Understanding Autistic Young Adults' Intention to Engage in Physical Activity and Leverage Wearable Activity Trackers

by

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Abstract

Autistic young adults are underrepresented in research on physical activity (PA). However, many face serious health concerns due to sedentary lifestyles. A possible intervention is wearable activity trackers (WATs), which has demonstrated utility for monitoring and supporting PA outcomes within the general population. However, there is an absence of research to indicate if WATs are helpful interventions for the autistic community. The present study comprised of two components. First, the principal investigator (PI) utilized a participatory research (PR) approach to work directly with three advisory committees (an autistic advisory committee (AAC), a non-autistic advisory committee (NAC), and a professional panel of autistic trainers) to develop and implement a Canadian national survey to examine three key areas of investigation. Ajzen's (1991) Theory of Planned Behaviour (TPB) was applied as a theoretical framework to guide the survey development. Committee members engaged in a series of focused discussions to share their thoughts and experiences related to PA and using WATs. These discussions provided an enhanced understanding of the complexity that autistics experience associated with defining and understanding all of the areas that PA represents. Secondly, the survey was administered to 526 young adults (18-35 years old) across Canada. The study sought to answer three question: (a) whether differences exist in the degree to which autistic and non-autistic young adults intend to engage in various intensities of PA, (b) whether differences exist between autistic and non-autistic young adults specific to interest in using WATs, and (c) to understand what system of support (SOS) elements would be perceived as helpful in learning to use WATs. Study results suggest that autistics have positive intention towards engaging in PA. The findings also indicate that autistics have positive interest towards using WATs and utilizing online technology such as YouTube and social media to support learning with WATs. This research addresses a significant gap with PA assessments that utilize unclear or misconstrued definitions to describe PA (e.g., exercise, fitness). The use of ambiguous concepts can present unanticipated bias, adversely affecting the accuracy of interest/intention towards PA. In addition, previous research has infrequently solicited feedback directly from the autistic young adult but rather from secondary external sources (e.g., caregivers/parents, health professionals). Previous research has indicated that autistic people are interested in wearable technology but not specifically using WATs to track PA. The findings of this study suggest the positive possibilities of using WAT technology in PA interventions with autistic young adults.

Preface

This dissertation is an original work by Michael C.G. Barrett. No part of this thesis has been previously published. The research project, of which this dissertation is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Understanding Behavioural Intention to Engage in Physical Activity and Use Wearable Activity Trackers for Autistic Young Adults." No. Pro00118119, June 14, 2022.

Dedication

This thesis is dedicated to my beloved family, Eva, Jada, Maya, Nigel, and Dash. In my life’s journey, it is their unconditional love and support which have, and always will be, the most influential factors in encouraging me to push forward and focus on trying to make the world a better place for everyone.

To my wife Eva, you have been my steadfast companion, confidante, and guiding light in this journey. This dissertation stands not just as a testament to academic achievement, but as a monument to the love, support, and inspiration you have bestowed upon me. Your unwavering belief in my abilities has been the cornerstone of my success, providing me with the courage to pursue my dreams with perseverance and determination.

Your selflessness knows no bounds, and I am endlessly grateful for the love you pour into every aspect of our lives. Without your support, this story would never have been told. May this dissertation serve as a reminder of the profound impact you have had on my life and the boundless love that continues to flourish between us.

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List of Abbreviations and Terms

AAC	Autistic Advisory Committee
NAC	Non-autistic Advisory Committee
MVPA	Moderate to Vigorous Physical Activity
PA	Physical Activity
SOS	System of Support
TPB	Theory of Planned Behaviour
WAT	Wearable Activity Tracker

Chapter One: Introduction

The prevalence of autism diagnoses in Canada is growing at a significant rate (Public Health Agency of Canada [PHAC], 2023). More people are being diagnosed with autism and there are more support programs (Zervogianni et al., 2020) and research focused on supporting this population (Micai et al., 2023). Primary concerns for autistic individuals focus on social engagement, employment, housing, education, and transition to independence (Dudley et al., 2015; Nicholas et al., 2023). However, a lower priority concern is physical activity (PA). Although often overlooked, it is a significant concern because autistic individuals are at a much higher likelihood of being overweight or obese which can lead to numerous significant physical health concerns (Hamm & Yun 2018; Savage et al., 2018).

In the research available, there is interest in supporting autistic children to engage in PA, but there is a lack of research on autistic young adults, those aged 18-35. The transition to adulthood is an important age as it often leaves young people without support, leaving them responsible for prioritizing, learning, and executing skills that they may not have experience doing, such as PA. However, before we can design solutions to address these problems, we need a baseline understanding of the problem. In this case, the first question to understand is whether autistic young adults want to engage in PA to begin with.

A factor that adds complexity to this topic is the lack of a clear definition of PA (Piggin, 2020). Generally, people have heard the term PA, but what does it mean? Due to a focus on moderate to vigorous PA (MVPA) in many guidelines including from Health Canada, individuals often associate PA with moderate to vigorous PA and do not think of everyday PA that they are engaged in (e.g., walking the dog, vacuuming, gardening). Thus, there is a lack of baseline research that confirms our understanding of many factors: autistic young adults' intention to engage in PA and the specific intensity levels of PA.

A familiar PA intervention millions of people use worldwide is wearable activity trackers (WATs). This technology supports independent monitoring of PA and can potentially be a helpful intervention to support autistic young adults in monitoring their engagement in PA. We know that technology alone does not solve any problems. For technology to be a successful tool, individuals must desire and learn to use it. What is unclear from existing research is whether autistic young adults intend to use a WAT to support PA monitoring.

Technology is often touted as "user friendly" and "out of the box," meaning that a user can just take it out of the box and use it without any other assistance. However, many technology tools, such as WATs, are not truly "out of the box" for many users. They often require apps and connected devices or provide a wealth of information to interpret. In research, autistics have benefited from the provision of supports when learning how to use assistive technologies in many fields including communication, education, employment, social engagement, and management of health concerns (Benssassi et al., 2018; Boyd et al., 2017; Fletcher-Watson et al., 2016; Goel & Kumar, 2015). Thus, if autistic young adults are interested in using WATs to support PA monitoring, we will need to understand what systems of support (SOS) they will prefer to facilitate learning.

This study seeks to understand autistic young adults' interest in engaging in PA, their interest in using WAT to support PA engagement and their preferences in support mechanisms to learn how to use WATs. The following questions will guide the research:

1. To what extent do autistic young adults intend to lead healthy lifestyles that incorporate PA and do these intentions differ from young adults who do not identify as autistic?

a) What are their perceived attitudes and previous experiences (PBC) with PA, and does it vary based on the type of PA (e.g., walking, bicycling, team sports) or intensity (i.e., low, moderate, high)? b) Are individuals influenced to engage in PA by significant people in their lives (e.g., family, friends)?

2. In contrast to young adults who do not identify as autistic, to what extent are autistic young adults interested in using WATs to improve PA? Is interest/intention influenced by subjective norms (e.g., friends and family who use WATs), their attitudes about WATs (e.g., helpfulness in supporting PA engagement) or their ability (PBC) to learn to use a WAT?

3. In contrast to young adults who do not identify as autistic, to what extent do autistic young adults feel they can benefit from an SOS to support their engagement in PA with a WAT? An SOS may include techniques such as group training to activate the WAT and learn about feedback and self-monitoring tools (e.g., apps, minutes engaged in an activity, calories burned, distance, heart rate, stride, oxygen saturation, activities), personalized sessions to set goals and develop a plan, reviewing printed or online manuals to learn how to use the device or connecting with others in online forums or social media.

This study is designed based on the Theory of Planned Behaviour (TPB). The TPB posits that behavioural intention comprises of three constructs- attitude, subjective norms, and perceived behaviour control (PBC). All three constructs influence behavioural intention, and a high behavioural intention increases the likelihood of performing a behaviour.

Another important study design element used for this study is that of Participatory Research (PR). PR is the inclusion of the subjects in the research process. While this seems like a baseline requirement for all research, traditionally, many studies have not included autistic individuals beyond being subjects of the research. Research by Koumpouros and Kafazis (2019) notes that there is a need to develop instruments that can accurately assess the thoughts, feelings, and opinions of autistic young adults as currently, as no gold standard measures exist at present. Unreliable or inaccurate information provided through inappropriate sources (e.g., the application of studies not validated for use with this population) could misrepresent the person's perceptions and sentiments. For this study, it was vital for the principal investigator (PI), who is non-autistic, to take the PR approach to ensure that autistic young adults have a voice in this process.

This study aims to build on current autism research by developing and implementing a PA and WAT survey based on the Theory of Planned Behaviour (TPB) for autistic young adults. The study was designed to examine the behavioural intention of this population towards improving physical health through participation in PA and inquire about support methods that they perceive as having utility for using WATs.

The chapters that follow include:

- Chapter 2- A review of the literature exploring the research surrounding autistic young adults’ interest in PA, WATs and SOS
- Chapter 3- The methodology will cover the TPB, and the application of PR by using advisory committees, the survey development methods, and the participant recruitment process.
- Chapter 4- The data analysis and results of the national survey
- Chapter 5- Concludes with the discussion of this study.

Chapter Two: Literature Review

Physical inactivity is an increasing health concern for the autistic community. A growing body of research suggests that autistic people of all age groups are less physically active (Benson et al., 2019; Jones et al., 2017) and engage in fewer sports/recreational activities as compared to their non-autistic peers (Weir et al., 2021). Low engagement in physical activity (PA) is a troubling trend, as many studies examining health outcomes report that low PA is associated with an increased risk of many physical health and psychiatric conditions (Davignon et al., 2018; LaLonde et al., 2014; Weir et al., 2021). Many studies (e.g., Hillier et al., 2020; Jones et al., 2017; Stanish et al., 2017) report that large portions of the autistic population are more likely to engage in sedentary behaviours than non-autistic individuals.

Physical Activity

There is general agreement within the social science and medical research communities that engagement in regular PA is paramount for maintaining good health. Consistent participation in PA has been associated with many health benefits, including improvements to physical, psychological, and social well-being (Warburton & Bredin, 2017). The most accepted definition of PA includes “any body movement produced by skeletal muscles that results in energy expenditure” (Caspersen et al., 1985, p.126). The Canadian Physical Activity and Sedentary Behaviour Guidelines modified this definition slightly (i.e., the descriptor ‘requires’ has been introduced to replace the term ‘results in’) (Tremblay et al., 2011). Caspersen’s (1985) definition was also adopted by the WHO (2022) and expanded to consider a variety of activities including different types of daily routines (e.g., completing chores such as vacuuming, gardening, walking the dog), work activities (e.g., carrying equipment, taking the stairs instead of using an elevator, stretching at your workstation), sport, exercise and recreational behaviours, which can range from high (e.g., circuit training, intense yard work like excavating or moving dirt), moderate (e.g., jogging, shovelling snow, raking leaves), or low (e.g., walking, practicing yoga, dusting) intensity activities.

The Public Health Agency of Canada and the Canadian Society for Exercise Physiology (CSEP) introduced Canada's first PA recommendations for adults in 1998. In 2020, they launched a new Canadian 24-Hour Movement Guidelines for Adults with three core recommendations: move more- add movement throughout the day including various types and intensities of PA; reduce sedentary time; and sleep well by aiming for 7-9 hours (CSEP, 2021).

Physical Inactivity

In contrast, physical inactivity is a term used to describe when individuals do not achieve the recommended minimum standard of regular physical activity and is a serious public health concern among people in developed and developing countries. Research by the World Health Organization (WHO; 2024) reports that insufficient PA is the fourth leading risk factor for mortality, attributing to an estimated 3.2 million deaths annually. In Canada, the recent Canadian Health Measures Survey (Statistics Canada, 2021) reported that one in two Canadian adults do not meet the current recommended PA guidelines of 150 weekly minutes of moderate to vigorous physical activity (MVPA), and engage in sedentary activities (e.g., sitting) for significant portions (i.e., an average of 9.6 hours) of the day. A study by McCoy and Morgan (2020) found that autistic adolescents were 62% less likely to participate in regular physical activity and 81% less likely to have participated in organized sports.

According to the Centers for Disease Control and Prevention (CDC, 2022), low PA is linked to increased health risk factors, including increased susceptibility to certain cancers (e.g., colon, breast, and uterine), type 2 diabetes, and cardiovascular diseases. For autistic individuals, research shows a higher likelihood of obesity (Croen et al., 2015; Davignon et al., 2018; Healy et al., 2019). For example, a study by McCoy et al. (2016) found that autistic adolescents were more likely to be overweight (27%) and obese (72%) in comparison with their typically developing peers. Other risk factors that research has found are higher for autistic individuals are epilepsy, diabetes, cardiovascular disease, and hypertension (Croen et al., 2015; Davignon et al., 2018; Weir et al. 2021).

Autism

Autism is a lifelong neurodevelopmental condition characterized by pervasive differences in social communication and interaction, sensory experiences, the presence of highly focused interests or passions for one or many specific activities, and repetitive patterns of behaviours (American Psychiatric Association [APA], 2013). Autism exists on a spectrum meaning that each autistic individual will have a unique set of traits, strengths, and challenges that can take many forms and affect different areas of development in a variety of ways and to varying degrees (Autism Speaks, 2021). It is important to note that the prevalence of autism in Canada is increasing. In 2022, 1 in 50 children was diagnosed (PHAC, 2022) It has been suggested that the number of autistic individuals within Canada will continue to increase due to a variety of factors including changes in reporting practices, improvements in diagnostic criteria and understanding of underlying genetic and neuropsychological processes and increased public awareness (Canadian Health Survey on Children and Youth; PHAC, 2022).

Autistic Young Adults

In Canada, young adulthood spans between the ages of 18 and 35 (Department of Justice Canada, 2022). To describe this critical period, Bonnie et al. (2015) notes that young adulthood:

> "Is a transitional period during the life course when young people are traditionally expected to become financially independent, to establish romantic relationships and become parents, and to assume responsible roles as productive and engaged members of the community. From a developmental point of view, young adulthood is characterized by a period of normal and predictable biological and psychological maturation, but the specific social roles and tasks expected of each cohort of young adults are determined by the characteristics of the particular society at a particular time in history" (p.12).

The transition from adolescence to adulthood poses unique challenges for autistic people. Most resources for autistics primarily focus on providing intervention services during the early stages (e.g., during the elementary years) of their lives (Shattuck et al., 2012). For example, autistic children in Canada can access various financial, skill-building, and educational supports (Parsi & Elster, 2015). These supports are designed for autistic children to overcome impairments such as social communication, intense or restricted interests, rigidity, physical activity, and sensory sensitivities. However, once a child transitions to adulthood, they age out of many opportunities for skill development and the funding for them.

Unfortunately, many autistic young adults may not yet have developed the skills required to identify what is needed in terms of support, how to access support, and how to pay for support. As a result, autistic individuals may often encounter difficulties achieving specific developmental milestones, such as pursuing education options (Ward & Webster, 2018), identifying employment opportunities (Dudley et al., 2015), and finding appropriate health and support services (Parsi & Elster, 2015) to support their needs.

PA Engagement for Autistic Young Adults

Promoting PA engagement and sustaining a healthy lifestyle can be particularly challenging for autistic young adults. The 24-Hour Movement Guidelines for Adults recommend that adults (18-65) engage in a weekly minimum of 150 minutes of MVPA, muscle-strengthening activities at least twice a week, physical activities that challenge balance, and several hours of light physical activity including standing (CSEP, 2021). However, additional challenges that autistic young adults may face, specific to engaging in PA, include coordination and balance challenges, fatigue, disordered sleep, atypical (selective) eating behaviours, metabolic abnormalities, and social anxiety (Nichols et al., 2019; Lum et al., 2020; Wright, 2015).

It has been suggested that autistics often may not report interest in participating in PA or perceive these activities as enjoyable due to past negative experiences involving bullying and social challenges engaging with peers (Brewster & Coleyshaw, 2011; Hassani et al., 2020; Todd & Reid, 2006). Many autistic individuals experience setbacks related to their diagnosis (e.g., lack of engagement due to differences in social, behavioural, and motor skill development) and environmental barriers (e.g., lack of appropriate PA programs, lack of trainers/coaches with knowledge of best practices to support this population) which can negatively affect their motivation to engage in PA (Hillier et al., 2020; Nichols et al., 2019, Waldron et al., 2021). Other barriers associated with low engagement include challenges with social engagement in group activities, sensitivity concerns (e.g., playing in environments where issues such as loud noises, intense lighting, and in some cases the texture/feel of equipment, can become overwhelming for the individual), motor skill deficits, or fear of injury (Arnell et al., 2020; Healy et al., 2013).

Low engagement in PA is especially concerning for autistic individuals as engagement is reported to be low for autistic children (Durmuş & Sarol, 2023; Liang et al., 2020). Research by Arnell et al. (2018) notes that PA patterns (i.e., regularity, intensity, duration of activity) tend to decline with age. Therefore, parents' involvement in helping autistics learn about their healthcare needs as they transition into adulthood is essential (Buchanan et al., 2017; Parsi & Elster, 2015). Studies suggest that many autistic young adults continue to rely on their parents to identify and provide access, either directly or through financial support, to essential needs such as recreation and PA (Nichols et al., 2019).

Prior research has often relied on consultation with family members (e.g., parents/care providers) rather than directly with the autistic young adult (Eaves & Ho, 2008; Nichols et al., 2019) to develop specialized fitness (Todd & Reid, 2006) and sports programming (Barak et al., 2019; Yu & Jee, 2020). Input from autistic young adults in health promotion and PA research is essential for understanding their needs and preferences. Gotham et al. (2015) note that "given their unique first-hand experience, adults with autism…are de facto experts on their needs, problems, and priorities" (p. 794). At present, the needs of autistic young adults and the challenges they face do not receive a significant amount of attention in both policymaking and research efforts. These challenges can result in limited social, vocational, and recreational opportunities to engage in PA over time.

Growing evidence suggests many physical health conditions are more common in autistic adults than among the general population (Sedgewick et al., 2020; Weir et al., 2021). Physical inactivity places autistic young adults at a higher risk of health concerns and reduced life expectancy than non-autistic people (Hirvikoski et al., 2016). Research by Wise et al. (2017) notes that "it is estimated that adult care is the largest component of the lifetime societal costs of

ASD [autism], with 60% of medical costs accrued after age 21" (p. 1708). Thus, identifying cost-effective health interventions that increase PA is essential for improving health outcomes, especially for those at higher risk of experiencing severe chronic health issues that may pressure the Canadian healthcare system over time.

Wearable Activity Trackers

Considering the potential negative consequences of low PA engagement, interventions are needed to increase the behavioural intention of autistic young adults to engage in PA. Thus, identifying interventions for increasing PA engagement that autistic young adults can access independently or with minimal supervision is essential for improving health outcomes and alleviating pressure on healthcare systems.

Wearable activity trackers (WATs) are the most sought-after technologies in today's marketplace. These devices are worn on the body (i.e., on the wrist, around the chest, on fingers, and on ankles) and track numerous PA information including step counts, distance traveled, and calories burned. Since 2010, wearable technology was mainly considered a mainstay of the fitness industry in the form of activity trackers (e.g., Fitbit), accelerometers (e.g., ActiGraph), and devices used to store and manage personal fitness data (Henriksen et al., 2018). Indeed, WAT were the top worldwide fitness trend in six of the years between 2016-2023 (and within the top three trends in the other years) (Thompson, 2023). A growing body of research suggests that WATs (e.g., products such as Fitbit, Garmin Venu, Apple Watch, Samsung Galaxy Watch, Google Pixel Watch) are a cost-effective means with significant potential for supporting individuals to improve health behaviours (Buckingham et al., 2019; Lyons & Swartz, 2017). This is supported by consumers as the worldwide market for of WATs in 2024 is estimated to reach C$98.87 billion and in Canada alone, revenue from WATs is expected to reach C$935 million

(Statista, 2024). Research by Tankovska (2020) suggests that 22% of Canadian households already use WATs.

The potential value of using WATs for health promotion lies in their accessibility (i.e., range of affordability for WATs, flexibility (i.e., ability to interact with other devices), availability (i.e., information is always accessible), and adaptability (i.e., tailored interventions adjusted to the user). Users can benefit from WAT utility in many areas. WATS can support health outcomes by monitoring blood pressure, heart rate, physical fall detection, sleep patterns, and oxygen saturation (Shin et al., 2019; Song, 2024). WATs are primarily designed to support physical activity by providing information to the user on step counts, distance travelled, calories burned, the intensity of PA, and heart rate (Shin et al., 2019; Song, 2024). They can support adherence to physical activity by also including goal setting, reminders and coaching programs (Ridgers et al., 2016) For well-being, WATs often include functionality for monitoring stress levels, hydration, and sleep (Peake et al., 2018) Additional advances projected for WATs include: deeper integration with other wearables such as shoes, clothing, eyewear. (Forbes, 2023)

Ferguson and colleagues (2022) evaluated 25 systematic reviews and conducted a meta-analysis of the results on PA when using a WAT. They found that interventions using WATs increased step counts by approximately 2800 steps per day, walking time by approximately 40 minutes per day, and PA by approximately six minutes per day. Technology experts have long believed that getting wearable technology into the hands of individuals who are thinking about engaging in PA is crucial to supporting an active lifestyle (Li et al., 2021).

Use of WATs for Autistic Young Adults

Using technology to support autistic individuals has existed for almost 50 years (Colby, 1973). Recent advances in the use of wearable technologies in terms of enhanced passive or interactive monitoring, adaptive intelligence (e.g., machine learning), and built-in connectivity (i.e., using advance processing capabilities that can easily communicate or exchange information with other devices), can provide new possibilities with supporting autistic individuals in a variety of areas of their lives. Research by Benssassi et al. (2018) found that the use of wearable technologies can be very helpful in addressing social (i.e., social interaction and communication) (Keshav et al., 2017; Kinsella et al., 2017; Lopez & Wiskow 2019; O'Brien, et al. 2020) and emotion processing (Bosch et al., 2022, Daniels et al., 2018; Nuske et al., 2021) challenges connected with autism. Other studies (e.g., Boyd et al., 2017; Goldsmith & LeBlanc, 2004; Kientz et al., 2014) have also provided evidence demonstrating the utility of wearable technologies in teaching important skills such as proximity awareness (i.e., helping individuals to develop an awareness of the correct distance of where to stand when engaging in social interactions), developing strategies for accurate recognition of emotion based on facial expression and body language of others, and automated prompting (i.e., using devices to deliver the same level of prompting that an aide or assistant would provide with less human interaction and obtrusiveness) to decrease off-task behaviour when required.

In the last decade, wearable technology use has seen an expansive increase in personal use for autistic individuals (Koumpouros & Kafazis, 2019). New systems have become more advanced in terms of design, functionality, and are now supported by the development of innovative real-time applications to enhance the user experience by providing better access to personal information (e.g., health, physical activity monitoring, etc.), appropriate supports (e.g., automatic access to calming strategies such as breathing techniques to reduce anxiety) in times of crisis, and increasing autonomy and independence though providing users with opportunities to organize and manage daily routines electronically (Koumpouros & Kafazis, 2019; Torrado et al., 2017).

However, exploring the potential for using wearable technology to improve the health and well-being of autistic individuals has not been a significant focus of research (Garcia et al., 2021). Studies exploring the intention to use WATs have short durations with single session interventions as low as 10 minutes (e.g., O'Brien et al. 2020), small sample sizes of under 10 participants (e.g., Evmenova et al., 2019; Garcia et al. 2021; Lopez & Wiskow, 2019; O'Brien et al., 2016; O'Brien et al. 2020; O'Neill & Smythe, 2023; Sahin et al. 2018; Torrado et al. 2017; Wright et al. 2022;) , and a focus on autistic children (e.g., Keshav et al., 2017;Lopez & Wiskow, 2019; O'Brien et al. 2020; Sahin et al. 2018; Torrado et al. 2017; Voss et al., 2019). For WATs to have value and acceptance for autistic individuals, researchers, designers, and technology developers must have clarity in understanding the interests, needs, and preferences of this unique population. Technology itself will serve little purpose if it cannot be made useful to the people it is designed to support.

With the growth of WATs being considered as assistive aids for autistic individuals, researchers need to understand if they intend to use these devices and incorporate them into their daily lifestyles. Research has shown that user acceptance is important in ensuring the adoption and use of new technologies (Lunney et al, 2016). Currently there is a gap in the research as autistic individuals are often rarely consulted by researchers for their feedback, even though they are the end users who may have to manage potential concerns such as negative image, social stigma, or reduced self-esteem related to the use of such technologies (Sahin et al., 2018).

Research has demonstrated that mobile technologies such as WATs present a convenient and cost-effective way to facilitate PA behaviour change in sedentary adults within the general population (Sullivan & Lachman, 2017). WATs are considered "persuasive technologies" that are instrumental in providing users with helpful health information (e.g., current physical health data, feedback, and support tips for engaging in PA), which encourages users to engage in PA (Fritz et al., 2014). Moreover, to motivate users to maintain engagement with PA, some WATs adopt motivational techniques, such as gamification and social engagement, through friendly competition (Bunn et al., 2018; Savage et al., 2018). Currently, strong evidence from randomized controlled trials (e.g., Cadmus-Bertram et al., 2015; Hartman et al., 2018) and additional studies (e.g., Eisenhauer et al., 2016; Valbuena et al., 2015) suggest that participants using WATs and adhering to evidence-based behaviour change techniques often experience better health outcomes.

However, low motivation, avoidance, or abandonment of PA may be higher for sedentary autistic young adults due to a perceived lack of immediate health benefits (Sullivan & Lachman, 2017). O'Donoghue and Rabin (2015) define this issue as "present bias" when individuals perceive high value for immediate rewards (i.e., receiving benefits now) and place less emphasis on beneficial long-term outcomes (e.g., avoidance of a myriad of chronic health complications) of the health behaviour. Advancements in WATs have made it possible to provide users with instant health information to evaluate and provide immediate feedback on user progress. A common theme among studies using WATs (e.g., see Cadmus-Bertram et al., 2015; Hartman et al., 2018) was that most participants who received the WAT intervention reported increased awareness/interest in monitoring PA and other health outcomes (e.g., energy output, active heart rate, distance travelled) because the devices provided access to this information in real-time.

While WATs are often promoted for use "out of the box," research indicates that users with a system of support (SOS) to operationalize the WATs achieve improved results. A systematic review found that participants in studies that leveraged a SOS achieved higher PA outcomes (e.g., see Cadmus-Bertram et al., 2015; Hartman et al., 2018; Valbuena et al., 2015) over participant control groups. These researchers incorporated various support techniques in an SOS, including providing opportunities for learning through guided observation, ‘hands-on’ practice using the device, provision of intermittent feedback to enhance understanding and skill development, and consultation guidance for considering the next steps in improving PA behaviours.

Learning to use WATs

Although current research has demonstrated that people with autism are interested in using wearable technologies (e.g., see Benssassi et al., 2018; Koumpouros & Kafazis, 2019), the PI found no studies that seek to understand what supports might be helpful for autistic young adults to learn how to use WATs effectively. There is also a paucity of research examining whether the use of WATs with autistic young adults has utility for increasing PA engagement and promoting behaviour change to improve health outcomes for this population. A review of PA intervention studies that utilized WATs as a part of their behaviour change strategies (e.g., see Cadmus-Bertram et al., 2015; Eisenhauer et al., 2016; Hartman et al., 2018) found evidence suggesting that successful use of this technology required a scaffolded SOS.

Providing scaffolded support in learning is crucial because it helps instructors support learners in bridging “the gap between what they know and what they need to know” (Kampen, 2020). Recent studies using WATs included mechanisms for learning, such as technology training, support check-ins (e.g., via phone, email, text, in-person), and providing information on how to use feedback provided through the WAT to inform development of personalized goals (Eisenhauer et al., 2016; Garcia et al., 2021; Hartman et al., 2018; Sullivan & Lachman, 2017; Valbuena et al., 2015). The development and implementation of a scaffolded SOS may have utility for assisting autistic young adults learn how to best use and optimize WATs (i.e., learning what data output means and how the knowledge can be used to improve current health, setting up/syncing the WATs with other devices, uploading data) but this is an area of research that is still within early stages of exploration. Understanding what types of SOS that autistic young adults find helpful will support the design of future interventions and increase the likelihood of successful engagement and maintenance of PA.

Summary of the Challenges in the Research

Definition of PA

A significant concern with current studies that seek to assess PA engagement of autistic people is the unclear or ambiguous terms used to describe PA. Many of the studies that seek to gain insights into the PA habits of autistic individuals often make assumptions about what activities represent PA and do not define what PA can include. For example, Kerner and Grossman's (2001) *Scales: Attitude Toward PA, Expectations of Others, Perceived Behavioral Control, and Intention to Engage in PA* (as reported in Hillier et al., 2020) provide a narrow and limited definition of PA as "physical exercise" and "fitness." Physical exercise and fitness describe a subset of PA but are often misconstrued as encompassing all aspects within PA (Kruk, 2009). In contrast, physical exercise is defined as the repetitive, planned, and structured engagement in a vigorous activity explicitly designed to improve fitness and health (Caspersen et al., 1985). A review by Piggin (2020) notes that using definitions such as physical exercise and fitness to describe PA can be contentious and confusing and present an unanticipated bias which "produces a very specific way of understanding physical activity" (p. 2).

Canadian PA Guidelines have long sought to provide health professionals, researchers, and the public with clarity around evidence-informed benchmarks targets to achieve health benefits (LeBlanc et al. 2015). In 2011, CSEP, in partnership with ParticipACTION and the Healthy Active Living and Obesity Research Group (HALO) released a series of updated PA guidelines for children (aged 5–11 years), youth (aged 12–17 years), adults (aged 18–64 years), and older adults (aged ≥65 years) (Tremblay et al., 2011). However, research by LeBlanc et al. (2015) notes that "since the new Canadian guidelines were released, little work has been done to gauge their awareness among Canadians, and therefore it is unknown whether current efforts to disseminate the new guidelines have been effective, or if more intensive population health interventions are required" (p.717). More recently, the rebranded Canadian 24-Hour Movement Guidelines has taken a more inclusive approach towards PA by placing greater emphasis on encouraging Canadians to 'move more' by focusing on "the routine rituals of daily living such as casual neighborhood walks, gardening, household chores, and taking stairs instead of the elevator... (to) contribute towards a healthy 24 hours" (CSEP, 2021).

A significant need exists for researchers, professionals, and caregivers (e.g., parents) to be able to communicate an accurate description of PA to autistic individuals. Studies suggest that many autistic individuals often rely on parents or other professionals (e.g., nurse practitioner, occupational therapist, coaches etc.) to play a fundamental role in supporting the education of their autistic young adult on the purpose, importance, and benefits of participating in PA (Croen et al., 2015; Ohrberg, 2013; Tiner et al., 2021). Research by Nichols et al., 2019 found that parents often assume responsibility for identifying, assessing, and encouraging PA opportunities for their autistic children, even into adulthood. However, it is unclear is if parents themselves are informed on what constitutes PA following Canadian standards and guidelines.

Additionally, most of the limited research investigating PA with autistic young adults very rarely provides information specifically defining or describing what PA represents. In several studies examining PA with autistic adults, researchers often provided information describing (a) the benefits of PA (Hillier et al., 2020), barriers to PA (Nichols et al., 2019), effects of PA on aging (Waldron et al., 2022) and potential factors that may assist in improving PA (Tiner et al., 2021), but none of the studies reviewed *actually define what PA is*. Often engagement in PA is represented in studies as participation in sports (Stanish et al., 2015), fitness training (Borremans, et al, 2010; Savage et al., 2018), circuit training (Arslan et al., 2022), exercise-based interventions or in some instances, low impact activities such as walking (Garcia et al., 2021; Ptomey et al., 2017). In studies with no clear definition used to describe or establish boundaries to PA, it can be difficult to frame the problem and inform what measures should be used to understand the problem (Piggin, 2020).

Another problem arises when there is the potential for miscommunication between participants and researchers over what is meant by PA (Ceria-Ulep et al., 2011). The use of ambiguous concepts such as exercise and fitness in PA studies can adversely affect how autistic young adults think about participating in PA, based on their perception of what they believe they are being asked. For example, to assess PA engagement, it is plausible that a researcher might ask participants about 'how much daily exercise do they get' when what they really want to evaluate is the daily total amount of PA that they engage in. Research by Ceria-Ulep and colleagues (2011) provide an excellent example of this point noting that an individual who:

> "May spend a large proportion of the day physically mowing the lawn, hand washing the laundry, scrubbing the floors, walking to the bus and so forth. All of these types of physical activities may come to mind when the individual answers the question, "How much exercise do you get every day?" However, we may not consider these activities to be exercise because they are not part of structured exercise" (p. 476).

Ambiguous concepts can significantly affect autistic individuals, as research literature often describes this population as ‘literal or concrete thinkers’ (Hobson, 2012; Stuart-Hamilton, 2013). Thus, similar to the findings of Ceria-Ulep et al. (2011), autistic young adults may be more likely to focus on the literal meaning of exercise and fitness (i.e., how much do I *only* engage in repetitive, planned, structured and vigorous activities?) which would significantly impact research findings and limit generalizability of results. The lack of understanding of the differences between concepts such as PA, fitness, and exercise may represent a potential barrier in contributing to poor health outcomes for autistic adults, which may also misconstrue the accuracy of their true intentions toward PA.

Autistic Voice in Understanding PA

For decades, academics have acknowledged community engagement’s significance in research and practice (Arnstein, 2019). However, traditional approaches have rarely considered including the subjects being studied in the creation of research (Cascio et al., 2020). This lack of engagement calls into question whether current research is beneficial in meeting the needs or priorities of the communities that scientists and academics serve. Research by Raymaker and Nicolaidis (2013) suggests that studies that do not take steps to understand a community’s culture or the priorities of the people who comprise the population run the risk of offending or ostracizing groups, creating distrust between the community and researchers.

There is an increasing call to action for including autistic perspectives and collaborative participation in research that directly affects their communities (Raymaker & Nicolaidis, 2013). To date, autistic individuals experience exclusion in several significant areas, including education, employment, and scientific research (den Houting et al., 2021). Discriminatory practices and societal stigma have had a pervasive impact on limiting the inclusion and integration of autistic individuals to participate fully within their communities (Stark et al., 2021). There is often reported widespread dissatisfaction from the autism community about the lack of consultation with researchers regarding their own needs and priorities (Pukki et al., 2022). For example, Fletcher-Watson and colleagues (2018) point out that current autism research often fails to consider or incorporate the perspectives of autistic people and their allies that are specific to what research is necessary and how it is implemented. As one participant in a study by Stark et al. (2021) notes:

> "Autistic people have long been excluded from research, and it is possible this has seriously skewed the direction of studies and understanding about autism. Due to researchers being non-autistic, this meant pre-project assumptions, research questions, and interpretations did not necessarily reflect the reality of an autistic life/struggles" (p. 198).

Autistic Voice in WAT and SOS Research

As WATs continue to become more sophisticated, researchers will need to be more intentional in their focus on understanding the needs of their potential users (Buenaflor & Kim, 2013). Despite the potential for using WATs to improve the life quality for autistic individuals, there is a paucity of research involving researchers collaborating with autistics and their allies (e.g., family members, advocates) to investigate the utility of these devices within the autistic community. Research by Lunney et al. (2016) notes that "perceived usefulness significantly influences an individual's acceptance of technology" (p. 117).

Engaging in a collaborative investigative process with autistic users can provide researchers with opportunities to gain informed insights into their specific needs, develop a greater understanding of potential concerns (e.g., worries related to sensitivity issues, social stigma, etc.), as well as provide a conduit to receive direct feedback which can be advantageous in designing better products over time (Benssassi et al., 2018). However, it is important for researchers to first determine if the autistic community is interested in using this technology. If researchers can determine if autistics are willing to accept using these devices for the purpose of improving PA, this information can be used to help develop feasible interventions using WATs that autistic individuals accept and are more motivated to use. A review of the research suggests that studies that use WATs with autistic children and youth often tend to lead with technology to try and solve problems (O'Brien et al., 2016). However, researchers rarely check with participants to ask if they are interested in using the technology. It also remains unclear whether autistic young adults are interested in adopting and using this technology to improve health outcomes and quality of life.

In studies that provided an SOS to autistic participants (e.g., Lopez & Wiskow, 2019), none of the investigators asked the autistic participant if they were interested in using this form of scaffolding within the intervention. Instead, they were provided with an SOS at the researcher's discretion. At present, it is unknown whether autistic young adults would be interested in using a SOS to guide their learning as it relates to learning to use WATs.

Theory of Planned Behaviour

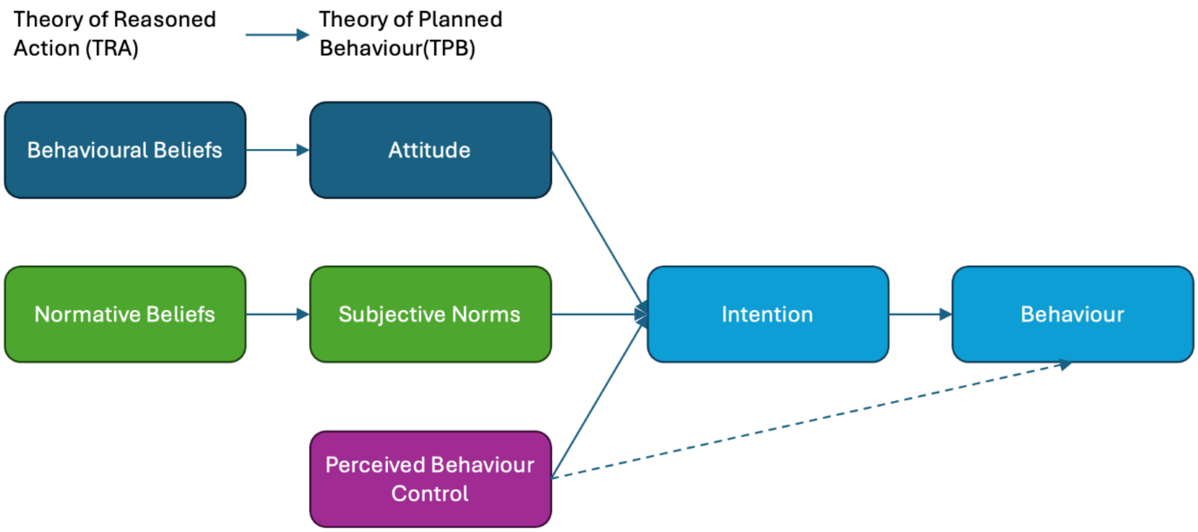
The study uses the Theory of Planned Behaviour (TPB; Ajzen, 1991) as a framework to guide the research. Assessing interest in PA engagement and using WATs can be a complex and multifaceted process. The application of theories can play a crucial role in explaining and predicting health behaviour, with interventions grounded in theory proving to be more effective than those based solely on theoretical approaches (Michie et al., 2014). Having robust theoretical foundations is crucial for public health and behavior change interventions. This enables researchers to comprehensively grasp, tackle, and document the factors that are most effective in facilitating behavior change in a systematic and evidence-driven manner. A popular model that has received wide attention as a useful framework for understanding behaviour intention is the Theory of Planned Behaviour (TPB; Ajzen, 1991).

The TPB is an expansion of Ajzen and Fishbein's (1975) Theory of Reasoned Action (TRA), which describes behaviour as a combined product of two related beliefs: behavioural and normative beliefs. Behavioural beliefs refer to an individual's perception of the consequences of a behaviour, whereas normative beliefs pertain to the influence of social pressure on an individual's decision to engage in a particular behaviour (Ajzen, 2020). Taken together, TRA posits that an individual's engagement in a target action/behaviour is determined by their intention (i.e., motivational factors that influence their decision and level of effort) towards performing the behaviour. However, Ajzen (1991) theorized that a third belief, which he described as 'control beliefs' could directly or indirectly combine with behavioural and normative beliefs to predict behaviour. Thus, the TPB model expanded upon the TRA by adding perceived behaviour control (PBC), a as a factor to address the limitations of the TRA in explaining behaviours over which are beyond the individual's volitional control (Ajzen, 1991). Research by Ajzen (2020) found that when an individual's intention to participate in a target behaviour is high, it increases the likelihood (i.e., predictability) that they will engage in the specific behaviour.

According to the TPB, behavioural intention is influenced by three factors: attitude, subjective norms, and PBC. Attitude is determined by the individual's attitude toward the behaviour (i.e., the degree to which the individual perceives the behaviour of interest as favorable/unfavorable) (Ajzen, 1991). Subjective norms are specific to the perceived social influences (i.e., the individual's estimation of social pressures to perform/not perform the target behaviour, and the expectations of whether people close to the individual would approve/disapprove of the behaviour) concerning the behaviour (Ajzen, 1991). Finally, PBC is the individual's perceived belief in their ability to perform the behaviour and the extent that they believe they have voluntary control over the behaviour (Ajzen, 1991). Ajzen (2020) notes that it is possible to improve behavioural intention by manipulating the three constructs. Research by Sheeran (2002) suggests that if one of these constructs is missing or deficient, there may be an "intention-behaviour gap" resulting in no action being taken.

Figure 1

Constructs of the Theory of Planned Behaviour



The TPB has been recognized as one of the most utilized theories in social and behavioural science (Senkowski et al., 2019). It has been used successfully in the prediction and change of behaviour, across a multitude of behaviour domains including PA (Hillier et al., 2020; Plotnikoff et al., 2010), alcohol and drugs (Morell-Gomis et al., 2019), medical regimens (Krejany et al., 2021), nutrition (Anyango et al., 2021), hygiene (Moore et al., 2022), sexual behaviour (Abdullah et al., 2020), work settings (Knaeps et al., 2016) school settings (Opoku et al., 2021), and technology adoption and acceptance (Joo et al., 2019). The TPB has been used extensively in health intervention studies among a variety of unique populations to understand the influence of intention in relation to behaviour change (Hillier et al., 2020; Jaarsma et al., 2017; McEachan et al., 2011).

A comprehensive review of its efficacy by Steinmetz et al. (2016) reviewed 82 studies utilizing the TPB in their interventions and found that they were effective in changing the target behaviour. Of the 82 studies, 41 were focused on physical activity. Evidence also suggests that the TPB is not only a useful model for predicting participation in specific behaviours, but also offers an effective framework for implementing behavior change interventions (Senkowski et al., 2019).

The use of the TPB model has been limited in autism research. However, some recent studies have used it including a recent study by Hillier et al. (2020) who was the first to look at applying the TPB to investigate participation in PA, attitudes toward PA, and barriers to participation among autistic young adults. Other autism studies using TPB have focused on compliance with diet interventions (Mardsen et al., 2019), social communications interventions (Hugh et al. 2022), and assessing the intention of non-autistic students towards learning in the classroom with autistic children (Opoku et al. 2021).

Participatory Research

Researchers appreciate the richness of diverse and intricate life experiences. Moreover, they strive to comprehend and interpret data within its context as it unfolds (Creswell & Poth, 2018). This study is grounded in participatory research (PR), an approach to research that encourages the involvement of members of the community as equal contributors within the research process. The following section provides an overview of the PR approach.

Research in education and other social sciences often relies heavily on the engagement and participation of people within the research process. PR encompasses a variety of research designs, methods, and frameworks to promote collaborative partnerships between the scientific community and the public they serve (Aldridge, 2014; Vaughn & Jacquez, 2020). Rather than being perceived as 'subjects', as in older traditional research, PR prioritizes the pairing of research professionals with community members who may not have formal research training but belong to, or advocate for, the interests of the communities targeted by the research (den Houting et al., 2021; Schubotz, 2020). Stakeholders may include those individuals directly impacted by the issues under study, influential community members (e.g., elders, leaders, policy makers), or others with lived experiences whose knowledge can be utilized to inform research decisions better and affect change (Erves et al., 2017, Jagosh et al., 2012). PR methods have utility in connecting researchers directly with the people who can address issues relevant to their specific community (Pellicano et al., 2014; Stark et al., 2021).

Advocates of PR suggest this practice provides many benefits, including helping to increase the capacity of marginalized communities to identify and prioritize issues relevant to their needs (Raymaker & Nicolaidis, 2013), ensuring alignment and relevance of research questions and objectives with community priorities (Holkup et al., 2004); increasing stakeholder interest in data collection, analysis, and interpretation (Cargo & Mercer, 2008); and strengthening the relationship between researchers and knowledge users by bringing together people with local knowledge, varied expertise, and unique experiences to address complex issues within the decision-making process (Wallerstein et al., 2019).

Many descriptions (e.g., Participatory Action Research [PAR], Cooperative inquiry, Citizen Science, Community Based Participatory Research [CBPR], Emancipatory Research) and frameworks (e.g., User-Centered Design) have been used to describe PR since Lewin (1946) first used the term ‘action research’ to describe the process of working with minorities to address social issues in the United States. However, although the nomenclature of PR approaches may vary, they all share a common emphasis on conducting research alongside the subjects of research rather than on them (Vaughn & Jacquez, 2020). This approach is predicated on the belief that the insights and perspectives of individuals directly impacted by the issue are vital for crafting the solution (Aldridge, 2014; Fletcher-Watson et al., 2019). As partners within the research process, stakeholders may collaborate with researchers and scientists on various aspects. This may include engagement in determining (a) what research should be conducted (i.e., working alongside social scientists to think critically in developing questions or addressing issues based on community interests), (b) participation in the creation/development of instruments/tools used to conduct the research, (c) consultation on best practice methods for conducting the research (e.g., methodology), (d) participation in the collection/interpretation of results, and (e) participation in the communication and circulation of research findings (Jivraj, 2014).

Many social scientists have applied PR approaches as a means of providing a critical lens to current research practice primarily “in response to concerns about its lack of social impact, relevance and usefulness for those who were the subjects and the center of... research” (Schubotz, 2020, The History and Nature of Participatory Research Methods section). Studies focusing on integrating PR in their methodologies have reported many advantages to increasing citizen participation within the research process in recent years (Aldridge, 2014; Key et al.,

2019) These benefits include providing researchers with greater knowledge of priorities considered relevant to the community, improved quality of research based on the integration of ‘real-world’ experiences with scientific expertise to assist with addressing complex issues, applying stakeholder insights to design more applicable interventions that can be more easily disseminated within community settings, and improving trust between the public and scientific community (Chilisa, 2019; International Collaboration for Participatory Health Research (ICPHR), 2022). These collaborations often result in developing research that is considered pertinent and practical for all stakeholders involved in the process (Key et al., 2019).

A PR approach helps in many ways. For example, PR is “ethically informed by the values of the community” (Flecher-Watson et al., 2019, p.944) suggesting that non-autistic individuals would benefit from soliciting meaningful input from autistic individuals about their opinions regarding the significance of this research (e.g., is the topic relevant to the autistic community and consistent with the community's values?). It helps to maximize effective communication by discussing potential barriers (e.g., identification of confusing terms and jargon used in the PA research) and collaborating to develop strategies to address concerns (e.g., co-creating information that provides survey respondents clarity on specific definitions). Additionally, a PR approach helps to connect directly with members of the autistic community to understand what approaches are considered appropriate for information gathering within this population.

PR is central in assisting in developing meaningful contributions in critical autistic studies frameworks identified within current literature (e.g., see O'Dell et al., 2016 and Woods et al., 2018). However, research by Koumpouros and Kafazis (2019) notes that there is a need to develop instruments that can accurately assess the thoughts, feelings, and opinions of autistic young adults, as no gold standard measures currently exist. To date, there is a paucity of effective survey measures designed or validated for use to study the health behaviours of autistic people. As Arnstein (2019) notes, "surveys are not very valid indicators of community opinion when used without…input from (its) citizens" (p. 28). Unreliable or inaccurate information provided through inappropriate sources (e.g., the application of studies not validated for use with this population) could misrepresent the person's perceptions and sentiments. The only previous study that explored PA behavioural intention in autistic young adults reported that the accuracy of their findings might have been affected by a “lack of appropriate, validated questionnaires for this population” (Hillier et al., 2020, p. 883).

Summary

Autistic young adults are at greater risk of significant negative health outcomes due to physical inactivity and an increase in sedentary behaviours. Addressing this issue requires research to include the autistic voice in a meaningful way. PR is an approach proven to build community engagement through collaboration between stakeholders and social scientists as equal partners in the research. Bringing autistic young adults into the research to understand their intention to engage in PA, use WATs to monitor PA, and understand their preferences for using a SOS contributes important data to this field. The next chapter will summarize this study’s methodology in approaching these research questions.

Chapter Three: Methodology

This chapter provides an overview of the processes followed in the development, and implementation of a national survey designed to assess the behavioural intention of autistic and non-autistic young adults to participate in PA, use WATs for the purpose of monitoring PA and their preferred SOS to learn to use WATs. The chapter will begin with a discussion of the PR approach that included the establishment of three advisory committees including an Autistic Advisory Committee (AAC), a Non-Autistic Advisory Committee (NAC), and a professional panel. This will be followed with a review of the committee engagement processes including onboarding and committee meeting structure. The chapter then provides a commentary on the collaborative process with the committee members in survey development including the composition, review, refinement, and final selection of questions for the survey. This will be followed by a review of the validation mechanisms of think out loud protocols and a survey pilot. Next will be a description of the survey launch and participant recruitment. Finally, this chapter will conclude with a summary of participant characteristics who completed the survey.

Participatory Research Approach

To support a PR approach, the PI solicited the support of several community stakeholders consisting of autistic young adult self-advocates, non-autistic young adults, and a professional advisory group to assist in the co-development of the survey. Establishing and working with diverse stakeholders provided a significant opportunity to ensure that various perspectives are considered, which in turn influenced, informed, and advanced the research process. The following section provides the rationale behind developing partnerships with each stakeholder group.

Developing an Autistic Advisory Committee (AAC) was an appropriate first step that aligned this study with PR. The AAC supported the non-autistic PI in collaborating directly with members of the autistic community, who possess unique insights through lived participation, knowledge, and understanding of the experiences of autistic people. The AAC's purpose was to ensure that the proposed research is relevant for autistic young adults, measures the appropriate constructs, and that the language is clear, respectful, and accessible. The PI acknowledged that the experiences and subjective knowledge of PA and WAT use among autistic young adults are unique and differ between individuals. Thus, the AAC reviewed and refined the research objectives of survey questions (i.e., providing insights to adapt questions to best support participant understanding) and discussed methods for circulating the survey to maximize its potential to reach as many autistic young adults as possible across Canada.

A Non-autistic Advisory Committee (NAC) was established to capture young adults' perspectives, values, and experiences of those who do not have an autism diagnosis. As the study aimed to explore whether differences exist between autistic and non-autistic young adults, it was essential to ensure meaningful involvement from both groups in decision-making throughout the research process. The NAC ensured that the proposed research was relevant for non-autistic young adults, measured the appropriate constructs, and that the language was clear, respectful, and accessible.

Additionally, the PI established a professional panel to allow input from professionals working with autistic populations in PA environments. All members of the professional panel were involved with the '*Beast Mode Fitness'* program offered though the University of Calgary's active living program. The program is specifically designed for autistic young adults interested in learning about how to become more physically active in their lives. The primary focus of the program involves working with autistic young adults to develop and implement PA programming plans based on the individual's interests and current skill level. The panel consisted of a head trainer from the University of Calgary, a registered occupational therapist, and a personal trainer with a background in exercise physiology who all have experience working with autistic young adults.

The focus of working with committee members centered around two primary goals. The first goal was to collaborate with stakeholders to co-produce a survey instrument which assessed whether differences exist between autistic and non-autistic young adult's intention to engage in the following activities: (a) participation in PA, (b) using WATs to monitor PA, and (c) using a system of support (SOS) to assist with learning how to operate a WAT. This information was collected and used to inform various stages of the study, including survey development, review, piloting, and final revision/refinement of survey questions. The second goal was to collaborate on determining the best methods for distributing the survey across Canada. This information was used to inform the development of a strategy to maximize the ability to connect with the target population of autistic/non-autistic young adults. Shared responsibility between committee members resulted in the co-development of survey materials and survey distribution methods.

Committee Recruitment

This study was conducted during the worldwide COVID-19 pandemic. The pandemic was declared a national public health emergency in Canada in March 2020, and its status was not downgraded until May 2023 by the International Health Regulations (IHR) emergency committee of the WHO (Infection Prevention and Control Canada [IPAC], 2023). Pandemic restrictions prohibited in-person interactions, resulting in this study being completed online. All correspondence, including with the participants involved in the development/production of this research, occurred via a combination of several online platforms, including email, text messages, telephone calls, and virtual meetings. Thus, the selection of respondents to participate in this study phase was limited to young adults who had access to reliable technology (e.g., computers, tablets, cell phones) and internet access.

Ethics approval for this study was granted in the spring of 2022. Once approved, purposive sampling was used to recruit a sample of autistic young adults to participate in the AAC. The PI recruited the AAC using a digital newsletter and weekly community updates through a local autism community foundation in Calgary, Alberta. The foundation works to reduce barriers and enhance opportunities in education, employment, and housing for autistic youth and adults, and its newsletter is effective in reaching hundreds of autistic individuals and families across the province. Additional recruitment strategies included posting advertisements for the study on social media sites (e.g., Discord, Reddit, WrongPlanet.net), as research suggests that many autistic adults use social media (Mazurek, 2013).

Recruitment for the NAC consisted of posting advertisements for candidates on the websites of local universities and community activity centers (e.g., YMCA, local community centers). Additionally, The PI contacted the professional panel by email to recruit individuals with experience working with autistic young adults in PA settings.

Inclusion criteria. AAC member inclusion criteria specified that candidates were Canadian young adults (18-35yrs) with formal evidence of an autism diagnosis, fluent in English, possess basic computer literacy skills (e.g., send emails, join virtual meetings, etc.), and have access to a computer with an internet connection. Twelve candidates who matched the inclusion criteria contacted the PI, expressing interest in collaborating on the study. NAC member inclusion criteria sought to identify candidates who were young adults, Canadian residents, and fluent in English. Like the AAC, non-autistic candidates were also required to have basic computer literacy skills and access to a computer with reliable internet access. Seven candidates who matched the inclusion criteria contacted the PI, expressing interest in collaborating on the study.

The inclusion criteria for professional panel members consisted of selecting individuals with qualifications in exercise physiology, kinesiology, physical training and/or coaching, and possessing at least five years of direct service engagement to the autistic community. Four candidates who matched the inclusion criteria expressed interest in collaborating on the study.

Membership Selection. In June 2022, the PI conducted brief telephone interviews with all candidates and asked questions about 1) their preferences for receiving information to optimize learning (e.g., visual, auditory, written, or kinesthetic); 2) their availability for attending one 30-minute introduction meeting, and four 60-minute committee meetings over a three-month timeframe; 3) their level of comfort participating in small group (e.g., 5-6 individuals) settings; 4) their familiarity/comfort with using different digital communication tools (e.g., virtual meetings, surveys, text, email); and 5) their concerns or barriers that may impact their ability to engage fully with group discussions or interactions with committee members. Candidates for the AAC and NAC were also informed that they would be compensated for their participation with a $100 gift card after the series of committee meetings. After interviews, five candidates were selected to participate in the AAC, four were selected for the NAC, and three individuals agreed to form the professional panel. See Table 1 for characteristic information.

Table 1

Committee Member Characteristics

Category	Autistic Advisory Committee (n=5)	Non-Autistic Advisory Committee (n=4)	Professional Advisory Committee (n=3)
Age (range)	18- 35 years	19-35 years	27-60 years
Autistic vs Non-autistic	5:0	0:4	0:3
Gender			
Female	2	1	1
Male	3	3	2
Ethnicity			
White	80.0%	25.0%	66.6%
Black	0.0%	25.0%	0.0%
Asian	20.0%	25.0%	33.3%
Indigenous	0.0%	25.0%	0.0%
Employment Status			
Employed	60.0%	50.0%	100.0%
Not Employed	40.0%	50.0%	0.0%

Committee Engagement

The following section summarizes the collaborative survey development process between the PI and the committee members.

Onboarding Members

Committee members attended a 45-minute 'meet and greet' introduction session to meet their peers and receive detailed information describing the study. The purpose of the session was to discuss with members their expectations around (a) the organization/structure of meetings, (b) provide information regarding the types of digital tools (e.g., Zoom, Mural) that would be used in meetings, and (c) options for maintaining regular communication (e.g., email, text, phone) with the PI and group members. After the meeting, the PI contacted each committee member to ensure they were comfortable using the digital and communication tools and to provide support if required. Research by Bissonnette (2015) suggests that autistic adults thrive in environments and situations where they feel prepared and know what's expected of them.

A key outcome from this meeting was the agreement on a decision-making process for developing materials in which any action (e.g., modification, addition, or deletion of questions) was made based on mutual agreement and group consensus. All decisions were shared with group members, and no action was taken without the collective consent of committee members. To address potential disagreements, the committee agreed that discussions would be held to identify a compromise between all members.

Meetings

The PI facilitated structured meetings with each committee. This consisted of checking in with members to inquire about any questions or information that they would like to address in the meeting. The PI would start meetings with a review of agenda items and invite members to take turns in sharing their feedback/reflections with the group. The PI encouraged members to contribute to the conversation by building on ideas/suggestions raised by other members. Also, progress within the meeting was contingent upon reaching consensus that transitioning to the next agenda item was a productive step.

Scheduling Meetings. All meetings were scheduled using an online scheduling site (www.doodlepoll.com), which allowed members to choose from options of dates/times when members are available to connect.

Agenda and Pre-read Materials. The PI shared agendas and pre-read materials one-week before meetings with committee members. Studies have shown that having access to pre-read information enhances comprehension and the ability to contribute meaningfully during meetings (Van Hees et al., 2014). Pre-read materials were used to provide background, context, and definitions to ensure all participants understood the topic equally. By offering materials in advance, the PI avoided overwhelming members with excessive content during meetings, as committee members had enough time to review and absorb the information at their own pace.

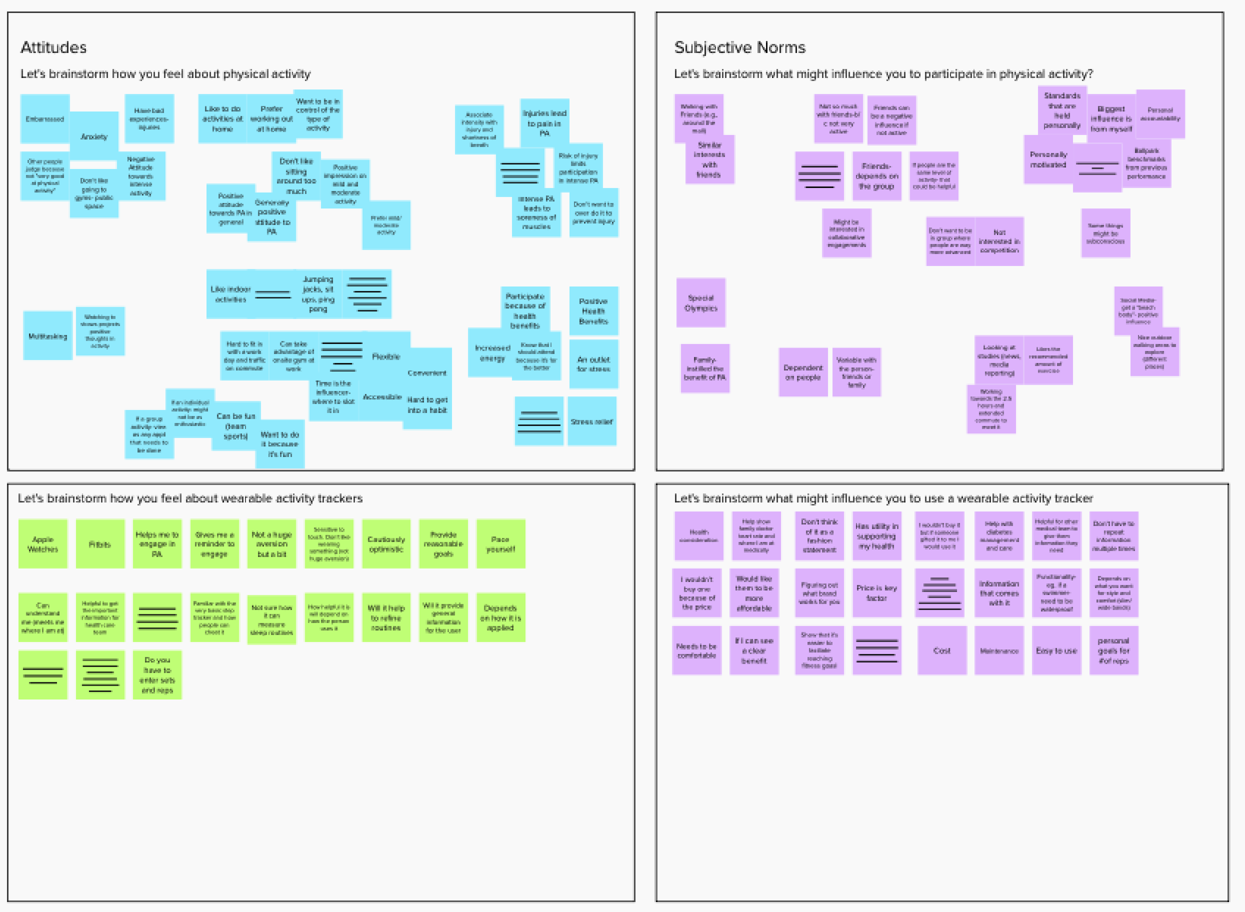
Brainstorming. Each meeting concentrated on specific themes related to participation in PA and using WATs. For example, the initial discussions centred on asking members to share their perceptions of 'how they define physical activity' and their opinions or experiences using WATs. The PI gave members discussion questions before meetings to provide more time for reflection and processing information. This helped to create a relaxed atmosphere where members could share their thoughts/opinions within a safe environment.

All discussions were followed by an activity to help generate/organize feedback to inform the development of survey questions. For example, using the TPB as the primary framework for developing and structuring questions, committee members engaged in brainstorming ideas that aligned with each of the predictor variables (i.e., attitudes, subjective norms, PBC, and intention). The PI guided the group by asking open-ended, probative questions regarding PA (e.g., In your opinion, how do previous experiences engaging in PA affect your current perceptions of PA?) and using WATs (e.g., What factors influence your decision to use/not use WATs?).

To capture feedback from the members during the meetings, the PI utilized a virtual whiteboard (i.e., Mural.co) and enlisted a volunteer scribe (E. K.) who attended all meetings and recorded the discussions on the virtual whiteboard. Using a scribe offered several advantages by providing a visual capture of ideas. This helped to ensure that committee meetings were focused and efficient, and that information was accessible, accurately captured and retained for future reference. Meetings were also designed so that members who were uncomfortable speaking in front of the group could type their responses in the chat to ensure they could participate fully. Committee members were also encouraged to take breaks when needed and to contact the PI after meetings if they had additional reflections to share.

Figure 2

Partial View of the Virtual Whiteboard After a Brainstorming Activity



Meeting Summaries. At the end of the meetings, the PI incorporated committee member feedback into the materials (e.g., refinement of PA intensity definitions) that were shared back to the groups. This process ensured that members could see that important feedback was reflected in the materials in a timely manner.

Committee members would receive an email containing updated materials and a short agenda detailing any new discussion topics one week before the next meeting. This step allowed members to review document changes and ensure that their responses were accurately reflected. In situations where members felt that additional information or changes were required, they could email the PI their comments, and they would be added to the agenda for discussion.

Meeting Schedule. The PI held five virtual meetings with the AAC and NAC committees (10 in total) and two meetings with the professional practice panel between June and September 2022. Meetings were conducted using Zoom video conferencing and were held on evenings or weekends to accommodate member's work/school schedules. Table 2 provides a synopsis of committee meetings' purpose, duration, and general outcomes. Verbal informed consent was obtained from committee members before meetings began.

Table 2

AAC/NAC Committee Meeting Plan and Outcomes

Meeting Number	Purpose	Duration	Outcomes
0	Onboarding information session	45 minutes	Committee member introductions. Provision of information describing the study and introduction of the TPB.
1	Understanding what is PA?	60 minutes	Committee members provided PI with insights on what factors: (a) motivate/discourage their attitudes towards participating in PA, (b) the impact of social influence/pressures towards incorporating PA in their lifestyles, and how perceived ability (i.e., current skills) affects the frequency of PA. Development of PA definition.
2	Defining intensity in PA	60 minutes	Development of intensity definitions designed to provide respondents with better clarity regarding differences between mild, moderate and strenuous activity, with examples.
3	Defining WATs	60 minutes	Development of a definition describing WATs for the survey. Members discussed the benefits and features of WATs that they considered useful. Discuss whether a SOS would be helpful for young adults learning how to use the technology.

			Develop questions to learn what SOS's autistic/non-autistic young adults perceive as useful.
4	Final survey review	60 minutes	Final review and revision of survey. Preparation to pilot survey with a volunteer group and development of a plan for circulating survey across Canada.

Survey Development and Review Process

To assist with the initial development of survey questions, several resources were used as a reference guide, which included the manual for the construction of questionnaires based on the TPB by Francis et al. (2004) and Kerner and Grossman's (2001) *Scales: Attitudes toward PA, Expectations of Others, Perceived Behavioral Control, and Intention to Engage in PA*. Development of survey questions followed an iterative process involving engagement in multiple rounds of question revisions, modifications and refinements based on feedback from committee members.

Gathering Survey Feedback

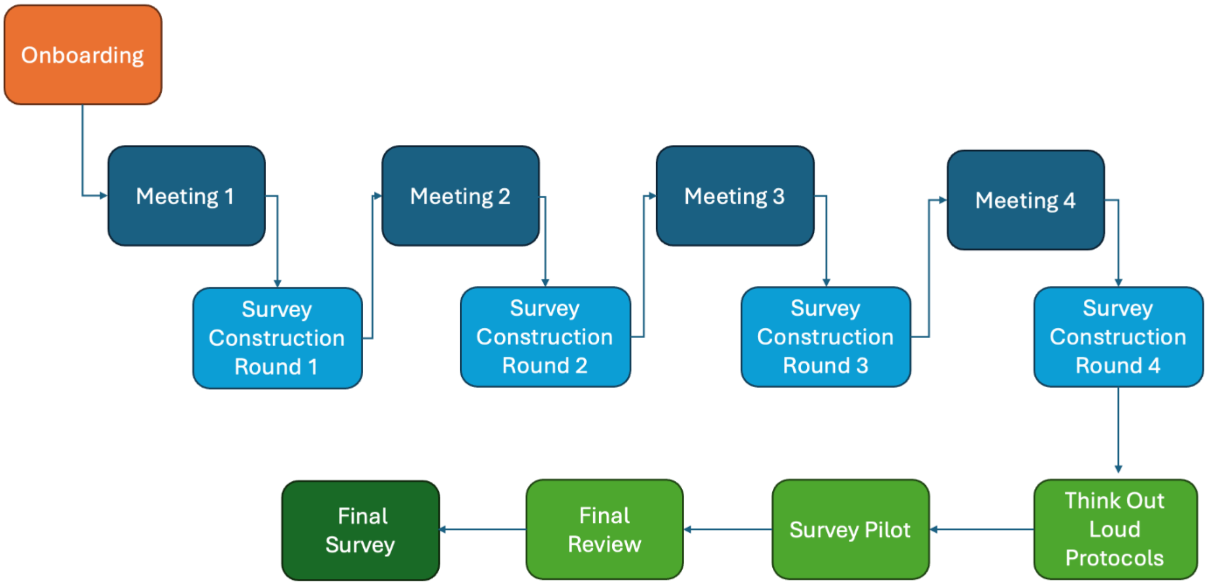
The PI leveraged Google Forms as a survey platform. Presenting an interactive online survey allowed committee members to visualize how questions were developed, selected, and categorized together according to the TPB predictor variables. Committee members were provided direct access to the survey which helped to maximize engagement by providing members with the flexibility to review questions, add comments, make suggestions, and track revisions in the survey's '*development comment sections tab'* outside of scheduled committee meetings and at their convenience. This helped ensure members were satisfied that questions accurately reflected their opinions, thoughts, and perceptions.

Survey Construction Rounds

Survey construction consisted of several rounds of review with committee members. The following section provides a description of this process.

Figure 3

Survey Development with the AAC and NAC



Meeting and Survey Construction Round 1.

In accordance with the recommendations put forth by Ajzen (1991) and Francis et al. (2004) an elicitation exercise was conducted during the first committee meeting to prompt committee members' attitudes, subjective norms, and PBC beliefs related to participating in PA and using WATs. To develop insights regarding their attitudes towards PA and using WATs, members were asked questions about their beliefs about the consequences of the behaviour (e.g., what do you think would happen if you were/were not to engage in PA on a regular basis?). Regarding subjective norms towards PA, members were asked about their beliefs about how other people (i.e., individuals with whom the committee member perceives as being important to them), would like or expect them to behave (e.g., how might your friend/spouse/parent respond if you were to decide to participate/not participate in PA?). To learn PBC towards PA, members were asked to share their views on how much personal control that they have over their behaviour (e.g., In your opinion, what activities do you think are involved with PA? and, how comfortable/uncomfortable would you be in engaging in the activities you just described?) and considerations related to how confident the member felt about being able to perform/not perform the behaviour.

Additionally, members were also asked to list the advantages and disadvantages of using a WAT (behavioural beliefs), identify which groups of people (e.g., friends, family, coworkers) would approve and disapprove of their decision to use/not use WATs (normative beliefs) and what considerations or circumstances would make it easy or difficult to use the devices (control beliefs).

Using feedback from the first committee meeting, the PI developed a series of questions designed to investigate the intention to engage in PA and use WATs. The first series of questions included 116 items organized into eight subscales, which included inquiries regarding PA Attitudes (16 items), PA Perceived Behavioural Control (18 items), PA Subjective Norm (13 items), PA Intention (16 items), WAT Attitudes (15 items), WAT Perceived Behavioural Control (11 items), WAT Subjective Norm (15 items), and WAT Intention (12 items). The initial high volume of questions was based on recommendations by Francis et al. (2004) to develop questions covering a wide range of behaviours and situations. Once the initial bank of questions was developed, it was presented to committee members for evaluation and feedback.

Members were asked to evaluate questions based on four aspects: (a) accuracy (i.e., does the question reflect feedback provided by the group?), (b) relevance (i.e., does the question provide information that addresses the specific subscale?), (c) clarity (is the question clear and makes sense to you?, is the language unambiguous and easy to understand?), and (d) inclusion (i.e., does the question align well with other items in the subscale?). Members were invited to make recommendations specific to adding/removing questions and identifying areas where the composition of questions could be improved.

Overall, members reported that the composition of questions was adequate and accurate but suggested eliminating some questions that they felt were not relevant and modifying others to help clarify the question. For example, members recommended removal of the question ‘How would you rate your current level of physical activity?’ providing the rationale that participants with potential health concerns may feel ‘judged’ or experience a negative reaction (e.g., anxiety, depression) if they are dissatisfied with their present level of PA. Another recommendation that was made by members was the elimination of time bound questions (e.g., I plan on completing 2.5 hours of PA starting within the next two weeks, and I plan to ask a friend to participate in PA with me within the next two weeks, and starting next week, and I plan to participate in PA for 50 minutes three times a week). Members explained that these questions made them feel ‘stuck on a timeline’ and ‘compelled to participate in PA’ over having an opportunity to engage in PA at a time/place of their choosing.

A general concern that was raised was that when asked, members of the AAC became very focused on the literal interpretations of the makeup of time bound questions (e.g., members focused on calculating specific time slots related around the duration, activity types, days of the week, and scheduling PA to consider minute details of their weekly schedules, etc.). During the discussion, several members suggested that they felt having time bound questions made it more complicated to arrive at a decision, which might frustrate or dissuade autistic respondents from answering questions. It was agreed that all time bound questions would be eliminated to avoid the possibility of making the survey more challenging for autistic young adults. Additionally, committee members recommended removing questions that focused on separating the 2.5 hours of weekly PA into increments (e.g., engaging in 30 minutes of PA daily over five days). Members found these questions did not consider the individual's choice in how they would break down and pursue PA on their terms.

Meeting and Survey Construction Round 2. During this round, the PI and committee members discussed whether specific physical activities (e.g., walking, running, cycling, etc.) should be paired to describe various PA intensities (i.e., mild, moderate, and strenuous activity). This was an area in which committee members felt would be confusing for autistic/non-autistic young adults. Members recommended developing a series of definitions that clearly describe PA and distinguishing between different levels (e.g., mild, moderate, and strenuous) of PA.

The committee members' brainstorming activities helped shape the definition of PA for the study. Upon learning that PA is more than engaging in physical exercise and includes many daily activities, some committee members began to re-examine their level of PA engagement, noting that they 'are far more active' than they realized. Some mentioned that they walked to work or they walked their dog daily, but they hadn't considered this to be PA. Members insisted on providing examples of 'regular activities' (i.e., activities that people might engage in daily, such as walking, vacuuming, yard work, etc.) to ensure that individuals completing the survey were better informed on activities to consider when considering how to answer questions.

It was in these meetings that committee members determined that participating in specific PA does not necessarily equate to a specific level of intensity (e.g., for a sedentary person, a 5 km walk might be considered 'strenuous physical activity' when compared to an active person who might consider a 5 km walk to be ‘mild physical activity’). This determination shifted the survey away from questions regarding specific types of activity to developing clear definitions describing the differences between intensities. This decision also led committee members to recommend eliminating or replacing several questions with more specific PA intensity questions related to the attitude and PBC subscales. Members also received draft copies of the information letter (Figure A2) and consent form (Figure A3) (see Appendix A) for review and feedback.

Meeting and Survey Construction Round 3. This round focused on identifying and discussing questions to assess what support methods autistic and non-autistic young adults believe would benefit them in learning how to use WATs. Based on this discussion, a system of support (SOS) question (e.g., “The following supports would help me with learning how to use a WAT”) with several selection options was developed for the survey.

Members also made an additional recommendation for providing brief definitions that would help respondents to be better informed on how to think about each series of questions, and using a single scale to record responses would help reduce potential mental fatigue associated with answering questions. Additionally, it was also agreed that questions would be presented within their associated subscale (e.g., PA attitude questions grouped and presented together, PA subjective norms grouped and presented together, etc.) with a brief description (e.g., *This section will help us learn more about your attitude towards physical activity*) explaining the purpose of the section. All committee members were strongly in favour of sharing this information to give respondents greater clarity regarding different sections of the survey.

Committee members provided additional feedback directly in the survey indicated that they felt that questions that paired ‘friends and family’ together could be perceived as confusing. In group discussions, AAC and NAC members suggested that young adults may have higher intention/motivation to engage in PA with friends, but this might not be reflected in their responses if the question also includes family (e.g., parents, siblings, etc.) members. Research by Buchanan and colleagues (2017) supports this assertion, suggesting that some autistic young adults may perceive the influence of parent engagement specific to PA as a barrier to their independence, as many are dependent upon direction from care providers, sometimes well into adulthood. To address this issue, the PI developed questions designed to focus on friends and separate questions focused on family members.

Another significant recommendation was to use a single consistent Likert scale (e.g., strongly agree to strongly disagree) for all questions. The survey was structured with several bipolar evaluative adjectives (i.e., a mixture of positive and negative endpoints) as suggested by Francis et al. (2004). Ideally, the list of responses following questions would range from (a) good to bad, (b) very pleasant to very unpleasant, (c) easy to difficult, (d) relaxing to stressful, (e) harmful to beneficial, (f) important to unimportant, (g) useful to worthless, and (h) agree to disagree. All committee members felt that the use of so many descriptors for answers was cumbersome and reduced their ability to focus. One member noted "it took more time to have to stop and think about what the question is asking" -Committee member 2. Several members suggested that providing too many choices could potentially pose a risk of confusing respondents who might be unfamiliar with the meaning implied from some of the descriptors used. Research by Brosnan et al. (2021), suggests that data quality suffers when respondents have difficulty completing complex tasks in surveys. Survey questions were updated to include a five-point Likert scale from 'strongly disagree to strongly agree'. All committee members agreed that this approach would make it easier for respondents to answer questions without feeling overwhelmed.

Meeting and Survey Construction Round 4. The final round of survey development consisted of committee members reviewing the survey's final revision. The decision to use a single Likert scale for all questions required the PI to make minor changes to the wording of some questions in several subscales. A summary of modifications are available in Table A1 (see Appendix A) Committee members were asked to complete a final review of all sections of the survey, including (a) introduction letter describing the study (Figure A2), (b) the consent form (Figure A3) (see Appendix A), (c) survey instructions, (d) definitions of PA, WATs, and intensity levels, and (e) final question revisions.

Additionally, the PI collaborated with committee members to determine what would be the best means to reach the target population of interest (i.e., autistic/non-autistic young adults) across Canada. Several recommendations were made, ranging from conducting an email campaign soliciting autistic support service organizations, requesting permission to post links for the survey on popular websites (e.g., Autism Speaks Facebook page), and enlisting the assistance of a survey management company. The final plan included (a) the PI contacting autistic support organizations across Canada to request permission to post the survey in their newsletters, websites and social media, resources centers, and (b) contacting a survey management company to assist with identifying a diverse and representative sample of autistic and non-autistic young adults. Once the PI received final approval from the committees, the survey was subjected to think-out-loud protocols before being piloted.

Survey Development Limitations with the TPB

Using the TPB as a framework for creating the survey in collaboration with AAC provided several insights which influenced the development of questions, responses to items, and the number of survey questions used. Initial question development relied heavily on guidance from TPB construction guides (e.g., Ajzen, 1991) and manuals (e.g., Francis et al., 2004). However, there are some areas in which the PI and committee members made changes/adaptations to some of the suggested manual recommendations.

A primary concern for AAC members was the theory's focus on time-bound elements of activities. Several members of the AAC were strongly opposed to the development of questions in which a specific time commitment (e.g., participating in PA every day for an hour, starting next week) was a factor. This was a departure from the TPB recommendation of defining the behaviour of interest in terms of its Target, Action, Context, and Time (TACT; Francis et al., 2004). A key critique of using time-sensitive questions was that most members felt that introducing PA associated with a specific timeline (e.g., running on a treadmill for 20 minutes three times a week) may unintentionally influence/pressure responses into thinking that they would need to engage in the specific activity and frequency to be considered actively engaged in PA.

Another concern that members raised was the application of different bi-polar adjective pairs (e.g., valuable - worthless, harmful – beneficial, etc.). Research by Azjen (1991) notes "to make sure that the bipolar adjectives selected for inclusion are in fact evaluative in nature (for the behavior and population of interest), the investigator should start with a relatively large set, perhaps 20 to 30 scales" (p.5). Although the manual strongly recommends the use of several bi-polar adjective parings, this was an issue that all AAC members felt was unnecessary and confusing. For example, members pointed out that several of the adjective scales contained wording that seemed either vague (e.g., harmful – beneficial) or very similar (e.g., pleasant – unpleasant vs. enjoyable – unenjoyable). Members pointed out that using too many scales could leave autistic respondents vulnerable to misunderstanding questions or frustrated trying to figure out the meaning of answers to each question. In listening to the concerns of the AAC a decision was made to shift away from using multiple bipolar adjectives and just using one. Members felt that this step represented the best way to ensure clarity of answers for autistic respondents.

Think-Out-Loud Protocols

Before piloting the survey, five volunteers (three autistic and two non-autistic) were recruited to participate in a series of ‘think out loud’ protocols to evaluate and establish construct validity. Based on the process developed by Trenor and colleagues (2011), think-aloud protocols involve asking each volunteer to read all survey questions aloud and verbalize their cognitive processes as it relates to (a) how the volunteer conceptualized the question (i.e., their perception of what they think the question is asking), (b) clarity of the survey questions (i.e., do questions make sense, or are they confusing?), (c) clarity of concepts (i.e., do definitions make sense or are they unclear?), and (d) logic of survey answers (i.e., do the answers to each question make logical sense and does it ‘fit’ the question being asked?). For each question, the researcher asked a series of probing questions (e.g., what thoughts come to mind when you read this question? what would make this question less confusing, etc.) to elicit feedback from each volunteer.

During this process, volunteers were asked to engage in a respective protocol (Trenor et al., 2011) where at the end of specific sections of the survey (e.g., questions on attitudes, subjective norms, PBC), the participant was asked to reflect upon the section questions and provide feedback on what they believed to be the focus of the question grouping. Specifically, this element of the think-aloud protocol provided information to determine if questions within specific sections of the survey seemed confusing/incongruent or if the volunteer felt additional information was required to ensure clarity for participants. Once the PI was satisfied that the survey questions were clear based on responses from the think-out-loud protocols, the survey was piloted using a small sample of autistic and non-autistic participants.

Survey Pilot

An online survey platform (i.e., Google Forms) was selected to pilot the survey with a small sample group. The design of the survey provided respondents with (a) a definition of PA, (b) guidelines for participating in PA, (c) information on differences between PA intensities (mild, moderate, and strenuous activity), and (d) information describing WATs, prior to answering questions. Survey questions used a five-point Likert scale and applied a bi-polar adjective (e.g., strongly disagree-strongly agree) to answer questions. All questions were organized into subcategories according to their respective TPB constructs (attitudes, subjective norms, PBC, and intention), and participants completed the survey starting with PA questions and moving to WATs.

Thirty-three participants volunteered to pilot the survey. The sample consisted of 15 (45.5%) autistic and 18 (54.5%) non-autistic young adults and contained more females (n=17, 51.5%) than males (n=15, 45.5%). One trans-gender male (3%) also completed the survey. Overall, the sample had fewer young adults between 18 and 25 years old (n=14, 42.5%) than older adults between 26 and 35 years old (n=19, 57.5%).

In total, 59 questionnaire items were retained. 35 items were used to develop the PA intention scale, 18 items were used to develop the WAT intention scale, and six items were used to collect characteristic information. Coefficient alpha was used to determine the reliability of the PA and WAT questions used in the survey. The strength of the alpha value was interpreted using the guidelines suggested by George and Mallery (2020), in which alpha scores of .9 or higher are Excellent, a > .8 Good, a > .7 Acceptable, a > .6 Questionable, a > .5 Poor, and an a < .5

Unacceptable. The alpha values for the majority of TPB constructs ranged between good and acceptable, apart from one construct (i.e., PBC strenuous intensity) that had an alpha value within the questionable range. Collectively, all items in the PA scale met the good threshold, and the alpha value for combined items in the WAT scale met the excellent threshold for internal consistency which can be referenced in Table B1 (see Appendix B).

After the survey pilot's completion, committee members were invited to participate in reviewing the survey pilot data. This provided members with a final opportunity to provide comments or make suggestions to refine questions. Suggestions for revising questions, shortening the survey length, and clarifying the logic and branching in several questions resulted in slight modifications to some questions, which were incorporated before engaging in preparations to make the survey accessible to the public.

Survey Launch

The final survey content (consisting of study introduction letter, consent form, PI contact information, definitions, directions for completing the survey, and survey items) in Figure A4 (see Appendix A) was uploaded and formatted using the Qualtrics XM survey platform. This survey platform provided more rigor in survey design and additional safeguards to protect against potential data quality errors such as preventing multiple submissions, bot detection, fraud detection, and advanced security to restrict access to the survey results to the PI.

A power analysis using G*Power software (Faul et al., 2009) was conducted to determine the minimal sample size necessary to detect medium differences between the autistic and non-autistic groups. Calculating a sample size for multiple regression (moderate effect size of 0.15, an alpha of 0.05, and a power of 0.95 and number of predictors =14) indicated a total sample size of 194 participants. Statistics Canada (2020) reports that close to 8.7 million young adults within the age group of interest (18-35 years old) live in Canada. A review by Anagnostou et al. (2014) suggests that approximately 1 - 2% of Canada's population is affected by autism. Thus, the estimated population size of autistic young adults is 173,579 (i.e., 2% of the 2020 young adult population). As the intent of this survey was to have a nationally representative sample of autistics and non-autistics across Canada, the PI consulted with a survey expert to inquire about the number of participants that would be required to meet this standard. Using the estimated population size of autistic young adults, the PI set a target goal of receiving feedback from 766 (383 autistic and 383 non-autistic) participants. The calculation used to determine the sample size for this target goal is presented in the appendix. Based on this goal, a participant recruitment target was developed and adjusted to account for the population density of each province/territory presented in Table A2 (see Appendix A).

Survey Participant Recruitment

Participant recruitment consisted of a combination of recruitment strategies which included using a recruitment poster in Figure A1 (see Appendix A) in the following locations:

- postings at several Canadian universities' campuses (e.g., University of Calgary, Mount Royal University, University of Alberta, and Western University),
- postings on social media
- postings in autism-specific newsletters and websites recommended by the AAC,
- direct email solicitation to 68 autism specific community support agencies in each province across Canada. Information on which agencies were contacted is in Table A3 (see Appendix A).
- Qualtrics participant recruitment services

Previous studies have demonstrated the value of using the Qualtrics platform when soliciting feedback from hard-to-reach populations (Holt & Loraas, 2019). Qualtrics utilizes multiple sources (e.g., traditional market research panels, social media, and niche panels identified through specialized recruitment campaigns to maximize access to diverse populations) to assist with survey promotion, recruitment, and data collection for participants across Canada.

Survey Participant Requirements. To be included in the study, participants had to be between the ages of 18-35, able to read/understand English, have access to a computer/digital device (e.g., tablet, smartphone) capable of accessing the survey, and be a Canadian resident. The study used purposive sampling, a technique designed to identify groups with specific attributes of interest to the research to identify autistic participants (Campbell et al., 2020).

Survey Access

Participants could access the survey through the www.activehealthproject.com website. Informed consent for participation in the study was obtained by having respondents review and consent to on an online document before being granted access to the survey. The information summarized in the consent letter provided a thorough description of the study, instructions for completing the survey, details on the risks/benefits, and contact information for the research and supervisor for participant inquiries. The Information Letter is available in Figure A2 and the Consent Form is available in Figure A3 (see Appendix A). Participants who completed the informed consent documentation were taken to a new webpage that provided a short list of basic definitions describing PA, differences in the range of intensities (e.g., mild, moderate, and strenuous) associated with PA, and a Health Canada guideline providing information on the recommended amount of PA to attain optimal health benefits. These definitions were designed with the AAC to provide participants with greater clarity around the different types of activities, environments, and contexts in which PA can occur. Data collection occurred from February 1, 2023 to April 30, 2023.

The survey data was extracted from Qualtrics and uploaded into SPSS version 29.0 for Mac OS X. Prior to analysis, the data was reviewed for accuracy and missing information. A total of 526 survey responses were collected, but 71 respondents did not meet the participation inclusion criteria (i.e., failure to provide diagnosis/no diagnosis information or meet the required minimum survey completion cutoff) to have their responses included in the study. These participants were removed from the final data analysis.

Qualtrics flagged five participants with the response quality feature, ‘Expert Review,’ which checks the overall quality of the data collected prior to analysis. These participants were flagged for having identical responses to multiple questions and for how quickly they completed the survey (e.g., ranging from three to six minutes) in comparison to the group average of eight minutes and 10 seconds. Each response was reviewed to determine if they were valid responses. However, each of the identified five participants displayed unusual response patterns on the survey. These participants selected the same answer (e.g., only selected the answer strongly disagree) for all items on the survey, and the discrepancy was apparent based on their answers to reversed coded questions.

Previous research suggests that when survey participants provide identical answers to items in a battery of questions using the same response scale, this is referred to as straight-lining, which can reduce data quality (Kim et al., 2018). Reuning and Plutzer (2020) note that straight-lining is a common type of survey error that can result in inconsistent responses, lead to inaccurate data collection, and could have serious implications for studies seeking insights based on participant data. For this reason, the data from these participants was also excluded from the final analysis.

In total, data from 76 participants were removed from the analysis, and the final sample consisted of 450 participants. A summary detailing the rationale for the removal of these participants can be found in Table A4 (see Appendix A). Sampling distributions of all variables of interest (i.e., attitude, subjective norms, PBC, and intention for both PA and WAT, and PA intensity: mild, moderate, and strenuous) were graphically inspected. The normality of distributions was acceptable for each variable.

Participant Characteristics

The sample consisted of 138 males (30.67%), 245 females (54.44%), 21 (4.67%) another gender (i.e., non-binary/gender nonconforming, transgender males and females, and two-spirit Indigenous), and 46 (10.22%) participants who chose not to identify their gender. Most participants identified themselves as non-autistic (n= 328, 72.89%), and most participants from both groups identified as having attended a post-secondary (e.g., technical/trade, college, or university) educational institution (n= 236, 52.4%). There were significant differences between the groups in relation to employment, where more than half of the non-autistic sample reported engagement in full-time employment (n= 181, 56.0%) compared to less than a third of autistic participants (n=38, 31.1%). The autistic sample also reported higher percentages of unemployment (n= 43, 35.3%) in comparison to the non-autistic sample (n= 64, 19.5%). This information aligns with current studies suggesting that autistic young adults have some of the poorest employment outcomes when compared to the general population (Nicholas et al., 2017).

Autistic participants provided personal confirmation of their autism diagnosis, and many (n= 88, 72%) provided some additional information (e.g., information on health professionals who provided autism confirmation) specific to their diagnosis. It was not possible to obtain specific detailed information (e.g., psychological reports) to confirm a diagnosis due to the nature of the study (i.e., completion of an online survey) and its intended reach across Canada. Participants from the autistic sample consisted primarily of female young adults (n=56, 45.9%), which was interesting considering past studies estimated the male-to-female prevalence ratio for autism as three to one (Loomes et al., 2017). Of note, almost twice as many female participants completed the survey as compared to males. This is in line with research by Becker (2022), who found that women tend to be more likely to participate in online surveys than men. Table 3 provides a detailed summary of the survey participants.

Table 3

Frequency Table of Survey Characteristics

	Autistic		Non-Autistic		Full Sample	
Characteristics	n	%	n	%	n	%
Age						
18-25	94	77.0	189	57.6	283	62.9
26-35	28	23.0	139	42.4	167	37.1
Gender						
Male	38	31.1	100	30.5	138	30.7
Female	56	45.9	189	57.6	245	54.4
Another Gender	13	10.7	8	2.44	21	4.7
Transgender Male	*4*	*3.3*	*0*	*0.0*	*4*	*0.9*
Transgender Female	*2*	*1.6*	*2*	*0.6*	*4*	*0.9*
Two-spirit Indigenous	*2*	*1.6*	*3*	*0.9*	*5*	*1.1*
Non-binary or gender nonconforming	*5*	*4.1*	*3*	*0.9*	*8*	*1.8*
I prefer not to answer this question	15	12.3	31	9.5	46	10.2
Location						
British Columbia	17	13.9	43	13.1	60	13.3
Alberta	39	32.0	43	13.1	82	18.2
Saskatchewan	8	6.6	7	2.1	15	3.3
Manitoba	4	3.3	14	4.3	18	4.0
Ontario	33	27.0	119	36.3	152	33.8
Quebec	13	10.7	81	24.7	94	20.9

Newfoundland and Labrador	1	0.8	6	1.8	7	1.6
New Brunswick	1	0.8	4	1.2	5	1.1
Nova Scotia	3	2.5	10	3.1	13	2.9
Prince Edward Island	1	0.8	1	0.3	2	0.4
Nunavut	1	0.8	0	0.0	1	0.2
Yukon	1	0.8	0	0.0	1	0.2
Education						
High School	51	41.8	114	34.8	165	36.7
Some high school	*4*	*3.3*	*15*	*4.6*	*19*	*4.2*
High school diploma/certificate	*47*	*38.5*	*99*	*30.2*	*146*	*32.4*
Post-Secondary	59	48.4	177	54.0	236	52.4
Technical/Trade Institution diploma	*15*	*12.3*	*16*	*4.9*	*31*	*6.9*
College diploma	*25*	*20.5*	*55*	*16.8*	*80*	*17.8*
University degree	*19*	*15.6*	*106*	*32.3*	*125*	*27.8*
Graduate School (graduate degree or higher	8	6.6	33	10.1	41	9.1
I prefer not to answer this question	4	3.3	4	1.2	8	1.8
Current Employment Status						
Full Time	38	31.1	181	56.0	219	48.7
Partially Employed (Part-Time, Seasonal Work, Self-Employed)	41	33.6	83	25.3	124	27.6
Not Employed (Not Currently Employed, Student, Volunteer, Other)	43	35.3	64	19.5	107	23.8

Note. Due to rounding errors, percentages may not equal 100%.

Summary

This chapter described the PR process used to work with three committees consisting of autistics, non-autistics, and community professionals. Committee members assisted in the process of developing questions for a Canadian survey to learn about interest in PA, using WATs, and interest in using an SOS to learn about WATs. The TPB was used as a framework for developing questions, but due to concerns from committee members, some adjustments had to be made, which represented a departure from some of the TPB suggestions. At the conclusion of the PR process of discussions and feedback review, 59 survey items were created. A final round of think-out loud protocols was used prior to piloting the survey with a small volunteer sample. Once finalized, the survey was made available on-line for several months. 526 responses were received and reviewed for accuracy and data quality. 450 responses were retained for analysis. The next chapter will provide a detailed analysis of the collected survey data and results.

Chapter Four: Data Analysis and Results

The chapter delves into the analysis of the survey data by looking at the TPB constructs of attitude, PBC, subjective norms and intention in PA, using WATs, and SOS. This chapter will outline the efforts made to ensure the reliability and validity of the statistical inferences. Following the details to validate assumptions, details will be provided on the various analysis conducted including multivariate analysis of variance (MANOVA), analysis of variance (ANOVA), linear and logistic regressions. Additionally, a review of any associated post-hoc tests will provide nuanced insights into the specific characteristics that were controlled for.

Multivariate analysis of variance (MANOVA) was used to test if differences exist between the autistic and non-autistic intention to engage in PA, use WATs, and preference towards different intensity levels (i.e., mild, moderate, strenuous) of PA. In instances which significant differences were discovered, post-hoc follow-up tests consisting of analysis of variance (ANOVA) were used to identify which variables between the autistic and non-autistic groups differ from each other. A linear regression was then applied to determine the extent to which the variable contributes to the group variations. Finally, frequency counts and percentages were used to examine differences between the autistic and non-autistic groups on what specific supports were perceived as beneficial for using WATs.

Independence of Variables

To assess whether other extraneous variables (e.g., age, gender, level of education, and employment status) may be influencing the results of the primary PA research questions, a Chi-square test of independence was used to determine whether a significant relationship exists between the characteristic variables and autistic/non-autistic groups.

Assumptions of Chi-Square Analysis. The assumption of adequate cell size for conducting a Chi-square test was assessed, which requires all cells to have expected values greater than zero and 80% of cells to have expected values of at least five (McHugh, 2013). All cells had expected values greater than zero, indicating the first condition was met. A total of 100% of the cells had expected frequencies of at least five, indicating the second condition was met. Results from the Chi-square statistic were based on an alpha level of .05 and indicated significant differences between the groups with regards to age: $\chi2$ (1, N=2) = 14.38, p < .001, gender: $\chi2$ (3, N=4) =15.82, p = .001, and employment status: $\chi2$ (2, N=3) = 22.04, p < .001. There were no significant differences between the groups associated with education level: $\chi2$ (3, N=4) = 5.06, p = .168.

Primary Analysis

To address the first three research questions, Multivariate analysis of variance (MANOVA) tests were selected to support the data analysis. The use of a MANOVA allows for the analysis of multiple variables while controlling for the categorical variables (i.e., gender, age, and employment status) of significance (Kahlert et al., 2017). Three MANOVA tests were conducted to assess if there are significant differences in the TPB variables used to assess PA (i.e., PA attitude, PA PBC, PA subjective norms, and PA intention), PA intensity preference (i.e., mild, moderate, and strenuous intensity level), and interest in using WATs (i.e., WAT attitude, WAT PBC, WAT subjective norms, and WAT intention) between the autistic and non-autistic groups after controlling for age, gender, and employment.

Assumptions of Multivariate Analysis of Variance.

Prior to completing the MANOVA analyses used for this study, all assumptions were checked.

Sample Size. To increase generalizability, the sample exceeded the minimal sample size target of 194 participants to detect a medium effect size as determined by a power analysis for a multiple regression group sample (Zodpey, 2004).

Multivariate Normality. To assess the assumption of multivariate normality, the squared Mahalanobis distances were calculated for the model residuals and plotted against the quantiles of a Chi-square distribution (DeCarlo, 1997; Field, 2017). In the scatterplot, the solid line represents the theoretical quantiles of a normal distribution. Multivariate normality can be assumed if the points form a relatively straight line. The scatterplots of normality for each linear combination are presented in Figures B1-B3 (see Appendix B).

Homogeneity of Covariance Matrices. Box's M test was conducted to examine the assumption of homogeneity of covariance matrices. Research by Hahs-Vaughn (2016) notes that the Box's M is susceptible to reporting errors (e.g., a statistically significant result when one does not exist) at an alpha level of .05. Specifically, Box's M has been criticized for being overly sensitive and more likely to report violations for large sample sizes (Warner, 2013). Using an alpha of .001, the results for PA Intention were not significant, $\chi2(10) = 13.32$, $p = .206$, as were the results of WAT Intention, $\chi2(10) = 21.74$, $p = .016$. This indicates that the covariance matrices for each group were similar to one another, and that the assumption was met. The results of PA Intensity were significant, $\chi2(21) = 48.79$, $p < .001$, indicating that the covariance matrices for each group were significantly different from one another, and the assumption was not met. However, additional research (e.g., see Allen & Bennett, 2008; Kang & Jin, 2016) has indicated when sample sizes are larger than 30 participants, then the MANOVA is robust against violations of homogeneity of variance. While the assumption was not met for PA intensity, the sample size is large enough that a violation of this assumption can be tolerated, and the analysis was conducted using a MANOVA.

Univariate and Multivariate Outliers. The survey data was also assessed for univariate and multivariate outliers. Research by Tabachnick and Fidell (2019) notes that univariate outliers are data points that consist of an extreme value on a single variable, whereas multivariate outliers represent a combination of unusual scores that include at least two variables. Standardized Z-score values were used to identify 12 univariate outliers in the sample. With the use of a $p < .001$ criterion for Mahalanobis distance, 11 multivariate outliers representing less than three percent of the total sample were identified.

Both types of outliers can affect the outcome of statistical testing (Tabachnick & Fidell, 2019). To assess the influence on the means of the groups, two sets of analyses were conducted, both including and excluding univariate and multivariate outliers. The results of the analysis found both univariate and multivariate outliers had a nonsignificant effect on the sample means. Based on these findings, the outlier data was included in the final analysis.

Prior studies (e.g., Brewster & Coleyshaw, 2011; Hassani et al., 2020; Todd & Reid, 2006) suggest that autistics may not perceive engagement in PA or other recreational activities as a favorable or important activity due to past negative experiences. Thus, it is reasonable to assume that some extreme scores would be a natural part of the population of interest. Research by Tabachnick and Fidell (2019) also notes that removing outliers can sometimes lead to a biased dataset or inaccurate conclusion. Additional studies have found that outliers have less of an effect on a study's results when the sample size is large (George & Mallery, 2019).

Absence of Multicollinearity. Correlation matrices were calculated to examine multicollinearity between the dependent variables of interest. When conducting a multiple regression, it is important for independent variables to show at least some relationship with their respective dependent variables (Tabachnick & Fidell, 2019). For the theory of planned behaviour (TPB) constructs for PA, the scales for attitude (r =.24, p<.001), subjective norms (r =.49, p<.001), and PBC (r =.63, p<.001) showed mild to moderate correlations. This pattern was similar for attitude towards PA intensity for mild (r =.75, p<.001), moderate (r =.50, p<.001), and strenuous (r =.26, p<.001) activity preferences.

Correlations for PBC towards PA intensity for mild (*r* =.80, *p*<.001), moderate (*r* =.44, *p*<.001), and strenuous (*r* =.24, *p*<.001) scales and WATs scales for attitude (*r* =.62, *p*<.001), subjective norms (*r* =.68, *p*<.001), and PBC (*r* =.57, *p*<.001) were also mild to moderate. In each case, all variable combinations had correlations less than 0.9 in absolute value, indicating the results are unlikely to be significantly influenced by multicollinearity. The correlation matrices are presented in Tables B2-B4 (see Appendix B).

Analysis of TPB Constructs for PA

To examine if there were significant differences between autistic and non-autistic participants in terms of intention to engage in PA, a MANOVA was conducted with PA attitude, PA PBC, PA subjective norms, and PA intention as dependent variables while controlling for gender, age, and employment. The results of this analysis yielded a significant multivariate effect, Pillai's Trace=.02, *F* (4, 439) = 2.59, *p* = .037, η^2_p = 0.02, indicating that PA differences exist between the autistic and non-autistic groups. Results of the MANOVA are presented in Table B5 (see Appendix B).

Post-hoc testing.

To further examine the effects of group affiliation, an analysis of variance (ANOVA) was conducted to determine whether there were significant differences for each dependent variable controlling for age, gender, and employment. In situations where gender, age, or employment were still identified as significant, linear regression analysis was applied to predict the extent of variance accounted for by the variable. Results of post-hoc testing are presented below, and Table B6 (see Appendix B) summarizes the results of all regression models in which age, gender, or employment were significant.

PA Attitude. The results for group self-identification were not significant, F (1, 442) = 0.88, p = .350, ηp2 = 0.00. However, results for age, F (1, 442) = 8.04, p = .005, ηp2 = 0.02, and gender, F (1, 442) = 3.25, p = .022, ηp2 = 0.02, were significant indicating that there were differences among the groups related to their attitudes towards PA. A linear regression analysis was conducted to further understand how the variables of age and gender predict attitude towards PA.

The results of the regression model indicated that two predictors, adults between 26-35 and participants in the gender category of 'I prefer not to answer this question' explained approximately 4.91% of the variance in attitude towards PA, F (4,445) = 5.75, $p < .001$, $R^2 = .05$. The age category of 26-35 predicted an average mean score increase of 0.45, and the gender category of 'I prefer not to answer this question' predicted an average mean score decrease of 0.73. Table B6 (see Appendix B) summarizes the results of the regression model.

PA PBC. The results for group self-identification were significant, F (1, 442) = 5.77, p = .017, ηp2 = 0.01, indicating that there were differences among the groups in how they perceived their ability to engage in PA. Eta squared was 0.01, indicating differences between the groups explain approximately 1% of the variance in PBC towards PA.

PA Subjective Norms. The results for group self-identification were significant, F (1, 442) = 6.09, p = .014, ηp2 = 0.01, indicating significant differences among the groups related to their perceptions of expectations/social pressures from family, friends, and social media. Eta squared was 0.01, indicating differences between the groups explain approximately 1% of the variance in subjective norms towards PA.

PA Intention. The results for group self-identification were significant, F (1, 442) = 8.83, p = .003, ηp2 = 0.02, indicating significant differences among the groups related to their intention towards participating in PA. The eta squared was 0.02, indicating differences between the groups explain approximately 2% of the variance in PA Intention. Additional results of the PA Intention ANOVA are presented in Table 4.

Table 4

Analysis of Variance for PA Attitude, PA PBC, PA Subjective Norms, and PA Intention by Group Self-Identification, Age, Gender, and Current Employment

Variable	Term	*SS*	*df*	*F*	*p*	ηp2
PA Attitude	Self-Identification	1.81	1	0.88	.350	0.00
	Age	16.58	1	8.04	.005	0.02
	Gender	20.11	3	3.25	.022	0.02
	Current Employment	3.62	2	0.88	.416	0.00
	Residuals	911.50	442			
PA PBC	Self-Identification	4.55	1	5.77	.017	0.01
	Age	0.31	1	0.40	.528	0.00
	Gender	2.50	3	1.06	.366	0.01
	Current Employment	0.33	2	0.21	.809	0.00
	Residuals	348.48	442			
PA Subjective Norms	Self-Identification	3.12	1	6.09	.014	0.01
	Age	0.008	1	0.02	.900	0.00
	Gender	2.42	3	1.58	.194	0.01
	Current Employment	1.92	2	1.88	.154	0.01
	Residuals	226.11	442			
PA Intention	Self-Identification	5.75	1	8.83	.003	0.02
	Age	0.04	1	0.06	.806	0.00
	Gender	2.49	3	1.27	.283	0.01
	Current Employment	0.48	2	0.37	.693	0.00
	Residuals	288.15	442			

Differences in TPB constructs for PA.

The first research question of this study was to assess whether differences exist between autistic and non-autistic adults regarding their intention to incorporate PA. An analysis of the sample's marginal means found a non-significant result regarding participants' attitudes toward PA. This finding suggests that autistic participants have attitudes ($M = 3.41$, $SE = 0.15$) towards PA that are similar to that of their non-autistic peers ($M = 3.56$, $SE = 0.12$). However, there were significant differences between the groups relative to each group's beliefs in their ability (i.e., PBC) to perform PA, perceptions about the social expectations/attitudes of friends/family members regarding participation in PA, and intention to participate in PA.

Overall, participants from the non-autistic sample produced higher mean scores on each of the constructs, consistent with previous research evaluating intention based on the TPB (Hillier et al., 2020). An observation of the self-reported information based on a 5-point Likert scale (strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, and strongly agree) suggests that autistics' sense of attitude, perceived behavioural control, subjective norms, and intention were between a neutral and somewhat positive opinion rating regarding PA. Table 5 compares the marginal means of each construct between the autistic and non-autistic samples. Each marginal mean represents the average response scores for the TPB constructs after controlling for age, gender, and employment.

Table 5

Marginal Means, Standard Error, and Sample Size for PA Attitude, PBC, Subjective Norm, and Intention by Group Self Identification Controlling for Age, Gender, and Employment

Variable	Group	Marginal Means	SE	n
PA Attitude	Autistic	3.41	0.15	122
	Non-Autistic	3.56	0.12	328
PA Perceived Behavioural Control	Autistic	3.52	0.09	122
	Non-Autistic	3.76	0.07	328

PA Subjective Norms	Autistic	3.41	0.07	122
	Non-Autistic	3.60	0.06	328
PA Intention	Autistic	3.55	0.08	122
	Non-Autistic	3.82	0.07	328

Analysis of PA Intensity

To examine if there were significant differences between autistic and non-autistic participants in relation to PA intensity preference, a MANOVA was conducted with PA attitude mild, PA attitude moderate, PA attitude strenuous, and PBC mild, PBC moderate, and PBC strenuous as dependent variables while controlling for gender, age, and education. The results of this analysis yielded a significant multivariate effect, Pillai's Trace=.05, *F* (6, 437) = 3.75, *p* = .001, η^2p = 0.05, indicating that there are significant differences between the autistic and non-autistic groups. Results of the MANOVA are presented in Table B7 (Appendix B).

Post-Hoc Tests for PA Attitude Mild. The results for group self-identification were significant, F (1, 442) = 6.31, p = .012, ηp2 = 0.01, indicating significant differences among the groups' attitudes towards mild intensity PA. The eta squared was 0.01, indicating differences between the groups explain approximately 1% of the variance in attitudes toward mild PA.

Post-Hoc Tests for PA Attitude Moderate. The results for group self-identification were significant, F (1, 442) = 14.44, p = <.001, ηp2 = 0.03, indicating significant differences among the groups' attitude towards moderate intensity PA. The eta squared was 0.03, indicating group differences explain approximately 3% of the variance in attitudes towards moderate PA.

Post-Hoc Tests for PA Attitude Strenuous. The results for group self-identification were not significant, F (1, 442) = 0.87, p = .350, ηp2 = .00. However, results for gender were significant, F (3, 442) = 8.92, p = < .001, ηp2 = .06. The results of the linear regression indicated that two predictors, being male, and participants who opted not to identify their gender (i.e., I prefer not to answer this question) explained 6.39% of the variance in strenuous PA intensity, F

(3,446) = 10.15, p < .001, R2 = .06. Being male was associated with a predicted mean score increase of 0.47, and those who opted not to identify their gender were associated with a predicted mean score increase of 0.33 for strenuous PA intensity as compared to females.

Post-Hoc Tests for PA PBC Mild. The results for group self-identification, F (1, 442) = 7.82, p = .005, ηp2 = .02, gender, F (1, 442) = 3.99, p = .008, ηp2 = .03, and age, F (1, 442) = 9.15, p = .003, ηp2 = .02, were significant. Results of the linear regression indicated that three predictors, being non-autistic, older (i.e., within the 26–35-year-old group), and participants who opted not to identify their gender (i.e., I prefer not to answer this question) explained 5.88% of the variance in PBC towards mild PA, F (5,444) = 5.55, p < .001, R2 = .06. Non-autistics were associated with a predicted mean score increase of 0.23, the older (26-35-year old) age group predicted a mean score increase of 0.20, and those who selected 'I prefer not to answer this question' predicted a mean score increase of 0.39.

Post-Hoc Tests for PA PBC Moderate. The results for group self-identification, F (1, 442) = 14.84, p = <.001, ηp2 = 0.03, gender, F (1, 442) = 6.33, p= .018, ηp2 = 0.02, and age, F (1, 442) = 6.85, p = .009, ηp2 = 0.02, were significant. Results of the linear regression indicated that three predictors, being autistic, older (i.e., within the 26-35 year old group) and participants who opted not to identify their gender (i.e., I prefer not to answer this question) explained 7.44% of the variance in PBC towards moderate PA, F (5, 444) = 7.14, p < .001, R2 = 0.07. Autistics predicted a mean score increase of 0.32 and the 26-35 age group predicted a mean score increase of 0.18. Additional results of the PA Intensity ANOVA are presented in Table 6.

Table 6

Analysis of Variance for PA Attitude Mild, Moderate, and Strenuous, and PBC Mild, Moderate, and Strenuous Intensity by Group Self-identification, Gender, Age, and Current Employment

Variable	Term	*SS*	*df*	*F*	*p*	η_p^2
PA Attitude Mild	Self-identification	5.48	1	6.31	.012	0.01
	Gender	2.93	3	1.13	.338	0.01
	Age	2.53	1	2.91	.089	0.01
	Current Employment	1.83	2	1.05	.350	0.00
	Residuals	384.18	442			
PA Attitude Moderate	Self-identification	11.04	1	14.44	< .001	0.03
	Gender	4.55	3	1.98	.116	0.01
	Age	1.38	1	1.80	.180	0.00
	Current Employment	0.04	2	0.03	.974	0.00
	Residuals	337.84	442			
PA Attitude Strenuous	Self-identification	0.79	1	0.87	.350	0.00
	Gender	22.45	3	8.29	< .001	0.06
	Age	0.004	1	0.00	.944	0.00
	Current Employment	3.26	2	1.80	.166	0.01
	Residuals	399.00	442			
PA PBC Mild	Self-identification	5.44	1	7.80	.005	0.02
	Gender	8.35	3	3.99	.008	0.03
	Age	6.38	1	9.15	.003	0.02
	Current Employment	4.14	2	2.97	.052	0.01
	Residuals	308.47	442			
PA PBC Moderate	Self-identification	9.26	1	14.84	< .001	0.03
	Gender	6.33	3	3.38	.018	0.02
	Age	4.28	1	6.85	.009	0.02
	Current Employment	1.57	2	1.26	.286	0.01
	Residuals	275.79	442			
PA PBC Strenuous	Self-identification	1.14	1	1.80	.181	0.00
	Gender	16.85	3	8.86	< .001	0.06
	Age	0.06	1	0.09	.768	0.00
	Current Employment	1.69	2	1.34	.264	0.01
	Residuals	280.38	442			

Differences in PA Intensity. The second research question sought to understand whether personal opinions (i.e., attitudes) and perceived ability (i.e., PBC) towards PA change based on different intensity levels of mild, moderate, and strenuous activity. A review of the data found significant differences in both attitude and PBC in relation to mild and moderate intensity PA between the autistic and non-autistic groups. In contrast, both groups were similar in their opinions and perceived skills related to strenuous PA. A general observation of the data suggests autistic participants' attitudes towards PA intensity were highest at a mild (M = 3.75, SE = 0.10) intensity level. Autistic participants also viewed mild intensity PA as most commensurate with their perceived skill level (M = 3.67, SE = 0.09) over moderate and strenuous activity. Similar to the TPB constructs for PA, participants from the non-autistic group reported higher means across all dependent variables. It is of interest that there was a positive correlation between perceived attitude and all the different intensity levels. However, there was a marked decrease in attitude and PBC for both groups as intensity levels increased. This would suggest that attitudes and beliefs in perceived ability towards PA tend to decrease as intensity increases. Marginal means and standard deviations for both groups specific to PA Intensity are presented in Table 7.

Table 7

Marginal Means, Standard Error, and Sample Size for PA Intensity Variables by Group Self-identification Controlling for Gender, Age, and Current Employment

Variable	Combination	Marginal Means	*SE*	*n*
PA Attitude Mild	Autistic	3.75	0.10	122
	Non-Autistic	4.01	0.08	328
PA Attitude Moderate	Autistic	3.54	0.09	122
	Non-Autistic	3.91	0.07	328
PA Attitude Strenuous	Autistic	3.28	0.10	122
	Non-Autistic	3.38	0.08	328
PA PBC Mild	Autistic	3.67	0.09	122
	Non-Autistic	3.93	0.07	328
PA PBC Moderate	Autistic	3.36	0.08	122

	Non-Autistic	3.70	0.07	328
PA PBC Strenuous	Autistic	2.96	0.08	122
	Non-Autistic	3.08	0.07	328

Analysis of TPB Constructs for WATs

To examine if there were significant differences between autistic and non-autistic participants in terms of intention to use WATs, a MANOVA was conducted with WAT Attitude, WAT PBC, WAT Subjective Norms, and WAT Intention as dependent variables while controlling for gender, age, and education. The results of the analysis yielded a significant multivariate effect, Pillai's Trace=.03, *F* (4, 439) = 2.82, *p* = .025, η^2p = 0.03, indicating that there are significant differences between the autistic and non-autistic groups. Results of the MANOVA are presented in Table B8 (see Appendix B).

Post-hoc Test for WAT Attitude. The results for group self-identification, F (1, 442) = 9.51, p = .002, ηp2 = 0.02, and gender, F (3, 442) = 3.19, p = .024, ηp2 = 0.02, were significant indicating differences among the groups' attitude towards using WATs. The linear regression model indicated that three predictors, males, another gender, and non-autistic explained 5.49% of the variance in WAT attitude F (4,445) = 6.47, p < .001, R2 = .05. Being male predicted a mean score decrease of 0.21, while those participants who identified as another gender predicted a mean score decrease of 0.55, and non-autistics predicted a mean score increase of 0.32.

Post-hoc Test for WAT PBC. The results for group self-identification, F (1, 442) = 9.34, p = .002, ηp2 = 0.02, and gender, F (3, 442) = 2.65, p = .049, ηp2 = 0.02, were significant indicating differences among the groups PBC specific to using WATs. Results of the linear regression indicated that two predictors, being male and non-autistic, explained 5.11% of the variance in WAT PBC, F (4,445) = 5.99, p < .001, R2 = .05. On average, males predicted a mean score decrease of 0.21, and non-autistics predicted a mean score increase of 0.32 in PBC using a WAT.

Post-hoc Test for WAT Subjective Norms. The results for group self-identification were non-significant, F (1, 442) = 2.65, p = .104, ηp2 = 0.01, but current employment was significant, F (2, 442) = 3.67, p = .026, ηp2 = 0.02, indicating that there were differences among the groups related to their perceptions of expectations/social pressures from family, friends, and social media towards using WATs. Results of the linear regression were significant, F (2, 447) = 5.00, p = .007, R2 = .02, and identified one predictor, 'Not Employed,' which explained approximately 2.19% of the variance in subjective norms towards WAT use. Participants who indicated they were not employed predicted an average mean score decrease of 0.30.

Post-hoc Test for WAT Intention. The results for group self-identification were non-significant, F (1, 442) = 3.83, p = .051, ηp2 = 0.01, but gender was significant, F (3, 442) = 3.71, p = .012, ηp2 = 0.02, indicating that there were differences among the groups related to their intention towards using WATs. Results of the linear regression were significant, F (3, 446) = 5.45, p = .001, R2 = .04, and identified one predictor, 'Another Gender,' which explained approximately 3.54% of the variance in WAT Intention. Members from this category predicted an average mean score decrease of 0.80.

Additional results of the WAT Intention ANOVA are presented in Table 8. Additional results of the linear regression are presented in Table B6. (see Appendix B).

Table 8

Analysis of Variance for WAT Attitude, WAT PBC, WAT Subjective Norms, and WAT Intention by Group Self-Identification, Age, Gender, and Current Employment

Variable	Term	*SS*	*df*	*F*	*p*	η_p^2
WAT Attitude	Self-identification	7.43	1	9.51	.002	0.02
	Gender	7.48	3	3.19	.024	0.02
	Age	1.06	1	1.35	.245	0.00
	Current Employment	2.01	2	1.29	.277	0.01
	Residuals	345.39	442			
WAT PBC	Self-identification	6.51	1	9.34	.002	0.02
	Gender	5.54	3	2.65	.049	0.02
	Age	1.88	1	2.70	.101	0.01
	Current Employment	0.77	2	0.55	.577	0.00
	Residuals	308.16	442			
WAT Subjective Norms	Self-identification	2.00	1	2.65	.104	0.01
	Gender	4.17	3	1.85	.138	0.01
	Age	0.14	1	0.18	.669	0.00
	Current Employment	5.52	2	3.67	.026	0.02
	Residuals	332.55	442			
WAT Intention	Self-identification	3.50	1	3.83	.051	0.01
	Gender	10.16	3	3.71	.012	0.02
	Age	0.000004	1	0.00	.998	0.00
	Current Employment	5.12	2	2.81	.061	0.01
	Residuals	403.45	442			

Differences in WAT Intention. The third research question sought to understand whether differences exist between autistic and non-autistic young adults in relation to their intention towards using WATs to assist with PA engagement. Survey results found significant differences between the groups in their opinions (attitudes) and beliefs in their ability (perceived behavioural control) to use WATs. The data also indicated that both groups have similar experiences with regard to their perceptions of social pressures or expectations from family, friends, and social media, and intention towards using WATs. Marginal means and standard deviations for both groups specific to WAT Intention are presented in Table 9.

Table 9

Marginal Means, Standard Error, and Sample Size for WAT Variables by Self-identification Controlling for Gender, Age, and Current Employment

Variable	Combination	Marginal Means	*SE*	*n*
WAT Attitude	Autistic	3.56	0.09	122
	Non-Autistic	3.86	0.07	328
WAT PBC	Autistic	3.61	0.09	122
	Non-Autistic	3.90	0.07	328
WAT SUB	Autistic	3.24	0.09	122
	Non-Autistic	3.40	0.07	328
WAT Intention	Autistic	3.32	0.10	122
	Non-Autistic	3.53	0.08	328

Analysis of SOS Needs

The final purpose of this study was to explore whether participants would be interested in receiving/utilizing specific supports to assist with using WATs and if differences exist between the autistic and non-autistic groups on what specific systems of support (SOS) are perceived as beneficial for learning to use WATs. Descriptive statistics were used to examine differences between the autistic and non-autistic groups on what specific supports were perceived as beneficial for using WATs.

Differences in Support Needs.

An overall observation of the sample suggests that, on average, higher percentages of autistic participants perceived the majority of SOSs as helpful for learning to use WATs over non-autistic participants. Participants from the autistic group exhibited higher interest than their non-autistic peers in using online (43.4% vs. 40.7%) and printed manuals (32.8% vs. 25.3%), online chat support (33.3% vs 26.8%), telephone support (20.5% vs. 17.1%), and participating in group (26.2% vs. 14.6%) and individual (29.5% vs. 21%) learning sessions. The non-autistic group had higher percentages of interest in two SOSs, which included YouTube videos (74.1%

vs. 61.5%) and forums or social media (37.5% vs. 35.2%). Although autistics had higher percentages in several SOS categories, large numbers of participants from both groups did not view SOS recommendations as useful. For example, watching YouTube videos was the only SOS recommendation that was perceived as appealing by both the majority of autistic (n=75, 61.5%) and non-autistic (n=245, 74.7%) group members.

A review of the data for autistic participants suggests many have low interest in using most SOS. Interest in using online manuals ranked second among the autistic sample, with less than half (n=53, 43.4%) of participants viewing this SOS as useful. The autistic group had even less interest in other SOS content, such as forums/social media (n = 43, 35.2%) and chat support (n = 37, 30.3%) options that were accessible online. Personalized learning (n =36, 29.5%) and group sessions (n = 32, 26.2%) also received very similar levels of interest from the autistic group. Telephone support was perceived as the least helpful SOS for helping autistics learn how to use WATs, with 79.5% (n = 97) of the sample expressing disinterest.

Most non-autistic participants did not indicate any SOS other than YouTube videos (n = 245, 74.7%) as helpful for learning to use WATs. Similar to the autistic group, interest in using an online manual ranked second in desired SOS (n =133, 40.5%), followed by forums/social media (n = 123, 37.5%), online chat (n=88, 26.8%), printed manual (n = 84, 25.3%), personal learning sessions (n = 69, 21%), telephone support (n = 56, 17.1%), and group learning sessions (n = 48, 14.6%). Frequencies and percentages are presented in Table 10.

Table 10

Frequency Table for SOS Variables

Variable	Autistic		Non-Autistic		Total Sample	
	n	%	n	%	n	%
Online Manual						
Yes	53	43.4	133	40.5	186	41.3
No	69	56.6	195	59.5	264	58.7
Printed Manual						
Yes	40	32.8	84	25.3	124	27.6
No	82	67.2	244	74.4	326	72.4
Group Learning Session						
Yes	32	26.2	48	14.6	80	17.8
No	90	73.8	280	85.4	370	82.2
Online Chat Support						
Yes	37	30.3	88	26.8	125	27.8
No	85	69.7	240	73.2	325	72.2
YouTube Videos						
Yes	75	61.5	245	74.7	320	71.1
No	47	38.5	83	25.3	130	29.0
Forums or Social Media						
Yes	43	35.2	123	37.5	166	36.9
No	79	64.8	205	62.5	284	63.1
Telephone Support						
Yes	25	20.5	56	17.1	81	18.0
No	97	79.5	272	82.9	369	82.0
Personalized Learning Sessions						
Yes	36	29.5	69	21.0	105	23.3
No	86	70.5	259	79.0	345	76.7

Differences in SOS Selection

A binary logistic regression was conducted to examine whether group self-identification, education, employment, age, and gender had a significant effect on the selection of any of the SOS options. A binary logistic regression is a linear regression model used for binary dependent variables.

Assumptions. The assumption of the absence of multicollinearity was examined.

Variance Inflation Factors. Variance Inflation Factors (VIFs) were calculated to detect the presence of multicollinearity between predictors. High VIFs indicate increased effects of multicollinearity in the model. VIFs greater than 5 are cause for concern, whereas VIFs of 10 should be considered the maximum upper limit (Menard, 2009). Within this sample, all predictors in the regression model have VIFs of less than 2. Results of the VIF are presented in Table B9 (see Appendix B).

SOS Results

Using an alpha level of .05, non-significant results were returned for SOS options which included online manual support $\chi^2(10) = 5.22$, $p = .876$, online chat support $\chi^2(10) = 11.78$, $p = .300$, telephone support $\chi^2(10) = 12.23$, $p = .270$, printed manual $\chi^2(10) = 13.46$, $p = .199$, and personalized learning session $\chi^2(10) = 13.78$, $p = .183$, suggesting that the variables of age, group self-identification, gender, education, and employment did not have a significant effect on the selection process. In contrast, significant results were returned for three SOS options which included YouTube videos $\chi^2(10) = 19.11$, $p = .039$, group sessions $\chi^2(10) = 20.74$, $p = .023$, and forums/social media $\chi^2(10) = 19.03$, $p = .040$, suggesting that the variables had a significant influence on the odds of selecting these SOSs. Each SOS option that produced significant results were further examined to determine which variables might impact the model. McFadden's R-squared was calculated and reported the following results for each SOS:

YouTube Videos. In the context of YouTube videos, the impact of gender and group was found to be significant, B = 0.55, OR = 1.74, p = .033. This suggests that participants identifying as male exhibit a 73.64% increase in the odds of providing a ‘Yes’ response to their interest in using YouTube videos compared to those identifying as female. Similarly, the effect of participants identifying as non-autistic was also significant, B = 0.58, OR = 1.79, p = .015. This indicates that participants who identify as non-autistic demonstrate a 79.11% increase in the odds of observing a positive 'Yes' response to interest in using YouTube Videos compared to participants who identify as autistic.

Group Sessions. The choice of male gender was observed to be significant, B = -0.69, OR = 0.50, p = .028, indicating that participants who identify as male decrease the odds of providing a 'Yes' response to their interest in leveraging group sessions by 49.86% compared to the female category. Similarly, the effect of selecting non-autistic in self-identification was also significant, B = -0.80, OR = 0.45, p = .005. This implies that identifying as non-autistic results in a 55.02% decrease in the odds of opting for 'Yes' to the option of group sessions relative to those who identify as autistic. Moreover, the impact of being in the high school category of education was significant, B = 0.71, OR = 2.04, p = .016. This indicates that participants with a high school education increase the odds of choosing 'Yes' to use a group session by 103.76% relative to those who have completed or are completing post-secondary education.

Forums or Social Media. The effect of the 'I prefer not to answer this question' category of gender was significant, B = -1.05, OR = 0.35, p = .009. This suggests that identifying in this group results in a 65.16% decrease in the odds of selecting 'Yes' for the use of forums or social media compared to the females. Additionally, the effect of the participants who are partially employed was significant, B = 0.51, OR = 1.66, p = .048. This indicates that participants who are partially employed increase the odds of selecting 'Yes' for the use of forums or social media by approximately 66.02% relative to those who are full-time employed. Tables B10-B12 (see Appendix B) summarize the results of each regression model.

Summary

This comparative quantitative study examined differences between autistic and non-autistic Canadian young adults’ intention to engage in PA, investigated their intention towards using WATs, and probed which supports they perceive as useful to leverage the use of these devices to engage in PA. MANOVAs were used to test if differences exist between the group’s intention to engage in PA, use WATs, and preference towards different intensity levels (i.e., mild moderate, strenuous) of PA. Frequencies and percentages were used to examine the trends of the system of support options. Overall, there were significant differences between the groups on age, gender and employment. Controlling for these variables, findings indicated significant differences between the autistic and non-autistic groups for intention to engage in PA, intensity preference, and intention towards using WATs.

Findings suggest that both groups reported positive perceptions of intention towards participation in PA. However, non-autistic young adults have a higher intention to participate in PA than autistic young adults. An examination of PA intensity preference provided evidence of significant differences between the autistic and non-autistic group's attitude and PBC specific to mild and moderate PA. While no significant difference was identified between the groups in relation to strenuous PA, there was evidence consistent with both groups, which suggests that attitude and PBC toward PA decrease as the level of intensity increases.

Further review of the results found significant differences between the autistic and non-autistic groups' attitudes and PBC toward using WATs. However, there was no significant results in relation to respondents’ subjective norms and intention toward using these devices. Finally, reviewing the data in reference to using a SOS, both the autistic and non-autistic groups provided remarkably similar results in identifying/selecting the same top three SOSs (i.e., YouTube

Videos, Online Manuals, and Forums/social media) as helpful for learning to use a WAT. The next chapter provides a detailed discussion of the analysis findings.

Chapter Five: Discussion

This study is a significant contribution to autism research as it is the first national survey of Canadian autistic young adults investigating their intention to engage in different levels of physical activity, their intention towards using WATs to support their physical activity engagement, and determining whether autistics have a preferred style of learning to use WATs compared to their non-autistic peers. The study adopted a participatory research approach, where autistic young adults provided input on the study design. The results showed that autistic young adults have a positive intention to engage in physical activity and use WATs, albeit lower than non-autistic young adults. Autistic young adults preferred certain styles of support in learning to use WATs more than non-autistic young adults. The study included 450 valid responses from every Canadian province and territory, with representation from both autistic and non-autistic participants. Out of these, 122 were autistic young adults (27.1%) and 328 were non-autistic young adults (72.9%). The study controlled for characteristic variables such as gender, age, employment, and education, revealing significant differences between the autistic and non-autistic groups regarding their intention to engage in physical activity, physical activity intensity preference, and intention towards using WATs. The following section will discuss these findings in detail.

Gender

Characteristic results of the survey revealed that there was notable engagement from several different gender groups. For example, the ratio of participation for female autistic young adult respondents was high (45.9%). This was a significant figure as it is often reported in autism research and meta-analysis data that males are traditionally diagnosed at a higher frequency than females at a rate of three to one (Loomes et al., 2017). Another interesting characteristic related to gender was that a large percentage (10.7%) of the autistic group's respondents identified as being associated with the 'another gender' category consisting of: transgender females (1.6%), transgender males (3.3%), non-binary or gender non-conforming individuals (4.1%), and two-spirit Indigenous individuals (1.6%). In comparison, only 2.4% of non-autistic respondents identified as being affiliated with another gender. This is an interesting finding that aligns with other research that has reported that autistic individuals are more likely than neurotypical people to identify as gender diverse (Cooper et al., 2018).

Employment

Differences in employment were observed with more than half of the non-autistic young adult participants identified as being employed full-time (56.0%) in comparison to less than a third of autistic participants (31.1%). The study also found higher percentages of unemployment reported by the autistic young adult sample (35.3%) as compared to the non-autistic sample (19.5%). These findings align with extant research suggesting that autistic individuals are often unemployed or under-employed in comparison to their non-autistic peers (Dudley et al. 2015, Shattuck et al., 2012; Taylor et al., 2022). This is important because the economic risks of low employment rates for autistic young adults can have significant ramifications regarding making decisions to engage in PA or investing in interventions to support PA, including that of WATs. For example, a study by Mason and colleagues (2018) reported that being engaged in steady employment was a predictor of increase physical health for autistic adults. However, additional research is required to better understand how employment may affect intention to engage in PA or use WATs.

Education

This sample included a broad range of participants representing several different levels of education. While there were similarities between the groups in terms of having a high school education (41.8% of autistics and 34.8% for non-autistics), the biggest differences between the groups were in the post-secondary breakdown. A higher percentage of autistic young adults completed college and trade schools (32.8%) as compared to the non-autistic group (21.7%). These percentages were reversed for those participants to report having a university degree. A higher percentage of non-autistic participants (42.4%) completed a university degree as compared to autistic participants (22.2%). These findings align with recent studies that suggest participation rates in post-secondary education are significantly lower for autistic individuals compared to the general population. (Schembri-Mutch et al., 2023; Shattuck et al., 2012).

Age

The sample had a higher percentage of 18–25-year-olds (77.0%) of autistics, and non-autistics (57.6%) in comparison to 26–35-year-olds. This difference, along with differences in gender and current employment are notable and were controlled for in the analysis of the findings below.

PA Findings

The first research question was to determine the extent to which autistic young adults intend to lead healthy lifestyles that incorporate PA and whether these intentions differ from those of young adults who do not identify as autistic. This section will summarize a review of the findings.

PA Intention

While controlling for gender, age, education, and employment, the survey findings suggest that both groups reported positive perceptions of intention towards participation in PA. However, findings suggest non-autistic young adults have a higher intention to participate in PA than autistic young adults. This finding aligns with research on PA engagement that shows that autistic youth who experience physical, mental, and sensory deficits often face barriers to access to fully participate in sports (Tovin, 2013). Most research often describes autistic participation in PA as one of low pleasure/enjoyment (Eversole et al., 2016), hampered by challenges related to social interactions within group settings (Milanese et al., 2019; Rosso, 2016), and involving potential movement and motor skills difficulties (Kucharczyk et al., 2012). Taken to together, these factors provide a compelling rationale for understanding lower PA intention between the groups.

PA Attitude

Results found that general attitudes were similar between both groups. This finding was interesting due to prior research, which suggests that autistic individuals may have adverse opinions towards PA participation due to negative past experiences (Hassani et al., 2020; Nichols et al., 2018). The results of this finding were also contrary to findings reported by Hillier and colleagues (2020) who reported notable differences in attitudes towards PA between a small sample of autistic and non-autistic young adults. However, the results of general attitudes towards PA should be interpreted with caution as coefficient alpha for this subscale was below the acceptable range.

PA Attitude by Intensity

The study focused on three types of PA attitude related to different levels of intensity: mild, moderate, and strenuous. Results found that autistic young adults have lower favorable attitudes in all three intensities of PA. Interestingly, both the autistic and non-autistic groups showed similar overall trends in attitudes towards different intensities of PA. For example, as the intensity of PA increased, respondents from both groups expressed a decline in favorable perceptions towards PA engagement. This finding suggests that both autistic and non-autistic groups may prefer participating in mild and moderate PA over strenuous activity.

PA PBC

Findings from the study suggest that significant differences exist between autistic and non-autistic young adults in their personal view of PBC towards engaging in PA. Autistic young adults demonstrated lower PBC towards preforming PA in comparison to the non-autistic group. This result aligns with previous research suggesting that autistics may experience challenges engaging in PA due to poor or underdeveloped fundamental motor skills (e.g., balance, uncoordinated gait, difficulties with fine-motor control, and visual-motor control) due to a combination of factors, including poor teaching, lack of practice opportunities, and marginalization or exclusion from sports and other PA (Durmuş & Sarol 2023).

Many of these skills are often perceived as a basic requirement to pursue an active lifestyle (Brewster & Coleyshaw, 2011). Development of PA skills typically occur in early childhood and the early teen years, but this may not be seen as a priority for families of autistic children. It is often during this time that parents of autistic youth may be more focused on helping their children to develop skills in other areas such as communication and social engagement skills over balance and body control (Dadgar et al., 2017; Healy et al., 2013). This may result in an atrophy of basic skills related to PA, and for more autistics to question whether they possess adequate skills to engage in PA.

PA PBC by Intensity

To learn about young adult’s perception of the ease or difficulty of performing PA, the study focused on three types of PBC related to different levels of PA intensity: mild, moderate, and strenuous. Results found that autistic young adults have lower PBC when compared to non-autistics in all three intensities of PA. Specifically, as intensity towards PA increased, autistic young adult's perceptions of their ability towards performing PA behaviour declined. This result aligns with research suggests that autistic children and adolescents tend to be less engaged in PA that requires higher levels of exertion or involves complex movements such as in team sports (Arnell et al., 2018). Thus, it would make sense that the PBC behaviour control of autistics would decline as intensity increases.

A similar trend was also observed with the non-autistic young adult group. This was an unexpected outcome as it had been anticipated by the PI that autistic young adults would demonstrate a higher rate of decline in PBC as intensity of PA increases. However, there was no evidence presented to explain why both groups had similar declines in PBC based on intensity.

PA Subjective Norms

Results found significant differences in subjective norms between the groups. Findings indicated that autistic young adults were less likely to be influenced by the social pressures and expectations of other (subjective norms). This result aligns with research which suggests that autism may be associated with reduced social conformity, as autistics may find conforming to social pressures/expectations to be less rewarding than non-autistics (Marsh et al., 2013). It may also be worth considering that many autistic young adults as children experience challenges developing and maintaining social relationships, which may also have an impact on their opinions towards social pressures and expectations of others (Yafai et al., 2013). This was confirmed in discussions with AAC members. Most members suggested that they were less likely to be influenced by social pressures from family (e.g., parents, siblings), peers, or social media. As one AAC member commented, "I don't follow anything related to PA on social media…the models that they use in commercials always appear in top shape, and I'll never look like that, so why would I bother paid attention to them?" -committee member 3.

These findings in comparison to the only other study on autistic young adults and PA by Hillier et al. (2020) had some notable differences. Hiller et al. (2020) found no significant differences in subjective norms or intention to engage in PA. However, Hillier's study included a small, homogenous group (i.e., all autistic participants were current or former members of a social skills group). It could be argued that these participants may no longer be representative of the general perspectives of autistic young adults as they would have received additional skills training and practice because of their participation in the social skills group.

It is important to note that parts of the results, PA PBC Strenuous and PA general attitude should be interpreted with caution due to poor reliability in coefficient alpha scores. For both constructs, the segmentation of the subscales into different intensity levels, reduced the number of questions resulting in one remaining question for PA general attitude and PA PBC Strenuous with coefficient alpha score of 0.58.

WAT Findings

This study is the first Canadian survey to research the extent to which autistic young adults are interested in using WATs to improve PA as compared to their non-autistic peers. The study evaluated the extent to which interest/intention influenced by social norms (e.g., friends and family who use WATs), their attitudes about WATs (e.g., helpfulness in supporting PA engagement) and their perceived ability (PBC) to use a WAT. As WATs represent a potential cost-effective PA intervention, it is important to first understand, directly from autistic young adults, whether they have an interest to begin with. The existing research on autism and WATs has been limited as studies lead with technology (e.g., O'Brien et al., 2016; Sahin et al., 2018) and thus we do not know if they are interested in their use. The findings below have controlled for the characteristic differences of age, gender and current employment.

WAT Attitude

An exploration of the differences between the groups found that autistics had favorable attitudes towards WATs although less pronounced than the non-autistic group. This finding is not surprising as past research describes autistics as having a high interest in using different forms of technology (Koumpouros & Kafazis, 2019).

WAT PBC

This finding on PBC for WATs was interesting as it had the highest marginal mean score for autistic young adults in all constructs. This is a strong indicator that autistic young adults are comfortable in using WATs, which aligns with the positive attitude towards WATs. However, it is important to note that there were significant differences between the autistic and non-autistic young adult group.

WAT Subjective Norms

This was the lowest indicator of intention for both groups and the differences between groups were non-significant. As discussed in the PA findings, this aligns with other research that autistic individuals are less influenced by external pressures (Marsh et al., 2013).

WAT Intention

Both groups indicated a positive intention to use a WAT for the purposes of PA monitoring. There were no differences between groups in their intention to use a WAT. However, a review of the data indicates the differences were trending very close to significance ($p= 0.051$).

Findings from this research clarifies that autistic young adults have a favorable intention to use WATs for PA monitoring. This suggests that the potential for using WATs as cost effective PA interventions is a viable option to support autistic young adults in increasing their PA.

System of Support

The final research question examined was the extent to which autistic young adults feel they can benefit from an SOS to support their engagement in PA with a WAT. New technology is often touted as “out of the box” and requiring very little, if any, support to use new devices. Indeed, considering the high PBC to use a WAT from both autistic and non-autistic groups, users have a higher PBC to use a WAT. However, this study did investigate which SOS would help them learn how to use a WAT. The autistic young adult group showed higher percentages of participants who perceived that the various types of SOS would be beneficial to them. However, the only SOS that most autistics indicated would be helpful was YouTube videos (61.5%). The next favoured SOS include online manuals (43.4%) and forums or social media (35.2%). Interestingly, in a review of the research, none of these SOSs have been applied to increase understanding of autistic young adults in learning to use WATs. Further research involving WAT use with the autistic adult population should consider asking participants if a SOS is deemed helpful and if so, what type of SOS would they prefer.

Survey Limitations and Future Recommendations

This survey and its design are not without limitations that should be considered for future research. This study did not apply a complete PR approach, (e.g., autistic participants did not pick the topic under research). The nature of PR involves engaging community stakeholders to work alongside academics across all stages of the research process. For this study, the AAC participated in the development and refinement of the survey tool used to assess PA and WAT intention. Future studies would benefit from working with autistic stakeholders from the initial onset to identify specific problems that they feel are important priorities, provide feedback in developing/refining research questions, to the dissemination of results to the public.

In regard to the TPB, although it has demonstrated success in other populations, it has not yet been used in many studies involving autistic young adults. In addition, while this survey had a large sample size, it was to be completed online and thus would not be accessible to autistic young adults who may not have access to an internet-connected device or be accessible to autistic young adults who have intellectual disabilities (ID) that might prevent them from understanding or completing the survey.

Autistic Participation and Influence

"Nothing about us, without us."

This study was intentional in its focus on gaining insights into the autistic experience and their perceptions of PA engagement and use of WATs directly from autistic young adults. The process involved working in partnership alongside autistic young adults. This approach represents a departure from past autism research in which the autistic voice has been disturbingly absent or drowned out amongst researchers, professionals, or others (e.g., family members, policymakers) (Pellicano & Stears, 2011). Autistics who are not academics or researchers have very few opportunities to provide meaningful feedback on studies that affect their health and well-being (Fletcher-Watson et al., 2019). This has been a frustration raised by autistic young adults who express concern that their experiences are often minimized or misinterpreted by well-meaning but ill-informed non-autistic researchers, educators, and autistic allies (Lebenhagen, 2020).

The AAC

The autistic advisory in the present study and their contributions to this study were significant: a) they helped to develop a clear definition of PA, b) they supported the need to investigate various intensity levels of PA, and c) they shaped the questions, the design of the scale and the length of the survey.

Understanding PA

The vague definitions of PA in research to date leads to challenges in interpreting the findings (Piggin, 2020). Social scientists, health practitioners, and researchers interested in accurately capturing PA trends among autistic young adults must think carefully in considering how they define, assess, and measure PA in all its forms beyond exercise and physical fitness. By not starting with a clear definition of what accounts for PA in research, it can make it very difficult to obtain a truly accurate measure of behavioural intention towards PA for autistic young adults.

A key learning emphasized by the AAC members to improve clarity of PA definitions in the study was to provide more examples of daily activities using visual examples and reducing 'fitness language jargon'. During discussions, members would point out that prior to their work on this study, they would often conflate PA with exercise and fitness. Members suggested that having more visual examples that reflect Health Canada's recommendation of engagement in 'light physical activity' using people engaging in mild PA tasks (e.g., shoveling snow, walking the dog, gardening, etc.) would help to provide greater clarity in knowing that these behaviours contribute to PA. As one member pointed out "One thing you don't know about me, aside from being autistic, is my dyslexia makes reading the recommendations in the movement guide feel like a chore. I rely on using pictures to help make topics easier for me to understand... If something feels hard to learn right away, I probably won't do it (committee member 1).

AAC members also suggested it would be helpful for PA definitions to use plain language when describing activities. Several members pointed out the need for the provision of tangible examples providing sensible descriptions of the activity (e.g., for moderate activity: you should be breathing hard, but still able to speak, over you should have an 'elevated heart rate'). Members suggested that the first description (i.e., breathing hard, but still able to speak) would be easier for an autistic individual to understand over fitness jargon such as having an elevated heart rate. A final learning from the AAC was their emphasis on the importance of having the independence to decide on the types of PA that autistics feel are appropriate for themselves. In learning that PA represents 'many daily activities' above and beyond sport, exercise, and fitness regiments, committee members expressed that autistic young adults need to become 'better informed of our options rather than feeling forced to participate in activities that make you uncomfortable" (committee member 4).

Intensity Levels of PA.

An added layer of complexity within this issue has been the focus on MVPA guidelines (e.g., 2011 Health Canada Guidelines). Feedback through discussion and engagement with the AAC, helped to raise the PI's awareness that definitions of intensity levels (i.e., MVPA) are not clear enough. A point of interest that was raised by the AAC was that the idea of 'PA intensity' is subjective and dependent on the individual themselves. Members discussed how engaging in the same type of PA (e.g., walking 5 kilometers) could represent all three intensities (mild, moderate, and strenuous) depending on the individual's current level of health/conditioning. This helped AAC members to rethink their approach from focusing on specific types of activities (e.g., walking, jogging, running) to highlight different PA intensities, to recommending using detailed descriptions which place more of an emphasis on what the individual should expect and how they should feel (e.g., describing moderate PA: This activity needs some effort and you may breathe harder or increase your heart rate. However, it is not exhausting, and you should be able to talk while doing the activity). Members hoped that these definitions when paired with examples of PA would help provide survey respondents with better clarity of the different intensity levels.

The newest (2020) version of Canadian PA guidelines (entitled the 24-Hour Movement Guidelines) designed in partnerships between the Public Health Agency of Canada, CSEP, Queen's University and ParticipACTION now include: "Several hours of light physical activities, including standing." This is a good step in the right direction, as the new recommendations will help to provide better clarity to academics, health practitioners, and members of the public as to what additional PA behaviours outside of MVPA should be considered when measuring PA.

Setting Up the AAC for Success

As important as it is to draw specific insights directly from the autistic community, it is equally important to set the autistic community participants up for success in engaging in the research. The purposeful design of the AAC helped prepare the committee members to know what to expect and fully participate. As one member commented, "I was quite relieved...as it provided me with context around the purpose of the study, and it also helped me get a better understanding of how I can contribute to the discussion groups." -Group Member 3

Through the learnings of this study, we identified five important principles to consider in the design of an AAC: a) structure for the meetings, (b) proactive planning and preparation, (c) onboarding, (d) achieving clarity in collaboration, and (e) consistent communication to ensure common focus.

Structure for the Meetings. It is very important to provide a structured approach where committee members receive important information (e.g., meeting confirmation dates/times, agenda information outlying discussion topics, meeting notes, etc.) prior to attending meetings. This will help establish a predictable routine, reduce anxiety, and boost confidence by ensuring that AAC members know what to expect, feel comfortable with any technology used, and have clarity regarding their roles and responsibilities within the study.

Proactive Planning and Preparation. Send reading materials ahead of time, as this provides members with control/autonomy over establishing personal timelines for reviewing materials, processing information, and responding to inquiries before meetings. This step will also help avoid overwhelming members with excessive content during committee meetings. Proactive planning and preparation in this regard will help to enhance the quality of conversations.

Onboarding. Autistic participants may not have participated in research studies before. They may also not have participated in many virtual or in-person meetings. It is a valuable exercise to offer the opportunity for autistic members to connect with researchers prior to the meetings to allow them to ask questions and discuss accommodations to maximize participant engagement. For instance, in this study's onboarding session, AAC members asked questions about meeting formats (e.g., technologies to be used for sessions), communication methods (e.g., text vs. email), and steps the PI considered to protect their privacy during meetings. This provided the benefit of the PI sharing information regarding the platform's security features (e.g., using password-protected meeting IDs to prevent unauthorized access, blurred background features to protect viewing of participant's home/office/personal space, etc.). It is also helpful to consider providing timing cues (e.g., in five minutes, we're going to discuss the next agenda item) to help maintain the conversation within the timeframe of the agenda and avoid digressions.

Achieving Clarity in Collaboration. Encouraging open conversation and dialogue is beneficial to provide AAC participants with relevant information on the study purpose and research objectives. The probability may be high that members will initially seek guidance in understanding the collaborative process, provide direct information that clarifies roles, responsibilities, and expectations within the partnership, and develop an appropriate process for sharing information and making decisions. Researchers should be mindful of the perceived power imbalance between themselves and AAC members and think carefully about how your views, values, and potential biases may affect the research process to avoid creating an unintentional power imbalance or limiting the voices of AAC members.

Consistent Communication. Communication is an important tool that can influence the success or failure of research projects (Lebenhagen, 2020). Consistent communication and interaction with AAC members, including group sessions, offering access to one-on-one check-ins, and other avenues for reciprocal feedback (e.g., text messages, email, or phone calls) can help to build team cohesion. Specifically, open communication is crucial for helping individuals from different backgrounds, with different life experiences and perceptions, to find common ground through exchanging information and aligning ideas.

For this study, creating a reliable process for staying connected with AAC members throughout the research provided several benefits. Firstly, when working with AAC members new to participating in research development, consistent communication helps maintain continuity of clarity with respect to sharing, processing, and evaluating information inside and outside committee sessions. Secondly, if disagreements within the research process arise, maintaining consistent contact with members increases the likelihood of identifying solutions that work for all members and resolving concerns faster. Finally, consistent communication between the researcher and the AAC helps to reduce misunderstandings and ensure that members feel comfortable sharing their ideas, opinions, and concerns within a psychologically safe and non-judgmental environment.

These principles helped to guide the process and ensure that members felt supported, listened to, and kept updated on how their contributions were used to inform the study.

Research Implications and Future Recommendations

Overall, this study's results can potentially affect meaningful change in autism research in three fundamental areas, including at the individual/family, organizational autism support, and policy development levels. The findings of this study indicate that not only do autistic young adults have the intention to engage in PA and use WATs, but it has provided researchers and health professionals with specific insights on the preferred level of intensity (e.g., mild intensity) that autistic young adults view most positively and which they perceive themselves as possessing the highest skillset for participating in PA. While previous research (e.g., Barak et al., 2019; Todd & Reid, 2006; Yu & Jee, 2020) often emphasizes moderate to vigorous PA, this study provides strong evidence directly from autistic young adult respondents suggesting that focusing on mild PA with this population may represent the best starting point and path forward for promoting participation in PA.

A key learning from this study provides evidence that PA is often poorly defined in autism literature, and for many autistic young adults, PA itself is not well understood. For example, in discussions with the AAC, some members were surprised that many daily activities (e.g., walking the dog, shovelling snow, and house and yard work) counted as PA. Reflections from these discussions shifted the perspectives of committee members from believing themselves to be physically inactive to having increased confidence in their ability to participate in PA. It is hoped that findings from this study will also help to inform ***autistic young adults and their*** allies (e.g., family members, caregivers) to expand their understanding and knowledge of the different forms of PA (i.e., including mild PA movements) that can help improve health outcomes of this at-risk population. As autistic young adults and their families or caregivers come to this shared understanding, it can help encourage the start or continuation of participation in mild to moderate PA.

Autistic service providers and support organizations should also take note of the findings in this study as there are currently very few PA programs offered in Canada (with the notable exceptions of Beast-Mode Fitness offered by the University of Calgary and Strong Minds through Active Bodies offered by Autism Ontario) for autistic young adults. Although social, cognitive, and communication support programs continue to remain of great importance within the autism community (de la Roche & Kelley, 2024), participation in PA should also be viewed as a high priority, especially taking into consideration the current poor physical health outcomes that autistics experience as highlighted in existing research and studies investigating this issue over the last several decades. At present, there remains a continued presence of inequity and disparity in terms of what support services are offered to autistic young adults in comparison to autistic children and adolescents. A recent review by Suhrheinrich and colleagues (2021) discovered that older individuals with autism were less ***likely*** to receiv*e* sufficient services compared to younger counterparts. Additionally, they exhibited higher levels of unmet service needs and experienced diminished service quality. To assist in improving health outcomes for this population, autistic service providers should consider implementing evidence-based strategies to promote/increase PA at an organizational level.

Finally, at the policy level, there needs to be more advocacy for PA as a significant contributor to positive health outcomes. Recently, the Canadian Academy of Health Sciences (CAHS, 2022) published a summary report outlining consideration for future public policy development to encourage thriving within autistic communities around the country. In its report, CAHS conducted an arms-length assessment of autism based on diversity, social inclusion, diagnosis, support, services, and economic inclusion. Although the report provides vital information to inform the Canadian federal government's National Autism Strategy, there is a notable absence of recommendations addressing the importance of PA for the autistic community.

PR Limitations

While this study took a PR approach, there were some notable limitations. The AAC did not represent the full spectrum of autistic young adults. For example, there was a notable lack of diverse representation (e.g., Black, Asian, First Nations, Transgendered, etc.) and ability (e.g., all candidates described themselves as not possessing any physical limitations or challenges with mobility). Committee member participation was also limited to individuals who owned technology (e.g., laptop, computer, or tablet) and possessed a viable internet connection. This may suggest that only individuals of a specified status (i.e., individuals who can afford these items) had the opportunity to participate in the research process. That said, this survey may not have had equal representation from volunteers unable to afford a computer or considered marginalized members of society.

Engagement in the PR process also presented some unanticipated challenges which impacted the study. For example, respecting and implementing suggestions from committee members, involved the decision to depart away from some of the TPB recommendations suggested in the Francis et al. (2004) and Ajzen (1991) manuals. While this action helped members to feel more comfortable with making suggestions, and providing feedback, this decision also served to reduce the reliability of several subscales within the survey. This departure also limited the strength and validity of survey constructs.

Conclusion

Research for autistic young adults and their participation in PA is important to support positive health outcomes. Current findings indicate that this population is at higher risk for many negative health issues. First and foremost, it is important to understand that there is a behavioural intention to engage in PA and this study indicates that there is a positive intention to engage in PA with a preference toward mild and moderate PA. Secondly, exploring potential technology interventions such as WATs also requires a foundational understanding if there is intention to use these devices for the purpose of PA monitoring. This study finds that indeed, autistic young adults have a positive intention to use WATS. Furthermore, while there are numerous mechanisms to support users in utilizing WATs, this study found that the preferred SOS was YouTube videos in both the autistic and non-autistic groups.

Future PR should consider how to design engagement with AACs and consider their unique needs so that they can contribute as full participants in the PR process. Consider that autistic people may often experience challenges engaging in unexpected and unfamiliar situations for the first time. However, many can manage unfamiliar circumstances better if they have opportunities to prepare for these situations in advance (Bissonette, 2015). While more research in these areas is needed, future studies should ensure that the autistic voice is involved as an equal participant throughout. A PR approach provides valuable perspectives that shape the findings and increase the likelihood of valid and meaningful contributions to the autistic community.

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Appendix A

The purpose of this appendix is to provide additional information specific to the development and implementation of this study.

Figure A1

Survey Participant Recruitment Poster

WE WANT TO HEAR FROM YOU!

We are seeking young adults (18-35) to participate in national survey on physical activity and wearable activity trackers.

Information and the survey can be found at activehealthproject.com

This research is conducted through the University of Alberta. Ethics ID: Pro00118119. Principal investigator: Michael Barrett (mcbarret@ualberta.ca).

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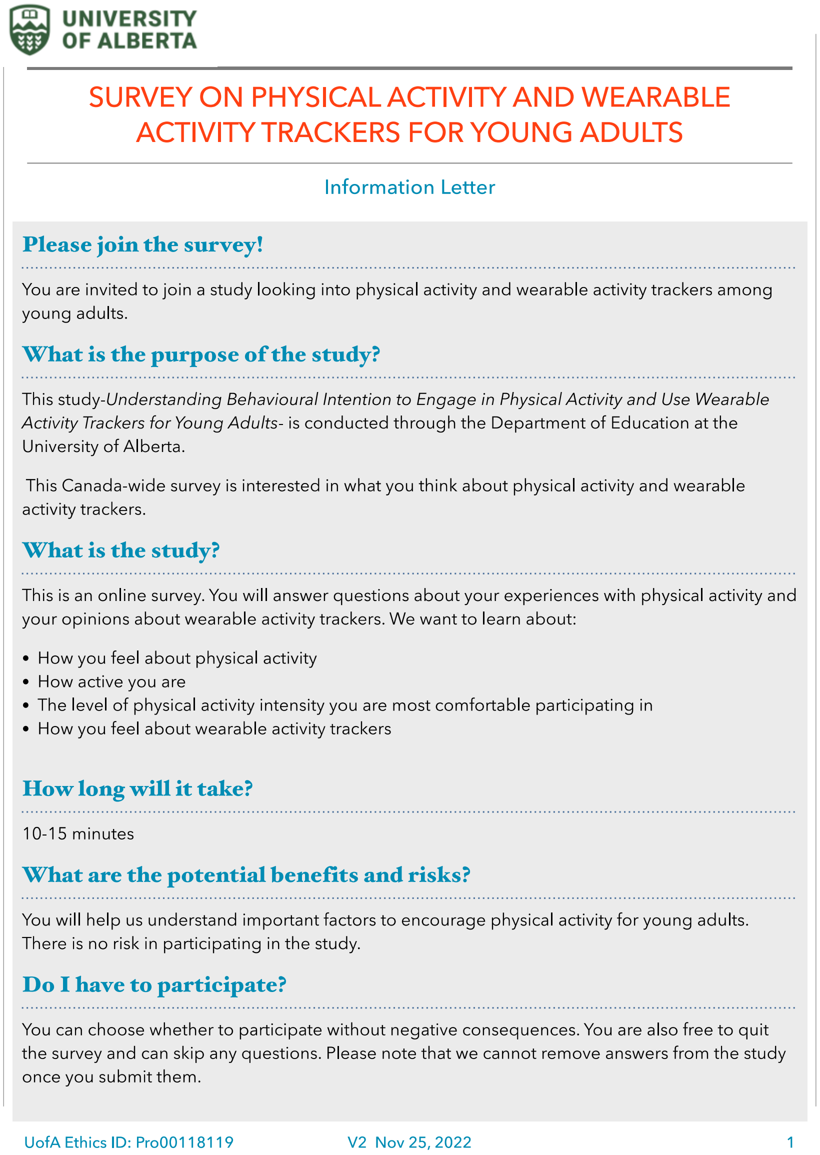
Figure A2

Survey Participation Information Letter



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SURVEY ON PHYSICAL ACTIVITY AND WEARABLE ACTIVITY TRACKERS FOR YOUNG ADULTS

Information Letter

Please join the survey!

You are invited to join a study looking into physical activity and wearable activity trackers among young adults.

What is the purpose of the study?

This study-*Understanding Behavioural Intention to Engage in Physical Activity and Use Wearable Activity Trackers for Young Adults*- is conducted through the Department of Education at the University of Alberta.

This Canada-wide survey is interested in what you think about physical activity and wearable activity trackers.

What is the study?

This is an online survey. You will answer questions about your experiences with physical activity and your opinions about wearable activity trackers. We want to learn about:

- How you feel about physical activity
- How active you are
- The level of physical activity intensity you are most comfortable participating in
- How you feel about wearable activity trackers

How long will it take?

10-15 minutes

What are the potential benefits and risks?

You will help us understand important factors to encourage physical activity for young adults. There is no risk in participating in the study.

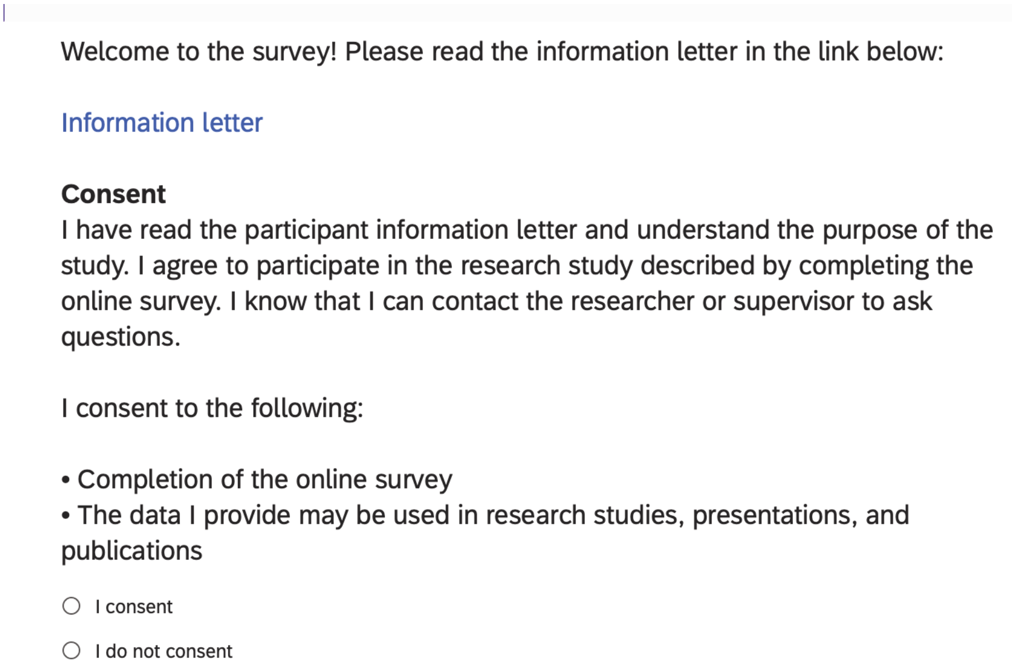
Do I have to participate?

You can choose whether to participate without negative consequences. You are also free to quit the survey and can skip any questions. Please note that we cannot remove answers from the study once you submit them.

UofA Ethics ID: Pro00118119 V2 Nov 25, 2022 1

Figure A3

Consent Page



Welcome to the survey! Please read the information letter in the link below:

Information letter

Consent
I have read the participant information letter and understand the purpose of the study. I agree to participate in the research study described by completing the online survey. I know that I can contact the researcher or supervisor to ask questions.

I consent to the following:

- Completion of the online survey
- The data I provide may be used in research studies, presentations, and publications

○ I consent

○ I do not consent

Figure A4

Survey on Perspectives on PA and the use of WATs for Young Adults

Survey on
Perspectives on PA ar

(Double click to open on Windows)

Table A1

Iteration of Survey Question by Committee Feedback

TPB Construct	AAC or Pilot Survey Comments	Original Item	Modified Item
PA Attitude	Wording too advanced	I intend to engage in a minimum of 2.5 hours of physical activity weekly. Extremely Likely-Extremely Unlikely I intend to learn more about how engaging in physical activity can be used to improve my health. Extremely Likely-Extremely Unlikely	I plan to engage in a minimum of 2.5 hours a week of physical activity. Strongly Disagree-Strongly Agree I will learn more about how engaging in physical activity can improve my health. Strongly Disagree-Strongly Agree
PA Subjective Norms	Wording too advanced	I intend to call a friend or family member to engage in physical activity with me in the next 2 weeks. Highly Likely-Highly Unlikely	I plan to ask a friend or family member to participate in physical activity with me in the next 2 weeks. Strongly Disagree-Strongly Agree
PA PBC	Reduce wording for clarity.	My current skills/abilities are good enough for me to participate in the following intensity levels [Mild/Moderate/Strenuous] of physical activities. Strongly Agree-Strongly Disagree	My current skills or abilities are not good enough to do (mild, moderate, or strenuous) physical activity. Strongly Disagree-Strongly Agree

Improve question clarity and/change scale	I am confident that I know techniques to use to reduce injury while participating in physical activity.	I am confident that I know how to reduce injury while participating in physical activity.
	Strongly Agree-Strongly Disagree	Strongly Disagree-Strongly Agree
Improve question clarity and/change scale	I am confident that I have the endurance to complete 2.5 hours weekly of these various physical activity intensity levels [Mild/Moderate/Strenuous]:	I am confident that I have the endurance for 2.5 hours weekly of mild, moderate, or strenuous physical activity
	Strongly Agree-Strongly Disagree	Strongly Disagree-Strongly Agree
Reduce wording for clarity	I feel that I possess the appropriate coordination skills to participate in different intensity levels [Mild/Moderate/Strenuous] of physical activity.	I have the coordination skills to participate in mild, moderate, or strenuous physical activity.
	Strongly Agree-Strongly Disagree	Strongly Disagree-Strongly Agree
Very similar to other questions	I am confident that I can participate in the following physical activity intensities [Mild/Moderate/Strenuous]	Eliminated Item
Confusing to answer	If I wanted to, I could participate in the various physical activity intensity levels [Mild/Moderate/Strenuous] for 2.5 hours weekly.	Eliminated Item
Too generic	I am confident in my ability to overcome any barriers/problems that could prevent me from completing 2.5 hours of physical activity every week.	Eliminated Item

	Too generic	I can safely engage in 2.5 hours of the following intensity levels [Mild/Moderate/Strenuous] of physical activity every week.	Eliminated Item
	Confusing to answer	For me to participate weekly in 2.5 hours of physical activity with the following intensities [Mild/Moderate/Strenuous] would be:	Eliminated Item
	Did not like the question	I lack the skill/ability to engage in physical activity at home/or in the community even if I were really motivated to do so.	Eliminated Item
PA Intention	Do not like how specific question is	I plan to complete 2.5 hours each week of physical activity in: [Short (5-29 minutes)/Moderate (30-60 minutes)/Long Durations (more than 60 minutes)]	Eliminated Item
WAT Attitude	Do not like the scale	Using a wearable activity tracker to monitor my physical health would be: Very Desirable-Very Undesirable	Using a wearable activity tracker to monitor my physical health would be very appealing. Strongly Disagree-Strongly Agree
	Do not like fill in the blank	I think using a wearable activity tracker would be ___________in achieving 2.5 hours of physical activity weekly. Very Unhelpful-Very Helpful	Using a wearable activity tracker would be helpful for me to do 2.5 hours of physical activity weekly. Strongly Disagree-Strongly Agree
	Do not like fill in the blank	I think the health information provided by a wearable activity tracker would be __________ in helping me monitor my	Information from a wearable activity tracker would be valuable in helping me

		progress to complete 2.5 hours of physical activity weekly.	with my progress towards 2.5 hours of physical activity weekly.
		Valuable-Worthless	Strongly Disagree-Strongly Agree
SOS	Questions are long and cumbersome	To help me understand how to use a wearable activity tracker, the types of instruction or support that I would find valuable would include: [12 SOS Options]	The following supports would help me in learning how to use a wearable activity tracker. Select all that apply.
		Very Helpful-Very Unhelpful	
WAT Subjective Norms	Do not like fill in the blank	I am ____________________to use a wearable activity tracker if my friends or family members use them.	I am more likely to use a wearable activity tracker if my friends use them.
		More Likely-Less Likely	Strongly Disagree-Strongly Agree
	Wording is confusing	My friends, whose opinions I value, do not think that it's important for me to monitor my daily physical activity levels.	My friends think that it is important for me to monitor my daily physical activity levels.
		Strongly Agree-Strongly Disagree	Strongly Disagree-Strongly Agree
	Do not like fill in the blank	If people I follow on social media are promoting a wearable activity tracker, I am ______________to use a wearable activity tracker.	If the people I follow on social media are promoting a wearable activity tracker, I am likely to be interested in using the device.
		More Likely-Less Likely	Strongly Disagree-Strongly Agree
	Do not like combining friends and family	My friends and family whose opinions I value would ______________ of my using	Important family members would recommend that I use a system of support to learn how to use a wearable activity tracker.

		a system of support to learn how to use a wearable activity tracker. Strongly Approve-Strongly Disapprove	Strongly Disagree-Strongly Agree
	Do not like combining friends and family	My friends and family, who own a wearable activity tracker, have used a system of support to learn how to use their devices. Strongly Disagree-Strongly Agree	Important family members who own a wearable activity tracker have used a system of support to learn how to use their devices. No change to scale
	Do not like combining friends and family	My friends and family use wearable activity trackers to monitor their health and physical activity. Strongly Disagree-Strongly Agree	My friends use wearable activity trackers to monitor their health and physical activity. No change to scale
WAT PBC	Do not like fill in the blank	When using a wearable activity tracker for the first time, I would feel _______________ in seeking support to learn more about it. Very Uncomfortable-Very Comfortable	When using a wearable activity tracker for the first time, I would feel comfortable in seeking support to learn more about it. Strongly Disagree-Strongly Agree
	Do not like the scale or fill in the blank	For me, using a wearable activity tracker for the first time without guidance or instruction would be_______________. Impossible-Possible	It would be impossible for me to use a wearable activity tracker for the first time without guidance or instruction. Strongly Disagree-Strongly Agree

Table A2

Participant Recruitment Targets Stratified by Province/Territory

Province/ Territory	Number of young adults [a]	Estimated number of young adults with autism [b]	Target number of respondents [c]	Target number for solicitation [d]
Alberta	1,051,349	21,027	46	155
British Columbia	1,192,979	23,860	53	175
Manitoba	328,990	6,580	15	48
New Brunswick	148,784	2,976	7	22
Newfoundland and Labrador	97,095	1,942	4	14
Northwest Territories	10,895	218	0	1
Nova Scotia	207,783	4,156	9	31
Nunavut	11,537	231	1	2
Ontario	3,527,183	70,544	156	519
Prince Edward Island	35,037	701	2	5
Quebec	1,790,297	35,806	79	263
Saskatchewan	267,513	5,350	12	39
Yukon	9,484	190	0	1
Total	8,678,926	173,579	383	1,277

Notes:

[a] Population is based on census data from Statistics Canada (2020).

[b] An estimated 1-2% of the population has autism. This calculation is based on 2% of the young adult population.

[c] Number of respondents is stratified by population density per province/territory.

[d] Calculated based on a target response rate of 30%.

Table A3

List of Organizations Contacted for Survey Recruitment.

Province/ Territory	Organizations (Location)
Alberta	Sinneave Family Foundation (Calgary) Autism Aspergers Friendship Society (Calgary) Autism Society of Edmonton (Edmonton)
British Columbia	Autism Okanagan (Kelowna) Autism Support Network Society (Richmond) Autism Society of BC (Richmond) BC Autism Foundation (Richmond) Canucks (Vancouver)
Manitoba	Autism United Canada (Winnipeg) Asperger Manitoba (Winnipeg)
New Brunswick	Autism Connections Fredericton (Fredericton) Autism Resource Centre (Moncton)
Newfoundland and Labrador	Autism Society of Newfoundland and Labrador (St. John's)
Northwest Territories	Autism Society NWT (Yellowknife)
Nova Scotia	Autism Society of Cape Breton (Sydney)
Nunavut	Nunavummi Disabilities Makinnasuaqtiit Society (Iqualuit)
Ontario	Autism Community (St Catherines) Autism Life Path (Burlington) Autism Society Canada (Toronto) Autism Society of Ontario (Toronto) Autism Speaks Canada (North York) Canadian National Autism Foundation (Stoney Creek)
Prince Edward Island	Autism Society PEI (Charlottetown)
Quebec	Autisme Montreal (Montreal) Autisme Quebec (Quebec City)
Saskatchewan	Autism Services of Saskatoon (Saskatoon) Autism Resource Centre (Regina)
Yukon	Autism Society Yukon (Whitehorse)

Table A4

Participant Data Removed from Final Analysis Based on Exclusion Criteria.

Exclusion Criteria	Starting number of participants	Number of exclusions	Remaining number of participants
Removed Response Status= Spam or Draft	526	6	520
Removed responses that did not complete at least 60% of the survey	520	25	495
Removed participants who were not young adults (18-35 years old)	495	37	458
Removed participants who did not identify as autistic or non-autistic	458	3	455
Removed participant data scores suspected of straight-lining	455	5	450

Appendix B

The purpose of this appendix is to provide additional information specific to the data analysis for this study.

Table B1

Coefficient Alpha for Intention Towards PA and Intention for Using WATs

Variable	Number of items	*a*
PA Total	35	.885
WAT Total	18	.902

Table B2

Correlations between PA Dependent Variables

Variable	1	2	3	4
1. PA Attitude	-			
2. PA PBC	.24*	-		
3. PA SUB	.21*	.43*	-	
4. PA Intention	.24*	.49*	.63*	-

*p<.001
Note: N=450

Table B3

Correlations between PA Intensity Dependent Variables

Variable	1	2	3	4	5	6
1. PA Attitude Mild	-					
2. PA Attitude Moderate	.75*	-				
3. PA Attitude Strenuous	.26*	.50*	-			
4. PA PBC Mild	.49*	.46*	.08	-		

5. PA PBC Moderate	.46*	.53*	.27*	.81*	-	
6. PA PBC Strenuous	.04	.23*	.54*	.24*	.44*	-

*p<.001
Note: N=450

Table B4

Correlations between WAT Dependent Variables

Variable	1	2	3	4
1. WAT Attitude	-			
2. WAT Intention	.62*	-		
3. WAT_PBC	.70*	.57*	-	
4. WAT_SUB	.55*	.68*	.53*	-

*p<.001
Note: N=450

Table B5

MANOVA Results for PA Attitude, Subjective Norms, PBC, and Intention by Group Self-identification While Controlling for Age, Gender, and Current Employment

Variable	Pillai	*F*	*df*	Residual df	*p*	η_p^2
Self-identification	0.02	2.59	4	439	.037	0.02
Age	0.02	2.51	4	439	.041	0.02
Gender	0.05	1.80	12	1323	.044	0.02
Current Employment	0.02	0.87	8	880	.538	0.01

Table B6

Results for Linear Regression Models

Dependent Variable	Independent Variable	*B*	*SE*	95.00% CI	β	*t*	*p*

PA PBC Mild	Non-Autistic	0.23	0.09	[0.05, 0.41]	0.12	2.46	.014
	Age: 26-35	0.20	0.08	[0.03, 0.36]	0.11	2.36	.019
	Gender: I prefer not to answer this question	-0.39	0.14	[-0.66, -0.12]	-0.14	-2.87	.004
	Male	0.08	0.09	[-0.09, 0.26]	0.04	0.93	.351
	Another Gender	0.08	0.19	[-0.30, 0.47]	0.02	0.43	.669
PA PBC Moderate	Gender: I prefer not to answer this question	-0.24	0.13	[-0.49, 0.02]	-0.09	-1.84	.067
	Male	0.16	0.08	[-0.003, 0.33]	0.09	1.92	.055
	Another Gender	-0.10	0.18	[-0.46, 0.26]	-0.03	-0.53	.596
	Non-Autistic	0.32	0.09	[0.15, 0.49]	0.18	3.73	< .001
	Age26-35	0.18	0.08	[0.03, 0.34]	0.11	2.32	.021
PA PBC Strenuous	Gender: I prefer not to answer this question	0.24	0.13	[-0.01, 0.49]	0.10	1.86	.064
	Male	0.45	0.09	[0.28, 0.61]	0.19	5.24	< .001
	Another Gender	-0.06	0.18	[-0.42, 0.30]	-0.03	-0.32	.748
WAT Attitude	Gender: I prefer not to answer this question	-0.05	0.14	[-0.33, 0.23]	-0.02	-0.35	.726
	Male	-0.21	0.09	[-0.40, -0.03]	-0.11	-2.24	.026
	Another Gender	-0.55	0.20	[-0.96, -0.15]	-0.13	-2.70	.007
	Non-Autistic	0.32	0.10	[0.13, 0.50]	0.16	3.32	< .001
WAT PBC	Gender: I prefer not to answer this question	-0.03	0.13	[-0.29, 0.24]	-0.01	-0.21	.832
	Male	-0.21	0.09	[-0.38, -0.03]	-0.11	-2.32	.021
	Another Gender	-0.36	0.19	[-0.74, 0.02]	-0.09	-1.88	.061

	Non-Autistic	0.32	0.09	[0.15, 0.50]	0.17	3.59	< .001
WAT SUB	Not Employed	-0.30	0.10	[-0.50, -0.09]	-0.15	-2.89	.004
	Partially Employed	0.02	0.10	[-0.17, 0.21]	0.01	0.21	.834
WAT Intention	Gender: I prefer not to answer this question	0.10	0.15	[-0.21, 0.40]	0.04	0.64	.524
	Gender Male	-0.18	0.10	[-0.38, 0.02]	-0.07	-1.75	.081
	Another Gender	-0.80	0.22	[-1.23, -0.37]	-0.29	-3.64	< .001

Table B7

MANOVA Results for PA Intensity by Group Self-identification While Controlling for Gender, Age, and Current Employment

Variable	Pillai	*F*	*df*	Residual df	*p*	η_p^2
Self-identification	0.05	3.75	6	437	.001	0.05
Gender	0.12	2.92	18	1317	< .001	0.04
Age	0.02	1.62	6	437	.140	0.02
Current Employment	0.04	1.46	12	876	.135	0.02

Table B8

MANOVA Results for WAT Attitude, Subjective Norms, PBC, and Intention by Group Self-identification While Controlling for Gender, Age, and Current Employment

Variable	Pillai	*F*	*df*	Residual df	*p*	η_p^2
Self-identification	0.03	2.82	4	439	.025	0.03
Gender	0.04	1.52	12	1323	.110	0.01
Age	0.01	1.36	4	439	.246	0.01
Current Employment	0.03	1.47	8	880	.164	0.01

Table B9

Variance Inflation Factors for SOS Variables

SOS Element	Age	Gender	Self-Identification	Education	Current Employment
Online Manual	1.20	1.18	1.11	1.24	1.42
Online Chat Support	1.18	1.19	1.10	1.24	1.41
Telephone Support	1.17	1.19	1.09	1.24	1.38
Printed Manual	1.18	1.19	1.10	1.25	1.41
YouTube Video	1.21	1.19	1.10	1.26	1.42
Personalized Session	1.22	1.17	1.12	1.27	1.42
Group Session	1.23	1.21	1.14	1.32	1.48
Forums and Social Media	1.21	1.11	1.16	1.22	1.41

Table B10

Logistic Regression Results with Age, Gender, Group Self Identification, Education, and Employment Predicting YouTube Video SOS

Variable	*B*	*SE*	χ^2	*p*	*OR*	95.00% CI
(Intercept)	0.48	0.30	2.53	.112	-	-
Age26-35	-0.14	0.24	0.36	.551	0.87	[0.54, 1.39]
Gender: I prefer not to answer this question	-0.18	0.35	0.28	.597	0.83	[0.42, 1.65]
Gender: Male	0.55	0.26	4.57	.033	1.74	[1.05, 2.88]
Gender: Another Gender	-0.68	0.49	1.94	.164	0.50	[0.19, 1.32]
Self-Identification non-autistic	0.58	0.24	5.87	.015	1.79	[1.12, 2.87]
Education: High School	0.17	0.25	0.47	.492	1.19	[0.73, 1.94]
Education: I prefer not to answer this question	0.70	0.89	0.62	.431	2.01	[0.35, 11.45]
Education: Graduate School	-0.10	0.38	0.07	.787	0.90	[0.43, 1.89]

Employment: Not Employed	-0.19	0.30	0.42	.516	0.82	[0.46, 1.48]
Employment: Partially Employed	-0.18	0.28	0.42	.515	0.84	[0.48, 1.44]

Note. $\chi^2(10) = 19.11$, $p = .039$, McFadden $R^2 = 0.04$.

Table B11

Logistic Regression Results with Age, Gender, Group Self-identification, Education, and Employment Predicting Group Session SOS

Variable	*B*	*SE*	χ^2	*p*	*OR*	95.00% CI
(Intercept)	-1.11	0.35	9.80	.002	-	-
Age26-35	0.33	0.29	1.32	.251	1.39	[0.79, 2.45]
Gender: I prefer not to answer this question	-0.32	0.44	0.54	.461	0.72	[0.31, 1.71]
Gender: Male	-0.69	0.31	4.86	.028	0.50	[0.27, 0.93]
Gender: Another Gender	0.18	0.57	0.10	.747	1.20	[0.39, 3.65]
Self-Identification: Non-Autistic	-0.80	0.28	8.06	.005	0.45	[0.26, 0.78]
Education: High School	0.71	0.30	5.82	.016	2.04	[1.14, 3.63]
Education I prefer not to answer this question	1.31	0.81	2.65	.104	3.71	[0.76, 17.99]
Education: Graduate School	0.06	0.49	0.02	.899	1.06	[0.41, 2.79]
Employment: Not Employed	-0.32	0.36	0.80	.372	0.72	[0.36, 1.47]
Employment: Partially Employed	-0.14	0.33	0.19	.666	0.87	[0.45, 1.67]

Note. $\chi^2(10) = 20.74$, $p = .023$, McFadden $R^2 = 0.05$.

Table B12

Logistic Regression Results with Age, Group Self-identification, Gender, Education, and Employment Predicting Forums and Social Media SOS

Variable	*B*	*SE*	χ^2	*p*	*OR*	95.00% CI
(Intercept)	-0.66	0.30	4.92	.027	-	-
Age26-35	0.02	0.23	0.01	.927	1.02	[0.65, 1.59]
Non-Autistic	0.12	0.24	0.26	.612	1.13	[0.71, 1.80]
Gender: I prefer not to answer this question	-1.05	0.40	6.90	.009	0.35	[0.16, 0.77]
Gender Male	-0.22	0.23	0.97	.324	0.80	[0.51, 1.25]
Gender Another Gender	-0.09	0.51	0.03	.868	0.92	[0.34, 2.50]
Education High School	0.21	0.23	0.83	.363	1.23	[0.79, 1.93]
Education I prefer not to answer this question	-1.14	1.10	1.09	.297	0.32	[0.04, 2.73]
Education Graduate School	-0.35	0.38	0.81	.369	0.71	[0.33, 1.50]
Current Employment Not Employed	0.05	0.29	0.03	.870	1.05	[0.60, 1.84]
Current Employment Partially Employed	0.51	0.26	3.93	.048	1.66	[1.01, 2.74]

Note. $\chi^2(10) = 19.03$, $p = .040$, McFadden $R^2 = 0.03$.

Figure B1

PA Variables Chi-Square Q-Q plot for Mahalanobis Distances Testing Multivariate Normality.

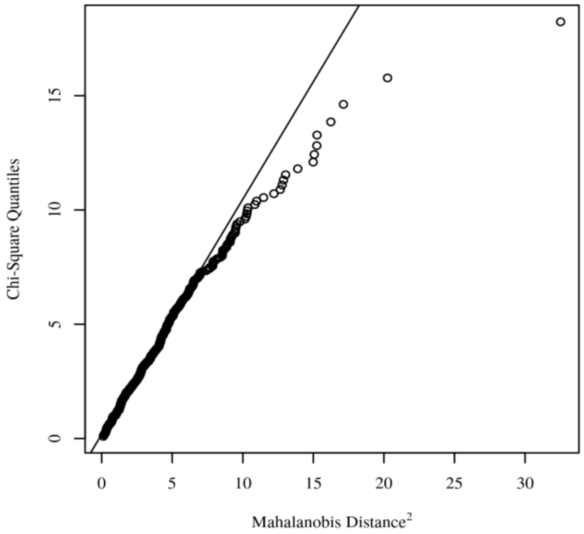


Figure B2

PA Intensity Chi-Square Q-Q Plot for Mahalanobis Distances Testing Multivariate Normality.

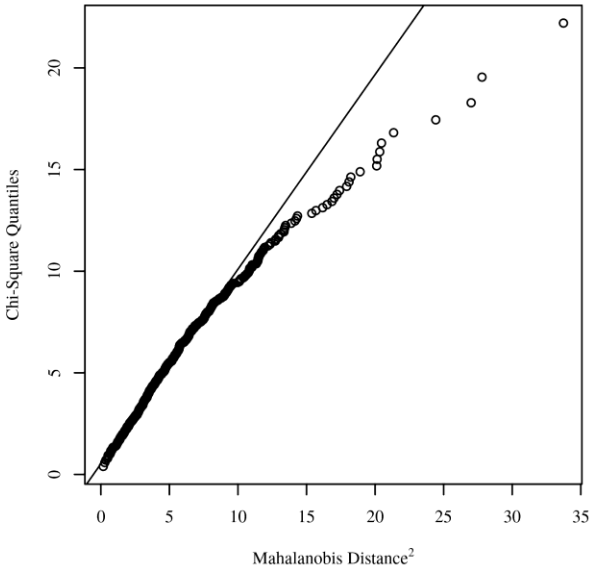


Figure B3

WAT Variables Chi-Square Q-Q Plot for Mahalanobis Distances Testing Multivariate Normality