabiston & Crocker, 2008). Conversely, where these drivers are often qualitatively described as 'having someone to exercise with' or 'undertaking physical activity that their peers value' (Cohen-Mansfield, 2003; Martins et al., 2015, p. 749), the current research suggests that social influences are enacted differently in specific autistic populations. Many participants cited a preference for exercising alone or alongside others who identify with them. This is a consideration for practitioners recommending exercise, promoting exercise, or developing and delivering exercise programmes. There is a clear need for more appropriate forms of physical activity programming where the needs of autistic

individuals are supported, particularly children and people with higher support needs. Supporting autistic individuals into roles as rehabilitation specialists and exercise professionals might offer a viable solution to this issue. As a minimum, autistic individuals should be actively engaged in the design of interventions to promote exercise uptake (Taylor et al., 2023). It was evident in the current research that there is limited autism-specific expertise in the field of physical activity promotion, a finding which has previously been established by healthcare professionals and rehabilitation specialists (Hunter et al., 2015; Cynthia et al., 2019).

Another important social opportunity theme which emerged related to body image and self-esteem, The current findings align closely with those of non-autistic populations, particularly in adolescents (Sabiston et al., 2019) and females (Cowley et al., 2021; Pawlowski et al., 2018). However, a challenge was identified in that the sub-theme was prevalent amongst autistic participants but was not mentioned by healthcare professionals, parents, or physical activity professionals. It is an important consideration when promoting physical activity. Health promotion interventions have the potential to increase sensitivity to weight and other body image issues, particularly in girls and overweight adolescents (Zabinski et al., 2001). It is imperative that interventions to increase physical activity do not cause unintended harm. The current findings support previous research with healthcare professionals suggesting a lack of capability, opportunity, and motivation to have person-centred conversations about physical activity (Reid et al., 2022).

This is in keeping with *The importance of exercise in others*; particularly in those who care for and support autistic individuals. It

Table 4

Mechanisms of Action identified, and behaviour change techniques that have shown significant efficacy according to Carey et al. (2019). *BCTs were selected only if they showed significance according to evidence synthesis. Further techniques show efficacy according to expert consensus (Connell et al., 2019).

Mechanisms of action (MoA) and definition	Theme identified in the present data	Potential behaviour change techniques and efficacy at targeting the MoA*
Knowledge- 'The awareness of the existence of something.'	Understanding and disguising exercise and the important of exercise in others were both sub-themes which suggest that positive modelling of behaviour is needed. The person providing support needs to understand the benefits of exercise and translate this in a way that is meaningful to the individual receiving support.	4.1 Instruction on how to perform the behaviour (p = 0.01) 4.2 Information about antecedents (p = 0.05) 5.1 Information about health consequences (p < 0.001)
Beliefs about capability- 'Beliefs about one's ability to successfully carry out a behaviour.'	Negative past experience sub-theme highlights that physically activity should be optimally challenging but in a supportive environment. Self-efficacy for physical activity was often damaged by past negative experiences.	1.2 Problem solving (p < 0.001) 4.1 Instruction on how to perform the behaviour (p = 0.01) 6.1 Demonstration of the behaviour (p < 0.001) 8.1 Behavioural practice/ rehearsal (p = 0.01) 8.7 Graded task (p < 0.001) 15.3 Focus on past success (p < 0.001) 15.4 Self-talk (p = 0.05)
Beliefs about consequences- 'Beliefs about the consequences of a behaviour (i.e. perceptions about what will be achieved and/or lost by undertaking a behaviour, as well as the probability that a behaviour will lead to a specific outcome).'	Understanding and disguising exercise sub-theme highlighted that many autistic individuals did not translate knowledge into action.	5.6 Information about emotional consequences (p < 0.001) 9.3 Comparative imagining of future outcomes (p = 0.001)
Reinforcement- 'Processes by which the frequency or probability of a response is increased through a dependent relationship or contingency with a stimulus or circumstance.'	Both negative and positive past experiences of exercise show positive reinforcement through enjoyment of the exercise or negative reinforcement through experiences of boredom.	10.3 Non-specific reward (p < 0.001) 10.4 Social reward (p = 0.02)
Intention- 'A conscious decision to perform a behaviour or a resolve to act in a certain way'	Understanding and disguising exercise suggests that intention to exercise is often low.	5.1 Information about health consequences (p = 0.004)
Social influences- 'Those interpersonal processes that can cause oneself to change one's thoughts, feelings or behaviours.'	Importance of exercise in others, physically active environments and social comparison all show the importance of exercise motivation in those who care for and support autistic people, including body image and social comparison and preference for individual activities	3.2 Social support- practical (p = 0.02) 6.2 Social comparison (p = 0.04)
Motivation- 'Processes relating to the impetus that gives purpose or direction to behaviour and operates at a conscious or unconscious level.'	Negative past experiences of exercise show poor motivation because of poor self-efficacy, lack of social support, and limited autonomy.	9.2 Pros and cons (p = 0.02)
Behavioural cueing- 'Processes by which behaviour is triggered from either the external environment, the performance of another behaviour, or from ideas appearing in consciousness.'	Habits, routines, and uncertainty highlight the lack of support for habit formation in the environment.	7.1 Prompts and cues (p < 0.001) 8.3 Habit formation (p < 0.001) 12.1 Restructuring the physical environment (p = 0.01)
Behavioural regulation- 'Behavioural, cognitive and/or emotional skills for managing or changing behaviour.'	Working in partnership highlighted the need for practitioners to support poor behavioural, emotional, and cognitive skills for behaviour regulation.	8.2 Behaviour substitution (p = 0.01)

appears that, without this third-party motivation and self-efficacy for exercise, it was unlikely for an autistic individual receiving support to independently initiate physical activity, rendering it almost impossible to develop a physical activity habit (Gardner & Lally, 2013; 2020). The important role of external agents is further strengthened by the theme *Working in partnership* which suggests that strong stakeholder engagement and positive communication between schools, exercise professionals, parents and, importantly, autistic individuals themselves improves the successes of physical activity engagement efforts. However, the current research highlights some challenges faced by stakeholders. Attempts at behaviour change are often met with deflection or defensiveness, which makes physical activity promotion challenging. This has been found in clinical populations, whereby the relationship between practitioner and beneficiary is damaged by attempts to encourage health behaviour change (Hunter et al., 2015). Healthcare professionals often felt that physical activity promotion was outside of the scope of their role. Thus, education about the importance of physical activity in the care of autistic people is needed to support a change in this perception. It is equally important that practitioners are sufficiently trained to manage the challenges they might face in promoting exercise. This theme highlights systemic barriers which might be mitigated with a drive towards fitting physical activity promotion into existing care pathways and promoting a culture of preventative care (Sharma et al., 2019).

Finally, the *positive* and *negative past experiences of exercise* sub- themes both highlight the importance of supporting positive experiences of physical activity. In much the same way that previous research has highlighted the need for autism expertise in the field of movement therapy (Cynthia et al., 2019), the current findings highlight a need for expertise in movement and physical activity in autism care and support pathways. Professionals (teachers, carers, healthcare providers) who regularly come into contact with autistic individuals must be educated about the importance of physical activity, and understanding how best to support physical activity behaviour. NICE (2013) suggest that conversations about physical activity between patients and practitioners are part of standard clinical care. For this to prove successful, professionals should be armed with the tools they need to understand both the population and the behaviour (Cynthia et al., 2019).

4.1. Implications

The three themes identified in this research indicate that systems-wide changes are needed to elicit behaviour change (Bagnall et al., 2019). Inclusion of beneficiaries in the co-design is paramount to ensure that physical activity behaviour change interventions address the needs of the individual. The current research identified determinants of physical activity in autistic populations and mapped them onto COM-B and TDF. The Theory and Technique tool (Carey et al., 2019; Connell et al., 2019; Johnston et al., 2021) has been developed by the same researchers who developed COM-B and BCW and is a heat map which identifies Behaviour Change Techniques that are efficacious in targeting specific mechanisms of action. Using the tool, Table 4 links the mechanisms of action to the techniques which have been evidenced to show clear links between the technique, the construct, and ultimately a change in behaviour. It is worth highlighting that such techniques appeal to the determinants of physical activity in the individual themselves. For systems-wide changes, a more effective approach might be to target the psychology of carers, parents, and others who promote physical activity to improve self-efficacy and motivation to promote exercise in those they care for. Equally, professionals who are positioned to broach conversations about physical activity with their patients or clients might make use of BCTs to promote uptake of physical activity.

The current findings support previous research identifying the multi-level barriers and enablers of physical activity in autistic populations (Arnell et al., 2018; Jachyra et al., 2020). It employs novel use of the COM-B model to identify specific techniques that might leverage mechanisms of action to overcome such barriers. By engaging with both autistic individuals and non-autistic stakeholders, it identified a discrepancy between autistic and non-autistic participants in the conceptualisation of autistic behaviours, and highlighted the important role that stakeholders play in the uptake of physical activity for autistic people.

The heterogeneity of the sample is both a strength and a limitation of the study. While it has allowed for insight into the different perspectives of both autistic and non-autistic stakeholders, future research might focus on stakeholders in order to identify their own barriers to implementing physical activity interventions. The current research focused on their perceptions of the barriers for autistic people in their lives. A further limitation of the study is in the need for participants to use verbal communication. This restricted participation from autistic individuals who do not use verbal communication.

The research has the potential to impact policy and practice, particularly given that some of the prominent drivers of exercise in this population were attitudes and motivation of third parties (carers, parents, care planners, etc.). This might change the target audiences in the development of interventions for autistic people with higher support needs. Focusing on the self-efficacy of support staff and family to promote health behaviours is likely to elicit positive outcomes for autistic people and has been shown to be effective in non-autistic populations (cf. Lawrence et al., 2016). Finally, the research highlighted a challenge with gaining direct perspectives of autistic people who are in receipt of additional care and support. Their potentially vulnerable status, presence of learning disabilities, or lack of traditional verbal communication produced ethical barriers that require greater efforts to overcome in the future.

CRediT authorship contribution statement

Wallace Joanne: Supervision, Writing – review & editing. **Payne Simon:** Supervision, Writing – review & editing. **Holt Nigel:** Project administration, Supervision, Writing – review & editing. **Parsons Katherine:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The authors would like to extend special thanks to our participants for sharing their stories and experiences. We would also like to thank Janet Kench and everyone at Mencap Ceredigion and Ceredigion Actif, who supported with recruitment. The work forms part of the first author's PhD which is funded by Aberystwyth University's Margaret Wooloff Scholarship.

References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.
- Arnell, S., Jerlinder, K., & Lundqvist, L. O. (2018). Perceptions of physical activity participation among adolescents with autism spectrum disorders: A conceptual model of conditional participation. *Journal of Autism and Developmental Disorders*, 48(5), 1792–1802.
- Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., & Michie, S. (2017). A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Science*, 12(1), 1–18.
- Bagnall, A. M., Radley, D., Jones, R., Gately, P., Nobles, J., Van Dijk, M., & Sahota, P. (2019). Whole systems approaches to obesity and other complex public health challenges: A systematic review. *BMC Public Health*, 19, 1–14.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589–597.
- British Medical Association (2020) Retrieved from <https://www.bma.org.uk/what-we-do/population-health/child-health/autism-spectrum-disorder> (Accessed 8 June 2021).
- Brown, H. E., Pearson, N., Braithwaite, R. E., Brown, W. J., & Biddle, S. J. (2013). Physical activity interventions and depression in children and adolescents. *Sports Medicine*, 43(3), 195–206.
- Buchanan, H., Newton, J. T., Baker, S. R., & Asimakopoulou, K. (2021). Adopting the COM-B model and TDF framework in oral and dental research: A narrative review. *Community Dentistry and Oral Epidemiology*, 49(5), 385–393.
- Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science*, 7, 1–17.
- Carey, R. N., Connell, L. E., Johnston, M., Rothman, A. J., De Bruin, M., Kelly, M. P., & Michie, S. (2019). Behavior change techniques and their mechanisms of action: A synthesis of links described in published intervention literature. *Annals of Behavioral Medicine*, 53(8), 693–707.
- Charmaz, K. (2014). *Constructing grounded theory* (Second ed.). London, UK: SAGE Publications.
- Cohen-Mansfield, J., Marx, M. S., & Guralnik, J. M. (2003). Motivators and barriers to exercise in an older community-dwelling population. *Journal of Aging and Physical Activity*, 11(2), 242–253.
- Connell, L. E., Carey, R. N., De Bruin, M., Rothman, A. J., Johnston, M., Kelly, M. P., & Michie, S. (2019). Links between behavior change techniques and mechanisms of action: An expert consensus study. *Annals of Behavioral Medicine*, 53(8), 708–720.
- Courtenay, M., Rowbotham, S., Lim, R., Peters, S., Yates, K., & Chater, A. (2019). Examining influences on antibiotic prescribing by nurse and pharmacist prescribers: a qualitative study using the theoretical domains framework and COM-B. *BMJ Open*, 9(6), Article e029177.
- Cowley, E. S., Watson, P. M., Foweather, L., Belton, S., Thompson, A., Thijssen, D., & Wagenmakers, A. J. (2021). "Girls aren't meant to exercise": Perceived influences on physical activity among adolescent girls—The HERizon Project. *Children*, 8(1), 31.
- Cynthia, C., Duck, M., McQuillan, R., Brazill, L., Malik, S., Hartman, L., & Jachyra*, P. (2019). Exploring the role of physiotherapists in the care of children with autism spectrum disorder. *Physical & Occupational Therapy in pediatrics*, 39(6), 614–628.
- Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of personality and Social Psychology*, 53(6), 1024.
- Esentürk, O. K. (2021). Parents' perceptions on physical activity for their children with autism spectrum disorders during the novel Coronavirus outbreak. *International Journal of Developmental Disabilities*, 67(6), 446–457.
- Flygare Wallén, E., Ljunggren, G., Carlsson, A. C., Pettersson, D., & Wändell, P. (2018). High prevalence of diabetes mellitus, hypertension and obesity among persons with a recorded diagnosis of intellectual disability or autism spectrum disorder. *Journal of Intellectual Disability Research*, 62(4), 269–280.
- Gardner, B., & Lally, P. (2013). Does intrinsic motivation strengthen physical activity habit? Modeling relationships between self-determination, past behaviour, and habit strength. *Journal of Behavioral Medicine*, 36(5), 488–497.
- Gehricke, J. G., Chan, J., Farmer, J. G., Fenning, R. M., Steinberg-Epstein, R., Misra, M., Parker, R. A., & Neumeyer, A. M. (2020). Physical activity rates in children and adolescents with autism spectrum disorder compared to the general population. *Research in Autism Spectrum Disorders*, 70, Article 101490.
- Gregor, S., Bruni, N., Grkinic, P., Schwartz, L., McDonald, A., Thille, P., & Jachyra, P. (2018). Parents' perspectives of physical activity participation among Canadian adolescents with Autism Spectrum Disorder. *Research in Autism Spectrum Disorders*, 48, 53–62.
- Grove, R., Hoekstra, R. A., Wierda, M., & Begeer, S. (2018). Special interests and subjective wellbeing in autistic adults. *Autism Research*, 11(5), 766–775.
- Gürkan, R. K., & Kocak, F. (2020). Perceived constraints and facilitators of participation in physical activity by individuals with autism spectrum disorders. *Physical Activity Review* (vol. 8)(1), 2020.
- Harrop, C., Amsbary, J., Towner-Wright, S., Reichow, B., & Boyd, B. A. (2019). That's what I like: The use of circumscribed interests within interventions for individuals with autism spectrum disorder. A systematic review. *Research in Autism Spectrum Disorders*, 57, 63–86.
- Healy, S., & Garcia, J. M. (2019). Psychosocial correlates of physical activity participation and screen-time in typically developing children and children on the autism spectrum. *Journal of Developmental and Physical Disabilities*, 31, 313–328.
- Hossain, M. M., Khan, N., Sultana, A., Ma, P., McKyer, E. L. J., Ahmed, H. U., & Purohit, N. (2020). Prevalence of comorbid psychiatric disorders among people with autism spectrum disorder: An umbrella review of systematic reviews and meta-analyses. *Psychiatry Research*, 287, Article 112922.
- Howlett, N., Schulz, J., Trivedi, D., Troop, N., & Chater, A. (2019). A prospective study exploring the construct and predictive validity of the COM-B model for physical activity. *Journal of Health Psychology*, 24(10), 1378–1391.
- Hunter, C., Chew-Graham, C. A., Langer, S., Drinkwater, J., Stenhoff, A., Guthrie, E. A., & Salmon, P. (2015). 'I wouldn't push that further because I don't want to lose her': A multiperspective qualitative study of behaviour change for long-term conditions in primary care. *Health Expectations*, 18(6), 1995–2010.
- Jachyra, P., Renwick, R., Gladstone, B., Anagnostou, E., & Gibson, B. E. (2020). Physical activity participation among adolescents with autism spectrum disorder. *Autism*. p.1362361320949344.

- Johnston, M., Carey, R. N., Connell Bohlen, L. E., Johnston, D. W., Rothman, A. J., De Bruin, M., & Michie, S. (2021). Development of an online tool for linking behavior change techniques and mechanisms of action based on triangulation of findings from literature synthesis and expert consensus. *Translational Behavioral Medicine*, 11(5), 1049–1065.
- Kinnaird, E., Norton, C., Stewart, C., & Tchanturia, K. (2019). Same behaviours, different reasons: What do patients with co-occurring anorexia and autism want from treatment? *International Review of Psychiatry*, 31(4), 308–317.
- Lawrence, W., Black, C., Tinati, T., Cradock, S., Begum, R., Jarman, M., & Barker, M. (2016). 'Making every contact count': Evaluation of the impact of an intervention to train health and social care practitioners in skills to support health behaviour change. *Journal of Health Psychology*, 21(2), 138–151.
- Martins, J., Marques, A., Sarmiento, H., & Carreiro da Costa, F. (2015). Adolescents' perspectives on the barriers and facilitators of physical activity: A systematic review of qualitative studies. *Health Education Research*, 30(5), 742–755.
- Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research?: A review of qualitative interviews in IS research. *Journal of Computer Information Systems*, 54(1), 11–22.
- Mercier, C., Motttron, L., & Belleville, S. (2000). A psychosocial study on restricted interests in high functioning persons with pervasive developmental disorders. *Autism*, 4(4), 406–425.
- McDermott, G., Brick, N. E., Shannon, S., Fitzpatrick, B., & Taggart, L. (2022). Barriers and facilitators of physical activity in adolescents with intellectual disabilities: An analysis informed by the COM-B model. *Journal of Applied Research in Intellectual Disabilities*, 35(3), 800–825.
- McPherson, A. C., Perez, A., Buchholz, A., Forhan, M., & Ball, G. D. (2022). "It's not a simple answer." A qualitative study to explore how healthcare providers can best support families with a child with autism spectrum disorder and overweight or obesity. *Disability and Rehabilitation*, 44(14), 3540–3546.
- Michie, S., Atkins, L., & West, R. (2014). The behaviour change wheel. In *A guide to designing interventions* (1st ed., 1003 p. 1010). Great Britain: Silverback Publishing.
- Michie, S., & Johnston, M. (2012). Theories and techniques of behaviour change: Developing a cumulative science of behaviour change.
- Michie, S., & Prestwich, A. (2010). Are interventions theory-based? Development of a theory coding scheme. *Health Psychology*, 29(1), 1.
- Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6(1), 42.
- Michie, S., Thomas, J., Mac Aonghusa, P., West, R., Johnston, M., Kelly, M. P., & O'Mara-Eves, A. (2020). The human behaviour-change project: An artificial intelligence system to answer questions about changing behaviour. *Wellcome Open Research*, 5.
- Milton, D. (2020). The double empathy problem.
- Milton, K., Cavill, N., Chalkley, A., Foster, C., Gomersall, S., Hagstromer, M., & Schipperijn, J. (2021). Eight investments that work for physical activity. *Journal of Physical Activity and Health*, 18(6), 625–630.
- Mitchell, P., Sheppard, E., & Cassidy, S. (2021). Autism and the double empathy problem: Implications for development and mental health. *British Journal of Developmental Psychology*, 39(1), 1–18.
- Obrusnikova, I., & Cavalier, A. R. (2011). Perceived barriers and facilitators of participation in after-school physical activity by children with autism spectrum disorders. *Journal of Developmental and Physical Disabilities*, 23(3), 195–211.
- Ojo, S. O., Bailey, D. P., Hewson, D. J., & Chater, A. M. (2019). Perceived barriers and facilitators to breaking up sitting time among desk-based office workers: A qualitative investigation using the TDF and COM-B. *International Journal of Environmental Research and Public Health*, 16(16), 2903.
- Pan, C. Y. (2014). Motor proficiency and physical fitness in adolescent males with and without autism spectrum disorders. *Autism*, 18(2), 156–165.
- Pan, C. Y., & Frey, G. C. (2006). Physical activity patterns in youth with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 36(5), 597.
- Pawlowski, C. S., Schipperijn, J., Tjørnhøj-Thomsen, T., & Troelsen, J. (2018). Giving children a voice: Exploring qualitative perspectives on factors influencing recess physical activity. *European Physical Education Review*, 24(1), 39–55.
- Pellicano, E., & den Houting, J. (2022). Annual Research Review: Shifting from 'normal science' to neurodiversity in autism science. *Journal of Child Psychology and Psychiatry*, 63(4), 381–396.
- Raulston, T. J., Hansen, S. G., Machaliece, W., McIntyre, L. L., & Carnett, A. (2019). Interventions for repetitive behavior in young children with autism: A survey of behavioral practices. *Journal of Autism and Developmental Disorders*, 49, 3047–3059.
- Reid, H., Smith, R., Williamson, W., Baldock, J., Catterson, J., Kluzek, S., & Copeland, R. (2022). Use of the behaviour change wheel to improve everyday person-centred conversations on physical activity across healthcare. *BMC Public Health*, 22(1), 1–26.
- Rhodes, R. E., Guerrero, M. D., Vanderloo, L. M., Barbeau, K., Birken, C. S., Chaput, J. P., & Tremblay, M. S. (2020). Development of a consensus statement on the role of the family in the physical activity, sedentary, and sleep behaviours of children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 17(1), 1–31.
- Rhodes, R. E., Janssen, I., Bredin, S. S., Warburton, D. E., & Bauman, A. (2017). PA: Health impact, prevalence, correlates and interventions. *Psychology & Health*, 32(8), 942–975.
- Sabiston, C. M., & Crocker, P. R. (2008). Exploring self-perceptions and social influences as correlates of adolescent leisure-time physical activity. *Journal of Sport and Exercise Psychology*, 30(1), 3–22.
- Sasson, N.J., Dichter, G.S., & Bodfish, J.W. (2012). Affective responses by adults with autism are reduced to social images but elevated to images related to circumscribed interests.
- Sharma, N., Harris, E., Lloyd, J., Mistry, S. K., & Harris, M. (2019). Community health workers involvement in preventative care in primary healthcare: A systematic scoping review. *BMJ Open*, 9(12), Article e031666.
- Shedlock, K., Susi, A., Gorman, G. H., Hisle-Gorman, E., Erdie-Lalena, C. R., & Nylund, C. M. (2016). Autism spectrum disorders and metabolic complications of obesity. *The Journal of Pediatrics*, 178, 183–187.
- Slattery, P., Saei, A. K., & Bragge, P. (2020). Research co-design in health: A rapid overview of reviews. *Health Research Policy and Systems*, 18(1), 1–13.
- Sorensen, C., & Zarrett, N. (2014). Benefits of physical activity for adolescents with autism spectrum disorders: A comprehensive review. *Review Journal of Autism and Developmental Disorders*, 1, 344–353.
- Stanish, H. I., Curtin, C., Must, A., Phillips, S., Maslin, M., & Bandini, L. G. (2017). Physical activity levels, frequency, and type among adolescents with and without autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 47(3), 785–794.
- Taylor, H., Ingham, B., Mason, D., Finch, T., Wilson, C., Scarlett, C., & Parr, J. R. (2023). Co-design of an NHS primary care health check for autistic adults. *Autism*, 27(4), 1079–1091.
- Tiner, S., Cunningham, G. B., & Pittman, A. (2021). Physical activity is beneficial to anyone, including those with ASD": Antecedents of nurses recommending physical activity for people with autism spectrum disorder. *Autism*, 25(2), 576–587.
- Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, 19(6), 349–357.
- UK Government chief medical officers guidelines for physical activity, UK. <https://www.gov.uk/government/publications/physical-activity-guidelines-uk-chief-medical-officers-report> (Accessed 7 June 2023).
- Ussher, M. H., Owen, C. G., Cook, D. G., & Whincup, P. H. (2007). The relationship between physical activity, sedentary behaviour and psychological wellbeing among adolescents. *Social Psychiatry and Psychiatric Epidemiology*, 42(10), 851–856.
- Weiler, R., Feldschreiber, P., & Stamatakis, E. (2012). Medicolegal neglect? The case for physical activity promotion and exercise medicine. *British Journal of Sports Medicine*, 46(4), 228–232.
- Whittal, A., Atkins, L., & Herber, O. R. (2021). What the guide does not tell you: Reflections on and lessons learned from applying the COM-B behavior model for designing real life interventions. *Translational Behavioral Medicine*, 11(5), 1122–1126.

- Wood, R. (2021). Autism, intense interests and support in school: From wasted efforts to shared understandings. *Educational Review*, 73(1), 34–54.
- Zabinski, Marion F., Calfas, Karen J., Gehrman, Christine A., Wilfley, Denise E., & Sallis, James F. (2001). Effects of a physical activity intervention on body image in university seniors: Project GRAD. *Annals of Behavioral Medicine*, 23, 247–252.
- Zeidan, J., Fombonne, E., Scolah, J., Ibrahim, A., Durkin, M. S., Saxena, S., & Elsabbagh, M. (2022). Global prevalence of autism: A systematic review update. *Autism Research*, 15(5), 778–790.