Research Article

The 'Work Rehabilitation and Adaptation Profile' for Adults with Autism, a Validated French-Canadian Observation Grid

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Abstract

Background: There is a critical absence of standardized assessment tools necessary for comprehensively evaluating the skills and competencies of adults with autism to establish their employability profile and support them in the development of their socio-professional skills, in pre-employment transitions services (Pre-ETS).

Objective: To validate the 'Work Rehabilitation and Adaptation Profile' for adults with Autism Spectrum Disorder (WRAP-ASD) by assessing its psychometric properties and confirming its suitability across multiple Pre-ETS.

Method: A scale development and validation method was applied across day activity center, workshops, work programs and internships (n = 41 trainees with autism, n = 19 vocational rehabilitation professionals). Work functioning was observed with WRAP-ASD for motivation, attendance, peer relationships, communication, cognitive skills, rules/safety, independence, physical demand, tool/machinery handling, productivity/quality. WRAP-ASD is an Excel-based observation grid (≈3-h-over-2-weeks) with 59 items using 4-point scales from 3-almost always to 0-never.

Results: The WRAP-ASD demonstrated strong construct and convergent validities and high internal consistency. Predictive validity identified key items exclusive for each Pre-ETS. The WRAP-ASD was updated with 49 items, by removing 8 items, merging 4, and revising 4.

Conclusion: WRAP-ASD is sensitive to the different vocational needs and support requirements for Autism Levels 1–3. This is an added value over the six existing measurement tools.

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Introduction

This manuscript addresses the critical absence of standardized assessment tools necessary for comprehensively evaluating the skills and competencies of young adults with autism to establish their employability profile and support them in the development of their socio-professional skills in support and accompaniment services for integration and job retention. Considering this, the present study aims to validate the 'Work Rehabilitation and Adaptation Profile for adults with Autism Spectrum Disorder' (WRAP-ASD) (Vincent, 2024) by examining its psychometric properties, with particular attention to its suitability in diverse pre-employment transition services.

Young autistic adults with significant support needs can, after their schooling, continue their work training in support services for integration and retention in employment. To ensure the quality of the training offered to them, it is important to have a standardized instrument, recognized by vocational rehabilitation (VR) professionals. In fact, it is important to examine the realization of different dimensions of work such as motivation, attendance, peer relationships, communication, cognitive skills, rules, safety, independence, physical demands, tool and machine handling, productivity and quality.

Pre-employment transition services (Pre-ETS) for vocational and socio-professional assistance are typically delivered in community and public settings (Shattuck et al., 2020). In the U.S., Pre-ETS typically refers to services for transition-age youth and young adults. In Canada, three different pathways are possible for the Pre-ETS (Gouvernement du Québec, 2025). People with disabilities have access to services ranging from maintaining and developing autonomy to integrating and maintaining employment in a regular workplace (more for transition-age youth). They can also opt for a job integration and retention program run by the employment and social solidarity network (more for transition-age youth, or later, if a disability happened in the adulthood). They can opt for a social participation pathway, under the responsibility of the health and social services network (adults of all ages). It is here that an assessment tool like the WRAP for people for intellectual disability is used since 2012 to guide people to the appropriate service. It is worth noting that the Canadian strategy for the integration and employment of disabled people (Gouvernement du Québec, 2019) refer to a taxonomy that goes farther with "employment-related skills" and "support and accompaniment services for integration and job retention". Pre-ETS (and employment-related skills services) are necessary to decrease low employment rates (∼22 to 46%) in different countries among individuals with ASD who typically have difficulties in social interactions and a lack of adequate resources for managing interpersonal relationships (Berrigan et al., 2023; Chan et al., 2018; Office for National Statistics, 2022; Roux et al., 2013; Statistics Canada, 2023; Wehman et al., 2020). As individuals with ASD transition from educational settings to the workforce, particularly upon reaching adulthood, they encounter significant obstacles (e.g., social communication, difficulty staying organized, managing their time and keeping track of their tasks, managing sensory particularities in a work environment) (Chan et al., 2018).

To help them overcome these obstacles, five Pre-ETS designed for transition-aged youth with disabilities were found through 26 peer-reviewed articles published between 2017 and 2023 (Rooney-Krona et al., 2024). **(1) Job exploration counseling**, which includes activities to help students identify their career interests and vocational options, such as career assessments, job shadowing, and informational interviews, aiming to enhance their understanding of various career paths and the skills required for them. **(2) Instruction in self-advocacy**, a critical component of Pre-ETS, empowers individuals, particularly those with disabilities, to understand and effectively articulate their own needs, strengths, and goals. This service includes self-advocacy workshops, peer mentoring programs, and training on workplace rights and responsibilities, enabling students to advocate for themselves in various settings, including the workplace. **(3) Workplace readiness training** focuses on developing essential soft skills for employment, such as communication, teamwork, and problem-solving, through workshops, role-playing scenarios, and sessions on time management, resume writing, and interview skills. Its aim is to prepare students for workplace demands and enhance their employability. Please note that part of the recruitment for this study was carried out in workshops. In Quebec (Canada), "workshops" for people with disabilities are coordinated by specialized educators who provide, among other things, support for the development of work skills, through work tasks (e.g., assembly, filing, packaging). Specialized educators adapt tasks and instructions with a view to job preparation. There is no employer, and workshops are supported either by non-profit organizations or the public health system. Not to be confused with 'sheltered' workshops, where disabled people work for low wages.

(4) Work-based learning experiences, including apprenticeships, internships, job shadowing, and paid work experiences, provide hands-on learning opportunities in real work environments, helping students develop job-specific skills, work habits, and an understanding of workplace culture. Please note that part of the recruitment for this study was carried out in work programs (apprenticeships) and in workplace internships. **(5) Counseling on opportunities for enrollment in comprehensive transition or postsecondary education programs** involves guiding students through further education options and requirements, including college and vocational training programs. It also provides information on financial aid, organizes college tours, and assists with application processes.

Poppen et al. (2024) conducted a survey to assess the provision and accessibility of school-based transition services aligned with Pre-ETS categories for students with

disabilities. However, the study did not measure outcomes attributable to each service, emphasizing the need for tools that can evaluate the specific impacts of Pre-ETS. Whittenburg et al. (2024) examined the implementation of Pre-ETS under the US Workforce Innovation and Opportunity Act (n = 200 000 youth aged 14 to 27 in at least one Pre-ETS between 2017 and in 2020 (n = 207 848)) but similarly did not address the outcomes of each service individually. An observation grid entitled the 'Work Rehabilitation and Adaptation Profile for adults with Autism Spectrum Disorder (WRAP-ASD)' was pre-validated for its content and applicability (Vincent et al., 2023), in the Pre-ETS category "Instruction in self-advocacy".

While these services are essential for providing support in areas such as career exploration, practical work experience, and self-advocacy, no standardized tool currently exists to evaluate their effectiveness (Poppen et al., 2024; Rooney-Krona et al., 2024; Taylor et al., 2022; Taylor & Whittenburg, 2024; Whittenburg et al., 2024).

Literature Review of Existing Assessment Tools

No further studies were found beyond those extracted by Mercure et al. (2025), who conducted a review of six databases and identified six standardized tools assessing work-related domains for individuals with autism: the Autism Work Skills Questionnaire (**AWSQ**) (Gal et al., 2013), the Basic Skill Assessment Tool for Adolescents with Autism Spectrum Disorder (**BSATA-ASD**) (Pongsaksri et al., 2017; Suchart et al., 2015), the Job Readiness Assessment Tool (**JRAT**) (Müller & VanGilder, 2014), the Maastricht Work Capacity Monitor (**MW$^{©}$M**) (Van Ruitenbeek & Zijlstra, 2019; Van Ruitenbeek et al., 2023), the Vocational Pre-Requisite Skills Assessment Tool (**VOSAT**) (Jiujias, 2020a, b), and the Work Readiness Inventory (**WRI**) (Suarta et al., 2021). The AWSQ, JRAT, VOSAT, and WRI are available in English (including administration instructions), while the BSATA-ASD (Thai) and MW$^{©}$M (Dutch) are not. None of these tools have been translated into French. The tools aim to identify an individual's functional profile across various employment-related domains. Table 1 shows which of these tools are validated exclusively for ASD clients, the number of items assessed, the number of dimensions assessed out of ten from the Work Rehabilitation and Adaptation Profile for adults with Autism Spectrum Disorder (WRAP-ASD), the assessment tool format, when it should be assessed in relation to the Pre-ETS and the latest psychometric qualities assessed for each.

The *Work Rehabilitation and Adaptation Profile* for adults with Autism Spectrum Disorder (WRAP-ASD) is an observation grid that corroborates six domains with the MW$^{©}$M and also supports the motivation domain evaluated by the VOSAT (Jiujias, 2020a, b) and the work rules and safety behaviours domains addressed in the WRI (Suarta et al., 2021). Considering that the WRAP-ASD is an existing tool that demonstrates more potential in work functioning than six tools inventoried for assessing vocational readiness; Considering that the WRAP-ASD proposes 4-level categorical scale designed for each item instead of general 4–5 Likert scales; considering that its feasibility has been demonstrated after being in a Pre-ETS setting (workshop), **research objectives** were:

1. to evaluate construct and convergent validities of the WRAP-ASD considering the application of its 10 theoretical domains of work functioning across Pre-ETS, that are workshop, apprenticeships in work program and workplace internships,
2. to assess WRAP-ASD's internal consistency,
3. to determine WRAP-ASD's predictive validity, and
4. to propose a more suitable version of the WRAP-ASD for VR professionals across workshop, apprenticeships in work program and workplace internships.

Methods

A scale development and validation method (Boateng et al., 2018), also labelled as psychometric design (Kline, 2015), was applied across a day activity center and three Pre-ETS (workshop, apprentisceships in work program, workplace internship). Key psychometric properties addressed are construct validity, convergent validity, internal consistency and predictive validity. The project was approved by the *Centre Intégré Universitaire de Santé et Services Sociaux de la Capitale Nationale* (CIUSSS-CN) Research and Ethics Committee (#2022-2378).

Target Population and Recruitment

The target population for this study consisted of adults with autism attending day activity centers (control group) and three Pre-ETS (intervention groups), ranging from 1 to 5 days per week. The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5; American Psychiatric Association, 2013) introduced three ASD levels of severity, that require different level of support.

Control group: To ensure that the assessment tool really does evaluate functioning at work, a control group was recruited in which no production or work-related activities took place. **Day activity centers** (Montreal West Island Integrated University Health and Social Services Center, 2024) offer structured activities to improve social skills, personal hygiene, meal preparation, and communication, but no work-related tasks. These centers serve individuals aged 18 and older with Level 3 autism requiring very substantial support. According to that, the DSM-5 precises

Table 1. Characteristics of the Six Tools Assessing pre-Employment Transition Services for People with Autism.

	ASD only	Most and least items	Number of WRAP-related dimensions assessed (out of 10) – the most	Observation grid (Obs) Questionnaire–self-administ. (Q)	Evaluation in relation to Pre-ETS – the best	Latest psychometric qualities–the strongest
AWSQ	Yes n = 37 20–40 y.o.	78	4 out 10	Q 4 or 5-level Likert scales	Only before	Internal consistency Discriminant validity
BSATA-ASD (Thai)	Yes n = 26 11–19 y.o.	10	4 out 10	Obs	Only before	Inter-rater reliability Test-retest reliability
JRAT	No n = 10 young adults with disabilities including some with autism 17–24 y.o.	29	5 out 10 Plus: intrapersonal functioning, particularly self-confidence	Obs 4 or 5-level Likert scales	Before and after Internship	Inter-rater reliability Social validity Predictive validity Trainees had a higher mean score (3.80 (0.11)) at the end of the program than non-hired trainees (3.18 (0.43)) (t-test = 2.67 (p < 0.05), effect size = 2.21).
MW@M (Dutch)	No People with developmental disorders, mental illnesses, or physical disabilities.	54	6 out 10: Attendance Peer Relations Communication Cognitive skills Independence Productivity and Quality Plus: intrapersonal functioning, particularly self-confidence	Obs Q 5-level Likert scales	Before and after	Content validity Feasibility (n = 16), Construct validity Internal consistency (n = 342) Test-retest reliability (n = 281 at T2, r = .67 to .79), Factorial validity (n = 485) Predictive validity (n = 455)
VOSAT	No	18	4 sur 10* includes Motivation	Obs Dichotomous questions Comments	Before and after	Tool development/ Content validation Social acceptance (8 clinicians; 7 employers)
WRI	Yes n = 121 17–29 y.o.	36	5 sur 10* includes work rules and safety behaviours Plus: intrapersonal functioning, particularly self-confidence	Q 4 or 5-level Likert scales	Only before with experts only	Concurrent acceptability: Retrospective acceptability with experts

"Severe deficits in verbal and nonverbal social communication skills; very limited initiation of social interactions and minimal response to social overtures from others; inflexibility of behaviour; extreme difficulty coping with change, restricted and repetitive behaviours markedly interfere with functioning; great distress or difficulty changing focus or action".

Intervention groups: To ensure that the evaluation tool could assess functioning at work, recruitment was done in three Pre-ETS, ranging from full-time specialized educator support to a few hours' external presence. **Workshops** (Montreal West Island Integrated University Health and Social Services Center, 2024) are facilitated by rehabilitation facilities or community organizations and emphasize self-regulation, independent living, job decision-making skills, and social participation. They are designed for individuals over the age of 21 with Level 2 autism requiring substantial (moderate to intensive) support, aligning with the Pre-ETS 'workplace readiness training' (Rooney-Krona et al., 2024). According to that, the DSM-5 precises "deficits in

verbal and nonverbal social communication skills; limited initiation of social interactions; reduced or abnormal response to social overtures from others; inflexibility of behaviour, difficulty coping with change, restricted or repetitive behaviours appear frequently and interfere with functioning; distress or difficulty changing focus or action". Apprenticeships in **Work programs** (Montreal West Island Integrated University Health and Social Services Center, 2024) provide structured opportunities to learn and enhance professional skills. Participants are expected to demonstrate a certain level of independence, follow routines, and manage basic needs, often with the support of a full-time specialized educator. These programs operate in various settings, including the private sector and school boards (education sector). Participants are likely individuals with Level 2 autism, aligning with the Pre-ETS 'work-based learning experiences' (Rooney-Krona et al., 2024). **Workplace internships** (Montreal West Island Integrated University Health and Social Services Center, 2024) provide practical experience in real work environments, with support from company employees. Participants are expected to demonstrate strong social skills and the ability to use public transit or manage specialized transportation independently, requiring minimal support from a specialized educator. Participants are likely individuals with Level 1 or 2 autism, aligning with the Pre-ETS 'work-based learning experiences' (Rooney-Krona et al., 2024). For Level 1 autism requiring support, the DSM-5 precises "without support in place, deficits in social communication cause noticeable impairments; difficulty initiating social interactions; atypical or unsuccessful response to social overtures of others; may appear to have decreased interest in social interactions; inflexibility of behaviour causes significant interference with functioning; difficulty switching between activities; problems or organization and planning hamper independence.

The Observation Grid 'Work Rehabilitation and Adaptation Profile'

The WRAP-ASD was developed in French in Canada (Vincent et al., 2023) and provides a more comprehensive assessment compared to the six tools presented in section 1.1. Content validation involved consensus among 17 experts from 10 disciplines. Its applicability was tested in a community organization workshop (a Pre-ETS corresponding to 'Instruction in self-advocacy'), where three specialized educators observed five young adults with Level 2 autism requiring substantial support (Vincent et al., 2023; Mercure et al., 2025). Typically, the full assessment using the WRAP-ASD requires approximately three hours over two weeks to be completed. The WRAP-ASD is an Excel-based observational grid, meticulously designed to assess **work functioning across 10 theoretical domains**:

✓ **Motivation**: Interest in performing a work task in a structured context and maintaining it over time, while engaging in a process to improve one's skills in a work context.

✓ **Attendance**: Adhere to agreed-upon work schedules and regularly report to work and workstations.

✓ **Peer relationships**: Establish and maintain relationships with other employees, adapting behavior to the rules of the workplace and to feedback received.

✓ **Communication**: Ability to make oneself understood and to understand others through various means of communication. Respect for the communication rules of the environment.

✓ **Cognitive skills**: Ability to make oneself understood and to understand others through different means of communication. Respect for local communication rules.

✓ **Rules and safety**: Ability to understand and comply with various regulations, including safety rules in a work context.

✓ **Independence**: A person who is independent at work is a person who exercises autonomy and freedom of action for all his or her responsibilities, and who can meet his or her own needs.

✓ **Physical demand/stamina**: Ability to work in a variety of contexts requiring different physical demands and skills.

✓ **Tool/machinery handling**: Ability to properly use, maintain and respect materials, tools, equipment and machines intended for the task.

✓ **Productivity/quality**: Quantity of work produced in a given period, meeting one or more known and required quality standards.

The tool contains 59 items, each further detailed by 413 explanatory boxes, which guide the evaluator in assessing specific aspects of work functioning (Vincent et al., 2023). Work functioning is rated using a 4-level scale: almost always (3), regularly (2), sometimes (1), or never (0). A fifth option, NA (not applicable), is available for instances where certain aspects of work functioning cannot be observed. The items address individual competencies, skills, attitudes, and behaviours, as well as tool usage, accommodations, and contextual factors in diverse work environments. Lower ratings are typically observed in day activity centers, while progressively higher ratings are noted in workshops, work programs, and internships (Tremblay et al., 2012).

Scores generation and interpretation–Mean scores of the 10 domains are compiled in a visual graph into quartiles in the 'Results and Recommendations 1' tab of the EXCEL file. Below this graph is a compilation of all the comments reported by the observer, item by item, in all 10 domains. For example, in Figure 1 there is the 'Motivation' tab where the observer has done his first observation on Date:1 01/08/2024 (grey column). The observer put an 'X' to indicate his choice of response at **1** for item 1, **NA**

Figure 1. Extract from the Latest WRAP-ASD Translated into an English Version for the Domain 'Motivation'. *Legend*: English version for the domain 'Motivation', presenting three revised items that can be observed on a 3, 2, 1, 0, or NA scale. The VR professional is required to add comments in Com. for the chosen level of notation. There are three possible observations in time (in grey, blue, orange). Red triangles, when clicked, provide further explanations in yellow boxes, as shown for item 1 at level 0, item 2 for NA, and item 3 for Com. For example, the triangle at level 0 of item 1 includes a five-line comment on attitudes. For items rated as NA, a note prompts the evaluator to specify observations from another context.

for item 2, and **0** for item 3 and should have written it down elements of context in the **Com** item. After that, in the 'Results and Recommendations' tab., a mean score of 50% ((1 + 2)/(2*3)*100%) would be represented by a bar at the motivation level in the graph as well as the comments below the graph. The interpretation of Motivation in the first quartile (0.5), with a score between 0 and 1, indicates that the trainee has shown no interest in performing work tasks in recent months. This tells the observer that his trainee is not interested in performing a job requiring the following type of task Figure 1.

Assessment duration and periods–The feasibility study with 5 autistic people in a workshop showed that WRAP-ASD administration could take 2–3 h that can be spread over as long as 3 weeks. The evaluation is completed by observing and consulting colleagues and the autistic trainee (Vincent et al., 2023). For the WRAP version

developed for persons with intellectual disabilities (Tremblay et al., 2012), educators observed the 10 dimensions of work after 1 year and even more. It is important to validate whether trainees were in the right Pre-ETS but also how the Pre-ETS could be enhanced for the trainee. We think that the timing for the WRAP-ASD should be at 3 months after being in a Pre-ETS, and after that each year.

Tool administration–In the 'Instructions' tab, it is recommended that the VR professional observes the trainee after three months, to better answer the questions, but it is not impossible to carry out the assessment before that time. Most often, it's the VR professional (the specialized educator) who completes one of the three WRAP measurement times (grey, blue, yellow in Figure 1). The second and third observation time can be completed by another VR professional, since all the data is kept in the same EXCEL file.

Inter-rater reliability–The tool contains a 'Welcome' tab, a 'Presentation' tab, an 'Instructions' tab, a 'Lexicon' tab and lots of spaces for comments which can all help if another VR professional at the second or third measurement time (e.g., one year later). Moreover, to support inter-rater reliability it is specified in the 'Instructions' tab, that: To answer the various items correctly, the VR professional should familiarize him/herself in advance with the 10 blue tabs and read the definitions of the 10 dimensions of work rehabilitation (top of each tab) and of each item. Also, the VR professional should gather data from discussions in addition to direct observations of the trainee in a work context, as well as from interviews with the staff in service, those close to him/her (family members, friends, etc.) and/or the employer. It is important that this information be used to establish a level of mastery for each item. The VR professional must ensure that the information gathered represents the best picture of the trainee being assessed.

Recruitment and Sample Size

Recruitment was conducted by the research coordinator, who approached six resources. Ultimately, four responded, including the heads of Pre-ETS at three hospital centers and community organisation. These leaders directed their VR professionals to administer the WRAP-ASD assessment across four types of Pre-ETS settings: day activity centers, workshops, work programs, and workplace internships. Both staff and participants provided signed consent forms. The targeted sample size was 57, consistent with the cohort used in the PRACT-PDI study (Tremblay et al., 2012). This sample size, equivalent to 75% of the previous study's cohort, was deemed sufficient for questionnaire validation, reflecting a 25% decrease in participation among individuals with ASD.

Data Collection

The VR professionals collected data using the WRAP-ASD observation grid. They started by completing the first three tabs of the Excel-based assessment. The 'Home' tab captures essential details such as the assessment date, setting, and individual demographics (name, gender, age, diagnosis, and educational level). Moving to the 'Presentation' tab, they reviewed the table of contents, which outlines the evaluation process, instructions for administration, a ten-tab questionnaire covering different domains, results compilation, and a lexicon. The 'Instructions' tab guided VR professionals to observe the participant for a minimum of three months to ensure thorough assessment. They engaged with adults with ASD, observed behaviours, discussed assessment items, and consulted with relevant staff. Following the observational period, VR professionals rated their observations for all 59 assessment items and wrote comments (to specify the context, if not applicable, or if there is an issue with the item). Subsequently, they proceeded to the 'Results and Recommendations' tab, where graphical representations of assessment outcomes were compiled. The 'Overall Result' tab provided a concise summary of the individual's progress. Once completed, assessments were submitted to the research coordinator for further analysis and compilation.

Data Analysis

Descriptive statistics were initially computed for all sociodemographic data, theoretical domains, and individual items, including totals, means, frequencies, and standard deviations. To compare means across the four socio-professional services, a non-parametric analysis of variance (Kruskal-Wallis test) was employed at a significance level of 0.05. Construct validity (**obj. 1**) was assessed through "extreme group" analysis using the Kruskal-Wallis test and Mann-Whitney U tests (post hoc) to compare autonomy levels between day activity centers and workplace internships. Known-groups validity (also known as extreme-groups validity) is demonstrated when a test or questionnaire can discriminate between two groups known to differ on the variable of interest (Davidson, 2014). Effect size was calculated using Pearson's method to quantify the magnitude of differences between extreme groups (Davidson, 2014). Convergent validity (**obj. 1**) was evaluated using a correlation matrix to examine relationships between WRAP-ASD's theoretical domains. High correlation coefficients (greater than 0.70) indicated robust convergent validity (Carlson & Herdman, 2012; Kline, 2015). Internal consistency (**obj. 2**) was analysed by calculating Cronbach's Alpha for all 59 items and for each domain independently (Cronbach, 1995; Tavakol & Dennick, 2011). Items that, when deleted, increased the alpha score were considered for removal or consolidation. Predictive validity (**obj. 3**) was assessed using a Kruskal-Wallis test to compare grade distributions and identify items that were not statistically significant (Sullivan, 2011). To ascertain their predictive relevance for specific Pre-ETS, the Mann-Whitney U test was employed. Similar scores suggest low predictive validity, classifying them as non-predictive for Pre-ETS. A more suitable version of the WRAP-ASD (**obj. 4**) was obtained following the best practices of Boateng et al. (2018) through item revision, elimination, and consolidation as well as through updates of sections of the tool (user orientation, tool presentation, glossary). Feedback from VR professionals, alongside statistical analyses of non-significant items (Kruskal-Wallis, p-value > 0.05 between the four services) and items that increased Cronbach's Alpha upon deletion, informed these revisions.

Results

Sociodemographic of Trainees and VR Professionals

Table 2 displays data from 41 trainees in day activity centers and three Pre-ETS, with a mean age of $33.2 \pm$

Table 2. Sociodemographic Characteristics of Trainees in day Activity Center and pre-Employment Transition Services (n = 41) and of VR Professionals Conducting the Observations with the WRAP-ASD n = 19).

	Total services	Day activity center	Workshop	Work program	Workplace internship	Kruskal-Wallis
TRAINEES:	41	14	11	7	9	p-value
Age in years (mean ± SD)	33.2 ± 11.2	32.4 ± 9.5	32.0 ± 10.3	37.7 ± 15.7	32.8 ± 11.7	0.785
Males (%)	78	81.8	85.7	71.4	66.7	
Women (%)	22	18.2	14.3	28.6	33.3	
Years attending the service (mean ± SD)	5.4 ± 6.2	10.6 ± 8.1	3.2 ± 3.5*	4.9 ± 4.2	2.9 ± 4.9*	0.006
Diagnosis (%) of autism /ASD[a]	100	100	100	100	100	
Other diagnosis (%)						0.387
No	30.6	0.0	50.0	33.3	44.4	
ADHD[b]	5.6	9.1	0.0	0.0	11.1	
Intellectual disability	36.1	63.6	30.0	33.3	11.1	
2 or more	27.8	27.3	20.0	33.3	33.3	
Education level (%)						0.727
Primary school	7.7	10.0	0.0	14.3	11.1	
High school	20.5	0.0	23.1	14.3	44.4	
Specialized class (+21 years)	30.8	70.0	30.8	14.3	0.0	
Adult education	7.7	0.0	15.4	14.3	0.0	
College	7.7	0.0	0.0	0.0	33.3	
Bachelor's degree	2.6	0.0	7.7	0.0	0.0	
Unknown	23.1	20.0	23.1	42.9	11.1	
VR PROFESSIONALS:						19
Women (%)						84
Males (%)						16
Years of experience with autistic people (mean ± SD)						10.1 ± 9.2
Years of knowing the participants (mean ± SD)						3.8 ± 6.5
Level of education (%)						
Specialized education (college)						89.5
Bachelor's degree (university)						10.5
Geographical location of services offered to the trainees (%)						
Intégration TSA (community organization in Quebec City)						19.5
CISSS[c] du Bas-Saint-Laurent (public)						7.3
CIUSSS[d] de la Capitale-Nationale (public)						70.7
CSS[e] de la Rivière-du-Nord dans les Laurentides (public)						2.4

Note. * = indicating that value is statistically different from Day activity center (Mann-Whitney, p ≤ 0.05). a = This includes the former diagnoses of Asperger's and autism spectrum disorder.
b = Attention-deficit/hyperactivity disorder. c = meaning Integrated health and social services center; d = meaning Integrated university health and social services center; e = meaning school services center (for internships).

11.2 years, and 78% being male. Trainees had spent an average of 5.4 ± 6.2 years in their respective services, with those in the day activity centers having the longest duration (10.6 years) (p-value = 0.006). All trainees were diagnosed with autism; 30.6% had no other diagnosis, 36.1% had an intellectual disability, and 27.8% had two or more diagnoses. More details on education level are provided in Table 2. Of the 19 VR professionals who completed the WRAP-ASD, 84% were women, with an average of 10.1 years of experience working with autistic individuals and 3.8 years of experience working with the same participants. Additionally, 89.5% were specialized educators with college training (technical program), and 70.7% were employed by CIUSSS-CN. Table 2 also indicates the geographical locations of the Pre-ETS settings where the VR professionals were employed.

Construct and Convergent Validities

Construct validity is well established and supported by significant differences in the overall global ratings between the day activity center and the three Pre-ETS programs (p = 0.002) (see Table 3). These findings indicate that the WRAP-ASD effectively discriminates between different types of Pre-ETS. Specifically, the Mann-Whitney U test shows significant differences in autonomy between day activity centers and the three Pre-ETS programs in five domains: 2, 3, 4, 6, and 10 (0.001 < p < 0.037). Additionally, differences were found between day activity centers and specific Pre-ETS programs in domain 7 (workshop and workplace internship) and domain 9 (workshop). To further support these findings, there is a significant difference in global ratings between the day activity center (n = 11) and workplace

internship (n = 9) (p < 0.001), with a large effect size (r = -0.765) (see Table 3), indicating a substantial divergence in global ratings between these settings. The convergence of the WRAP-ASD tool with its 10 domains is also notable, as ratings of some domains are not correlated with others, as shown in Figure 2. In green, seven out of the 10 domains exhibit strong interconnections, with correlation coefficients exceeding 0.700. Specifically, domains 4, 5, 6, 7, and 10 are highly interrelated.

Internal Consistency

Internal consistency of the WRAP-ASD is very high, as evidenced by a Cronbach's alpha of 0.965 across all items, as well as within its ten domains (see Table 4), indicating item redundancy. Notably, six domains (1, 3, 4, 5, 7, 10) demonstrate strong internal consistency, with Cronbach's alpha values ranging from 0.829 to 0.895. However, two domains exhibited lower internal consistency: '2. Attendance' ($\alpha = 0.362$) and '8. Physical demands and endurance' ($\alpha = 0.560$). Upon removing six items (5, 8, 16, 30, 43, and 50), internal consistency slightly improved across certain domains, resulting in increased Cronbach's alpha values. Significant improvements were observed by removing item 8 from domain 2, increasing Cronbach's alpha from

$\alpha = 0.362$ to $\alpha = 0.505$, and by removing item 50 from domain 8, increasing alpha from $\alpha = 0.560$ to $\alpha = 0.623$.

Predictive Validity

Predictive validity is moderate, as the Kruskal-Wallis's test identified only 26 out of 59 items as significant indicators for the three Pre-ETS programs (p-values = 0.001 to 0.033). These items are highlighted in grey in Table 5. In yellow, two specific items are identified as significant factors for differentiating outcomes across two Pre-ETS programs. Item 29, Capacity to focus on a task, in the workplace internship showed a score of 2.9, which is significantly higher than the other three settings (p ≤ 0.05). Item 44, Hours of work, in the work program settings showed a score of 2.3, significantly higher than in the workshop setting (p ≤ 0.05).

Proposition of a More Suitable Version of the WRAP-ASD for VR Professionals Across Multiple Pre-ETS

To make the WRAP-ASD more suitable for observations in Pre-ETS, we used previous statistics (3.2 to 3.4) and VR professionals' written comments. From the 34 non-significant items (Kruskal-Wallis, p-value > 0.05), we first removed items

Table 3. Construct and Convergent Validity Analysis of WRAP-ASD Ratings Across 10 Work Domains for Trainees in day Activity Center and pre-Employment Services Transition (n = 41).

	Total services		Day activity center		Workshop		Work program		Workplace internship		Kruskal-Wallis	Effect size§
Trainees (n)	41		14		11		7		9		p-value	
Level scale of 0, 1, 2 or 3£ Domains	/3	SD	/3	SD	/3	SD	/3	SD	/3	SD		
Total domains	1,8	0,6	1,3	0,4	2,0*	0,6	2,0*	0,6	2,1*	0,4	0.002	−0.765
1. Motivation (5 items)	1,5	0,8	1,1	0,7	1,7	0,8	1,4	0,9	1,7	0,9	0.287	−0.315
2. Attendance (3 items)	2,5	0,5	2,1	0,6	2,6*	0,4	2,9*	0,2	2,7*	0,4	0.008	−0.512
3. Relationship with peers (8 items)	1,8	0,7	1,0	0,6	2,1*	0,6	2,2*	0,5	2,0*	0,5	<0.001	−0.732
4. Communication skills (10 items)	1,7	0,8	1,0	0,5	1,8*	0,8	1,9*	0,8	2,1*	0,4	0.009	−0.824
5. Cognitive skills (9 items)	2,0	0,7	1,6	0,7	2,1	0,7	2,2	0,6	2,4	0,5	0.099	−0.570
6. Rules and safety (3 items)	2,4	0,6	1,7	0,6	2,6*	0,4	2,5*	0,5	2,9*	0,3	<0.001	−0.848
7. Independence (5 items)	1,2	0,8	0,7	0,5	1,3*	0,8	1,1	0,9	1,6*	0,7	0.037	−0.603
8. Physical demands and endurance (7 items)	2,1	0,5	1,8	0,4	2,0	0,6	2,4	0,5	2,1	0,5	0.140	0.342
9. Handling of tools and machinery (4 items)	1,8	1,0	1,0	0,7	2,2*	0,9	2,0	1,3	1,9	1,0	0.027	0.596
10. Productivity and quality (5 items)	1,7	0,9	1,0	0,7	1,8*	0,9	1,9*	0,9	2,3*	0,7	0.007	−0.691

Note. * = indicating that value is statistically different from Day activity center (Mann-Whitney, p ≤ 0.05); § = Effect size is calculated based on the following formula: r = z/$\sqrt{N}$; £ = Observation of work functioning with the WRAP-ASD is rated using a 4-level scale: almost always (3), regularly (2), sometimes (1), or never (0). The items address individual competencies, skills, attitudes, and behaviors, as well as tool usage, accommodations, and contextual factors in diverse work environments. The rating refers to the different levels of support (minimal to very important) deployed in the day activity center and three socio-professional settings.
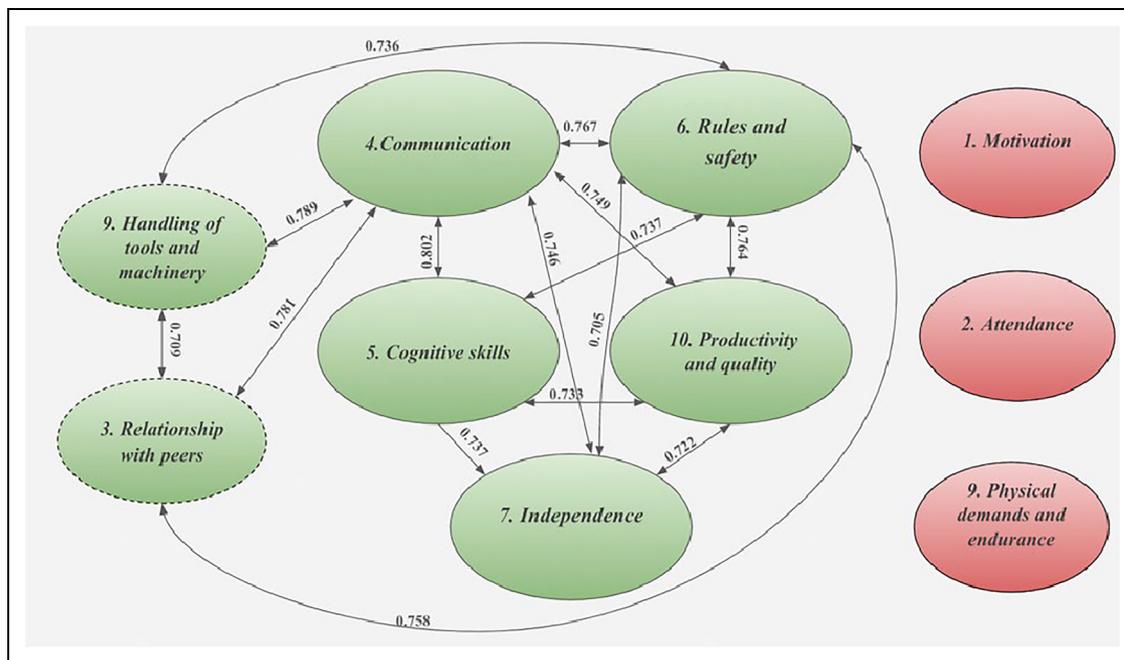
Figure 2. Correlation Matrix of WRAP-ASD's 10 Domains with Correlation Coefficients Greater than 0.700 for Convergent Validity. *Legend:* Full green border circles: domains that highly correlate with each other. Dotted green border circles: domains that moderately correlate with each other. Full red border circles or circles 1, 2 and 9: domains that do not correlate with each other.

Table 4. Internal Consistency Analysis of WRAP-ASD's 10 Domains Using Cronbach's Alpha (n = 41).

	Cronbach Alpha (α)	Item number that increases the (α) from the 59 items
Total domains	0.965	
1. Motivation (5 items)	0.855	5 (α= 0.862)
2. Attendance (3 items)	0.362	8 (α= 0.505)
3. Relationship with peers (8 items)	0.829	16 (α= 0.851)
4. Communication (10 items)	0.877	-
5. Cognitive skills (9 items)	0.839	30 (α= 0.849)
6. Rules and safety (3 items)	0.688	-
7. Independence (5 items)	0.848	43 (α= 0.854)
8. Physical demands and endurance (7 items)	0.560	50 (α= 0.623)
9. Handling of tools and machinery (4 items)	0.765	-
10. Productivity and quality (5 items)	0.895	-

5, 16, 30, 43, and 50, as their deletion increased Cronbach's Alpha and they represented common traits among individuals with ASD, leading to similar score results across the three Pre-ETS. Secondly, we merged items "2 and 3" and "7 and 8," as they consistently scored identically across all services and were redundant. Additionally, item 8 increased Cronbach's Alpha upon deletion, so merging them allowed for better integration in each domain. Thirdly,

items 34, 47, and 49 were removed due to their lack of discriminatory power, as they consistently scored similarly across all services. Fourth, items 24, 29, 52, and 55 were refined to enhance their specificity, based on feedback from VR professionals and the expertise of the principal investigator (PI). Finally, the remaining 21 non-significant items (1, 4, 6, 15, 20, 22, 23, 25, 27, 28, 31, 32, 33, 35, 39, 40, 41, 42, 45, 48, 57) were maintained in their original form, as no feedback were received from VR professionals, and trends in the results suggest the non-significance between groups may be due to a relatively small sample size. Consequently, the validated tool comprises 10 fewer items than its experimental predecessor and includes 4 revised items. See Table 6 for the proposed validated tool. The Canadian French new version of the validated WRAP-ASD is accessible online.

Discussion

All four objectives of this study have been reached. The psychometric properties of the WRAP-ASD have been clearly demonstrated with strong construct and convergent validities (obj.1), high internal consistency (obj.2), and moderate predictive validity (obj.3). These findings confirm the tool's ability to accurately assess work functioning in adults with ASD across various Pre-ETS settings, validating both its properties and its suitability for these contexts (obj.4). The significant distinctions observed between day activity centers and

Table 5. Predictive Validity Analysis of WRAP-ASD Item Ratings for Trainees Across day Activity Center and pre-Employment Transition Services (n = 41).

Trainees (n)	Total services		Day activity center		Workshop		Work program		Workplace internship		Kruskal-Wallis
	41		14		11		7		9		p-value
Level scale of 0, 1, 2 or 3 [£] Items	/3	SD	/3	SD	/3	SD	/3	SD	/3	SD	
Motivation											
1. Interest in activity at work	1.8	0.9	1.5	0.9	1.9	0.8	1.6	1.0	2.1	0.8	0,458
2. Interest to explore in various areas (No task no task to complete) (n = 36)	1.1	1.1	0.8	0.9	1.5	0.9	0.8	1.3	1.1	1.3	0,362
3. Interest to explore in various areas (With task to complete) (n = 37)	1.2	1.0	0.7	0.8	1.7	0.9	1.2	1.2	1.1	1.1	0,101
4. Perseverance to task (n = 40)	1.8	1.0	1.4	0.9	1.7	1.1	1.9	1.1	2.5	0.5	0,086
5. Interest in new tasks (n = 38)	1.4	1.0	1.2	1.1	1.6	1.0	1.4	1.0	1.3	1.2	0,836
Attendance											
6. Assiduity at work (n = 39)	2.8	0.5	2.5	0.7	2.9	0.3	3.0	0.0	2.9	0.4	0.039
7. Time of arrival/departure at work	2.7	0.7	2.5	1.0	2.8	0.6	2.9	0.4	2.8	0.4	0.799
8. Breaks and rest time	2.2	1.0	1.5	1.2	2.1	1.0	2.9*	0.4	2.6*	0.7	0.033
Relationship with Peers											
9. Response to requests	1.9	0.8	1.2	0.6	2.1	0.8	2.0	0.8	2.4*	0.5	0.005
10. Social distancing	2.0	1.1	0.9	1.0	2.4*	0.6	2.6*	1.1	2.6*	0.7	0.001
11. Initiating contacts(n = 40)	1.2	1.1	0.3	0.6	1.5*	1.0	1.6*	1.4	1.4*	1.0	0.014
12. Collaboration	1.6	1.2	0.4	0.7	1.8*	1.1	2.4*	0.8	2.2*	1.1	0.001
13. Sharing materials (n = 31)	1.9	1.3	0.1	0.4	2.6*	0.7	2.8*	0.4	1.6	1.4	0.000
14. Inclusion with the pairs	2.1	0.9	1.5	1.0	2.6*	0.5	2.6*	0.5	1.9	0.8	0.015
15. Relationship with authority	2.2	0.9	1.6	0.9	2.4	0.8	2.6	0.5	2.3	0.9	0.096
16. Reaction to critics (n = 37)	1.5	1.0	1.6	1.0	1.7	1.0	1.0	1.3	1.6	0.9	0.597
Communication Skills											
17. Conversation (n = 40)	1.2	1.2	0.3	0.5	1.1	1.2	2.0*	1.3	2.0*	1.0	0.004
18. Being understood	2.1	0.9	1.5	0.9	2.5*	0.5	2.6*	0.8	1.9	0.9	0.011
19. Expressing needs	1.7	0.9	0.9	0.7	1.9*	0.8	2.3*	0.5	2.0*	0.9	0.003
20. Understanding others (n = 40)	1.8	0.9	1.3	0.9	2.2	0.6	2.0	1.2	1.6	1.0	0.085
21. Understanding simple instruction	2.4	0.7	1.9	0.5	2.5*	0.7	2.7*	0.5	2.7*	0.7	0.015
22. Understanding complex instructions (n = 38)	1.4	1.1	0.7	0.9	1.8	1.0	1.9	1.3	1.3	1.1	0.086
23. Asking for help	1.5	1.1	0.8	0.8	1.7	1.1	1.4	1.4	1.9	0.8	0.101
24. Approval request (n = 37)	1.4	1.2	0.8	1.2	1.3	1.3	1.5	1.4	2.3	0.5	0.122
25. Lecture and comprehension (n = 40)	1.7	1.3	1.0	0.8	1.7	1.4	1.6	1.5	2.3	1.1	0.117
26. Writing (n = 39)	1.6	1.3	0.7	0.7	1.7	1.4	1.3	1.4	2.6*	1.1	0.029

Pre-ETS programs further underscore the WRAP-ASD's sensitivity to the diverse vocational needs and support requirementsf for level 1 autism to level 3 autism (American Psychiatric Association, 2013). The second version of the 'WRAP-ASD' is more suitable for 19 VR professionals across three different Pre-ETS. Following their feedback, adjustments were made to clarify different items. This second version, with 49 items, is better suited to observe and support individuals with ASD in a variety of vocational contexts, reinforcing its practical value in Pre-ETS settings.

This assessment tool can be used in practice in day activities centers, workshops, apprenticeship in work programs and internships, to check if the trainees with autism are ready to change service, what they still need to improve and adjust the tools that are put in place for them. By generating a visual graph of the 10 areas of work functioning, the data collected in the WRAP-ASD provides an overall picture of the trainee, followed by the compilation of comments as recommendations. The observation form in EXCEL mode allows compilation on three different dates, which allows monitoring over time of the trainee's work skills. Results from the WRAP-ASD inform deeply services or supports to provide further.

Added Value Compared to Other Tools

The construct and convergent validities of the WRAP-ASD shows that this tool can distinguish between participants from pre-ETS and day activity center for most dimensions. It is interesting to note that results from

Table 5. Predictive Validity Analysis of WRAP-ASD Item Ratings for Trainees Across day Activity Center and pre-Employment Transition Services (n = 41) (Continued).

Kruskal-Wallis	Total services		Day activity center				Workshop		Work program		Workplace internship
Trainees (n)	41		14		11		7		9		p-value
Level scale of 0, 1, 2 or 3 [£] Items	/3	SD	/3	SD	/3	SD	/3	SD	/3	SD	
Cognitive Skills											
27. Memory (n = 40)	2.4	0.8	2.0	0.9	2.3	0.8	2.7	0.5	2.8	0.7	0.057
28. Adaptation to a new task (n = 37)	1.8	0.8	1.4	0.7	1.9	0.9	2.1	0.7	1.7	0.8	0.281
29. Capacity to focus on a task (n = 40)	2.0	1.0	1.5	0.9	1.8	1.0	2.0	0.8	**2.9*αβ**	0.3	0.005
30. Distractions	1.9	1.1	1.8	1.2	1.4	1.2	2.0	1.0	2.3	1.0	0.278
31. Classification per category (n = 39)	2.4	0.9	2.0	1.1	2.8	0.4	2.6	0.8	2.3	1.3	0.255
32. A sequence of actions and tasks (n = 40)	2.2	1.0	1.8	1.2	2.4	0.9	2.1	1.1	2.3	0.7	0.528
33. Simple calculus (n = 33)	1.6	1.3	1.0	1.1	1.6	1.4	1.7	1.5	2.4	1.1	0.109
34. Colours (n = 38)	2.7	0.8	2.6	1.0	2.8	0.8	2.6	0.8	3.0	0.0	0.385
35. Measures (n = 31)	1.2	1.3	0.3	0.7	1.4	1.3	1.2	1.6	1.9	1.1	0.082
Rules and Safety											
36. Clothing and equipment (n = 38)	2.7	0.6	2.0	0.7	3.0*	0.0	3.0*	0.0	3.0*	0.0	<.001
37. Operating regulations (n = 40)	2.2	0.9	1.5	0.7	2.3*	0.7	2.0	1.2	2.8*	0.4	0.007
38. Security regulations (n = 38)	2.4	0.9	1.5	1.0	2.7*	0.5	2.6	0.5	2.8*	0.4	0.003
Independence											
39. Task independence alone (n = 39)	1.9	1.0	1.4	0.9	2.2	0.8	1.6	1.1	2.2	1.2	0.114
40. Organization (n = 38)	1.2	1.0	0.5	0.7	1.4	1.0	1.3	1.3	1.8	1.0	0.060
41. Problem-solving (n = 40)	1.0	0.9	0.5	0.8	1.1	0.9	0.7	0.8	1.5	0.9	0.051
42. Planning (n = 35)	0.8	1.1	0.2	0.6	0.8	1.1	1.2	1.6	1.3	1.2	0.129
43. Initiative (n = 40)	0.9	0.9	0.7	0.8	1.0	1.1	1.0	1.0	0.9	0.6	0.924
Physical Demands and Endurance											
44. Hours of work (n = 37)	1.2	1.2	0.6	0.8	0.8	1.0	**2.3*α**	1.0	1.8*	1.1	0.009
45. Environmental conditions (noise)	2.1	1.0	1.9	1.0	1.9	1.1	2.6	0.5	2.3	1.0	0.338
46. Stand or move (n = 40)	2.2	0.9	1.8	0.8	1.9	0.9	2.4	0.5	2.7*	1.0	0.024
47. Stay sitting (n = 38)	2.5	0.6	2.6	0.7	2.4	0.7	2.6	0.5	2.6	0.7	0.673
48. Body flexion position (n = 36)	2.0	1.1	1.1	1.2	2.3	1.1	2.6	0.5	2.0	1.1	0.055
49. Moving in the stairs (n = 40)	2.8	0.6	2.8	0.4	2.9	0.4	2.9	0.4	2.6	1.1	0.993
50. Physical strength (n = 29)	1.2	1.2	1.1	0.8	2.0	1.4	0.6	0.9	1.0	1.3	0.227
Handling of Tools and Machinery											
51. Simple tools (n = 33)	2.0	1.1	1.1	1.1	2.4*	0.7	2.3*	0.8	2.7*	0.5	0.013
52. Machinery (n = 14)	1.2	1.3	0.5	1.0	0.0	-	1.7	1.5	1.7	1.4	0.372
53. Information technology (n = 24)	2.0	0.8	1.4	0.7	2.8*	0.4	3.0	0.0	**1.7α**	0.5	0.003
54. Maintenance material (n = 30)	2.1	1.0	1.0	0.9	2.5*	0.7	2.8*	0.5	2.4*	0.7	0.005

motivation and physical demands were not different between settings and that they were not strongly correlated with other dimensions. Even though some items from these dimensions were modified to increase their relevance, it suggests that one clinician should not put to much emphasis to improve these dimensions if their goal is to bring the person with ASD into another setting. Convergent validity shows also a core of 5 dimensions (communication, rules/safety, cognitive skills, independence and productivity) that are strongly correlated to each other, suggesting that working on some of these dimensions might improve the other dimensions of this score.

Results demonstrated a significant advantage over the six other tools reviewed, because most of which were validated in only one Pre-ETS setting or not at all. For example, the AWSQ was validated in a single, unspecified Pre-ETS setting and targeted only high-functioning adults aged 18–39 (n = 46) who had completed secondary education and were either preparing for or already engaged in employment (Gal et al., 2013). Similarly, the BSATA-ASD, validated with a small sample (n = 6) of adolescents aged 12–19, focused only on two domains—work abilities and work attitudes—within a single context (Suchart et al., 2015), limiting its applicability compared to the WRAP-ASD's broader validation across multiple settings. The JRAT, validated during and after workplace internships within the Project SEARCH program, focused on predictive validity without explicitly assessing construct

Table 5. Predictive Validity Analysis of WRAP-ASD Item Ratings Across Trainees in day Activity Center and pre-Employment Transition Services (n = 41) (*Continued*).

Trainees (n) Level scale of 0, 1, 2 or 3 £ Items	Total services		Day activity center		Workshop		Work program		Workplace internship		Kruskal-Wallis p-value
	41		14		11		7		9		
	/3	SD	/3	SD	/3	SD	/3	SD	/3	SD	
Productivity and Quality											
55. Productivity (n = 36)	1.5	1.1	0.6	1.0	1.7*	0.8	1.9*	1.1	2.1*	1.1	0.019
56. Respect of deadlines (n = 26)	1.7	1.0	0.6	1.0	2.1*	0.7	2.3*	1.0	2.1*	0.6	0.021
57. Quality (n = 40)	2.3	0.8	1.8	1.0	2.5	0.5	2.1	0.7	2.7	0.5	0.076
58. Verification (n = 40)	1.5	1.2	0.6	0.8	1.5	1.2	1.7	1.4	2.4*	0.7	0.009
59. Precision (n = 39)	1.8	1.1	0.9	1.0	2.0*	0,9	1.9	0.9	2.4*	0.9	0.015

Note. * = Exact Mann-Whitney p-value: p ≤ 0.05 compared to Day activity Center. £ = Observation of work functioning with the WRAP-ASD is rated using a 4-level scale: almost always (3), regularly (2), sometimes (1), or never (0). The items address individual competencies, skills, attitudes, and behaviors, as well as tool usage, accommodations, and contextual factors in diverse work environments. The rating refers to the different levels of support (minimal to very important) deployed in the day activity center and three pre-employment transition services (Pre-ETS); In grey = items as significant indicators for the three Pre-ETS settings. In yellow = items predictive for Pre-ETS with α p ≤ 0.05 compared to Workshop, β p ≤ 0.05 compared to the Work program.

validity, and was validated with a small sample of 17–24-year-olds (n = 10) with various disabilities, including autism (Müller & VanGilder, 2014). The MW©M was validated before and during a Pre-ETS (specific context not mentioned) with a sample that included 23% of individuals with autism and ADHD (n = 141), but its focus remained on specific aspects like mental ability and work behavior (Van Ruitenbeek & Zijlstra, 2019), making the WRAP-ASD a more versatile tool. The VOSAT, designed for adults with cognitive disabilities, including autism, was validated primarily for workplace readiness skills in specific Pre-ETS settings, lacking the broad applicability seen in the WRAP-ASD (Jiujias, 2020a, b). Lastly, the WRI, validated with autistic individuals aged 17–29 (n = 121) prior to their integration into a Pre-ETS, concentrated on domains like responsibility and communication, but its validation was limited to a single pre-employment context (Wittevrongel et al., 2021), unlike the WRAP-ASD's validation across multiple settings.

The internal consistency of the WRAP-ASD is excellent across six out of 10 domains of work functioning, adding value compared to other tools. For example, the AWSQ demonstrated moderate to high internal consistency (Cronbach's Alpha = .59 to .82) across four domains (peer relationships, memory and attention, rules and safety, and independence) in a mixed sample of autistic and neurotypical individuals (n = 139) (Gal et al., 2013). The MWCM showed adequate internal consistency across four self-administered and observational scales for two domains (memory and attention, independence) (Cronbach's Alpha = .79 to .88) in a larger sample (n = 342) (Van Ruitenbeek & Zijlstra, 2019). Similarly, the BSATA-ASD demonstrated moderate to high internal consistency (ICC = .93 for work abilities; .54 to .64 for work attitudes) across four domains, though it was

tested with a much smaller sample size (n = 6 to 26) (Suchart et al., 2015). This underscores the WRAP-ASD's internal consistency as a key advantage over other tools, particularly due to its strong performance across six out of 10 domains of work functioning. Furthermore, deleting items that were increasing Cronbach's alpha improved dimensions homogeneity and reinforced their relevance.

Interestingly the **predictive validity** of the WRAP-ASD shows that 26 out of 59 items were identified as significant predictors distinguishing people from day activity center and all three Pre-ETS. Six other items show a tendency to be different suggesting that a higher number of participants would have confirmed this difference. Interestingly the item "capacity to focus on a task" was able to predict if people were in workplace internship compared to the other settings because they have a higher score. This suggest that working on this aspect might help people to integrate this setting. Another particularity is the fact that the knowledge or ability with technologies (e.g., computer) is not a prerequisite to be in a workplace internship as data from the information technology item reveal that people in workshop and work program have higher scores.

In contrast, the predictive validity of other tools is limited. For example, JRAT could distinguish only between two groups—those who were highly trained and those who were not—with significantly higher scores observed among hired versus non-hired trainees (3.80 vs. 3.18, p < 0.05) (Müller & VanGilder, 2014). Similarly, the MWCM focused on specific outcomes such as work accuracy and pace but only explained a small portion of the variance in work behavior (R² = 0.165–0.247) across a limited number of dimensions, unlike the WRAP-ASD's broader coverage of 11 domains. Thus, while both the JRAT and MWCM show some predictive validity, their applicability is more restricted compared to the

Table 6. An Updated 49-Items Version of the WRAP-ASD for VR Professionals Across Multiple pre-Employment Transition Services.

Domains of work functioning with their items

Motivation	*Rules and Safety*
1. Interest in activity at work	30. Clothing and equipment
2. Interest to explore in various areas (with and without task to complete)	31. Operating regulations
	32. Security regulations
3. Perseverance to task	*Independence*
Attendance	33. Task independence alone
4. Assiduity at work	34. Organization
5. Work schedule adherence	35. Problem-solving
Relationship with Peers	36. Planning
6. Response to requests	*Physical Demands and Endurance*
7. Social distancing	37. Hours of work
8. Initiating contacts	38. Environmental conditions (noise)
9. Collaboration	39. Stand or move
10. Sharing materials	40. Body flexion position
11. Inclusion with the pairs	*Handling of Tools and Machinery*
12. Relationship with authority	41. Simple tools
Communication Skills	***42. Machinery***
13. Conversation	43. Information technology
14. Being understood	44. Maintenance material
15. Expressing needs	*Productivity and Quality*
16. Understanding others	***45. Productivity***
17. Understanding simple instruction	46. Respect of deadlines
18. Understanding complex instructions	47. Quality
19. Asking for help	48. Verification
20. Approval request	49. Precision
21. Lecture and comprehension	
22. Writing	
Cognitive Skills	
23. Memory	
24. Adaptation to a new task	
25. Capacity to focus on a task	
26. Classification per category	
27. A sequence of actions and tasks	
28. Simple calculus	
29. Measures	

Note. **Italic** = items 20, 25, 42 and 45 were refined from their original version.

WRAP-ASD's comprehensive assessment across multiple settings.

Strengths and Limitations

Several strengths of our study lie in its internal validity, largely due to adherence to the method of developing and validating scales (Boateng et al., 2018). Objectivity and consistency are maintained through pre-established procedures for recruitment (FD), independent evaluations by 19 VR professionals, and independent analysis (FD, CZ). Regarding the observation grid sent to VR professionals, the wording of the items and explanatory notes encourages assessors to consider the tools available to the trainee, the adaptation of the environment, and the structural arrangements for carrying out the work tasks. However, one drawback was the inability to perform factor analysis due to an insufficient number of participants per Pre-ETS setting, which may affect the robustness of

the tool's structural validation. Additionally, while the tool's high Cronbach's alpha, exceeding 0.95, indicates strong internal consistency, it raises concerns about potential redundancy among items. This redundancy can lead to a ceiling effect, where the tool measures a narrow range of constructs, potentially diminishing its overall validity (Panayides, 2013). One limitation of our study is its external validity, as the results are generalizable only to day activity centers, workshops, work programs, and internships in three geographical regions of the province of Quebec, Canada. Furthermore, the tool is currently validated only in French, limiting its accessibility to non-French speakers.

Future Research

A future study should address the factor analysis consideration (insufficient number of participants per Pre-ETS setting) by expanding the participant pool in a cross-sectional study and enhancing the tool's broader applicability (Kyriazos &

Stalikas, 2018) and relevance across diverse Pre-ETS. To further assess the tool's test-retest reliability and sensitivity to change over time, a future observational and longitudinal study should be conducted across different pre-ETS types (XO_3XO_9, X = adapted working in Pre-ETS, O = observation) (Boateng et al., 2018). Observations at three and nine months would allow for the evaluation of the tool's ability to capture changes in individuals' skills and competencies, as well as track vocational progress and outcomes. Also, in countries where Pre-ETS programs are offered but where French is not the primary language, future cross-cultural validations of the WRAP-ASD should be carried out, to ensure its broader applicability.

Conclusion

The WRAP-ASD is a pioneering and essential tool for assessing work functioning in individuals with autism, marking a significant advancement in the field of vocational rehabilitation. As the first tool in French specifically designed for this population, it addresses a long-standing gap by offering a standardized, psychometrically validated method for evaluating vocational progress across three Pre-ETS settings. Its comprehensive scope and rigorous validation make it uniquely suited to meet the complex needs of individuals with ASD in workplace environments.

Our study confirmed four key properties of the WRAP-ASD: strong construct and convergent validities, high internal consistency, and moderate predictive validity, resulting in a refined tool consisting of 49 items. These items cover a broad range of 10 theoretical domains of work functioning, while also accounting for support levels and environmental factors, aspects often overlooked by other tools. Its adaptability to multiple Pre-ETS environments, along with its Excel-based format, streamlines data collection and reporting, making it a practical and versatile tool for vocational professionals.

By directly addressing the lack of standardized assessments within Pre-ETS services, the WRAP-ASD represents a major step forward in improving employment outcomes for individuals with ASD. Its development fills a critical need for a tool that evaluates vocational readiness and work functioning, paving the way for more individuals to transition successfully into competitive employment. As the tool evolves, further efforts to enhance its cultural adaptability and integrate environmental factors will broaden its relevance and impact.

The WRAP-ASD is more than just an assessment tool —it has the potential to dismantle many barriers faced by individuals with autism as they navigate the workforce. Its structured, evidence-based approach enables vocational rehabilitation professionals to provide tailored support, empowering individuals to meet workforce demands with confidence. Looking ahead, continued refinement of the WRAP-ASD, particularly in expanding its cultural and environmental considerations, will cement its role as an indispensable resource for vocational rehabilitation. In the broader context of improving Pre-ETS services, this tool is poised to play a crucial role in breaking down employment barriers, equipping individuals with autism with the skills and confidence needed to succeed.

Ethics Statement

The project was approved by the CIUSSS-CN Research and Ethics Committee–Rehabilitation and social integration (#2022-2378).

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Informed Consent

VR professionals and users' services were both fully informed about the research project and provided their written consent to participate before data collection.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

American Psychiatric Association. (2013). Neurodevelopmental Disorders. In *Diagnostic and statistical manual of mental disorders* (5th ed). American Psychiatric Association. DSM-5. https://doi.org/10.1176/appi.books.9780890425787.x01_Neurodevelopmental_Disorders.

Berrigan, P., Scott, C. W. M., & Zwicker, J. D. (2023). Employment, education, and income for Canadians with developmental disability: Analysis from the 2017 Canadian survey on disability. *Journal of Autism and Developmental Disorders*, *53*(2), 580–592. https://doi.org/10.1007/s10803-020-04603-3

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Front Public Health*, *11*(6), 1–18. https://doi.org/https://doi.org/10.3389/fpubh.2018.00149

Carlson, K. D., & Herdman, A. O. (2012). Understanding the impact of convergent validity on research results. *Organizational Research Methods*, *15*(1), 17–32. https://doi.org/10.1177/1094428110392383

Chan, W., Smith, L. E., Hong, J., Greenberg, J. S., Lounds Taylor, J., & Mailick, M. R. (2018). Factors associated with sustained community employment among adults with autism and co-occurring intellectual disability. *Autism*, *22*(7), 794–803. https://doi.org/10.1177/1362361317703760

Cronbach, L. J. (1995). Alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297–334. https://doi.org/10.1007/BF02310555

Davidson, M. (2014). Known-Groups validity. In A. C. Michalos (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 3481–3482). Springer. https://doi.org/10.1007/978-94-007-0753-5_1581

Gal, E., Ben Meir, A., & Katz, N. (2013). Development and reliability of the autism work skills questionnaire (AWSQ). *The American Journal of Occupational Therapy*, *67*(1), e1–e5. https://doi.org/10.5014/ajot.2013.005066

Gouvernement du Québec. (2019). *Stratégie nationale pour l'intégration et le maintien en emploi des personnes handicapées 2019-2024*. 53 pp. Gouvernement du Québec. Bibliothèque et Archives nationales du Québec, 2019 ISBN : 978-2-550-84268-2 (PDF). Stratégie nationale pour l'intégration et le maintien en emploi des personnes handicapées | Gouvernement du Québec (PDF). 53 pp. http://collections.banq.qc.ca/ark:/52327/3761369

Gouvernement du Québec. (2025). Vision commune sur les parcours de vie des personnes handicapées (A shared vision of life paths for people with disabilities). Parcours de vie des personnes handicapées | Gouvernement du Québec.

Jiujias, M. (2020a). Investigating the development of a vocational pre-requisite skills assessment tool (VOSAT) for adults with disabilities. Culminating Projects in Community Psychology, Counseling and Family Therapy, 70. https://repository.stcloudstate.edu/cpcf_etds/70

Jiujias, M. (2020b). Investigating the development of a vocational pre-requisite skills assessment tool (VOSAT) for adults with disabilities [master these, St. Cloud State University]. St. Cloud, Minnesota: Culminating Projects in Community Psychology, Counseling and Family Therapy. https://repository.stcloudstate.edu/cpcf_etds/70

Kline, P. (2015). *A handbook of test construction (psychology revivals): Introduction to psychometric design*. Routledge. 274 pp.

Kyriazos, T. A., & Stalikas, A. (2018). Applied psychometrics: The steps of scale development and standardization process. *Psychology*, *9*(11), 2531–2560. https://doi.org/10.4236/psych.2018.911145

Mercure, F., Vincent, C., Dumont, F., Caouette, M., Jolicoeur, E., Letscher, S., Boucher, N., Julien-Gauthier, F., & Bertrand-Ouellet, J. (2025). Profil de réadaptation et d'adaptation en contexte de travail pour les personnes ayant un trouble du spectre de l'autisme (PRACT-PTSA): Validité de contenu et applicabilité ". *Aequitas, Revue de développement humain, handicap et changement social [Journal of Human Development, Disability, and Social Change]*, *30*(1), automne 2025. (Under press).

Montreal West Island Integrated University Health and Social Services Center. (2024). Socio-professional services. Retrieved December 10, 2024, from https://www.ciusss-ouestmtl.gouv.qc.ca/en/care-and-services/intellectual-disability-autism-spectrum-disorder-and-physical-disability/socio-professional-services

Müller, E., & VanGilder, R. (2014). The relationship between participation in project SEARCH and job readiness and employment for young adults with disabilities. *Journal of Vocational Rehabilitation*, *40*(1), 15–26. https://doi.org/10.3233/JVR-130660

Office for National Statistics. (2022, February 10). Outcomes for disabled people in the UK: 2021. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/disability/articles/outcomesfordisabledpeopleintheuk/2021

Panayides, P. (2013). Research reports coefficient alpha. *Europe's Journal of Psychology*, *9*, 687–696. https://doi.org/10.5964/ejop.v9i4.653

Pongsaksri, M., Lersilp, S., & Suchart, S. (2017). Development and reliability of the basic skill assessment tool for adolescents with autism spectrum disorder (BSATA-ASD). *The Scientific World Journal*, *2017*(1), Article 2403943. https://doi.org/10.1155/2017/2403943

Poppen, M., Sheftel, A., Lindstrom, L. E., Rowe, D. A., Unruh, D., & Mazzotti, V. L. (2024). Transition self-assessment tool: The development and field testing of a statewide assessment of pre-employment transition services. *Journal of Vocational*

Rehabilitation, *60*(2), 163–197. https://doi.org/10.3233/JVR-240003

Rooney-Krona, M., Malouf, E. T., Brenner, H. R., Taylor, J., Whittenburg, H., Carlson, S., & Avellone, L. (2024). A scoping review of pre-employment transition services for transition aged youth with disabilities. *Journal of Vocational Rehabilitation*, *60*(2), 163–197. https://doi.org/10.3233/JVR-240003

Roux, A. M., Shattuck, P. T., Cooper, B. P., Anderson, K. A., Wagner, M., & Narendorf, S. C. (2013). Postsecondary employment experiences among young adults with an autism spectrum disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *52*(9), 931–939. https://doi.org/10.1016/j.jaac.2013.05.019

Shattuck, P. T., Garfield, T., Roux, A. M., Rast, J. E., Anderson, K., McGhee Hassrick, E., & Kuo, A. (2020). Services for adults with autism spectrum disorder: A systems perspective. *Current Psychiatry Reports*, *22*(3), 13. https://doi.org/10.1007/s11920-020-1136-7

Statistics Canada. (2023). Labour market characteristics of persons with and without disabilities in 2022: Results from the Labour Force Survey. https://www150.statcan.gc.ca/n1/daily-quotidien/230830/dq230830a-eng.html

Suarta, I. M., Gede, I. G. K., & Suwintana, I. K. (2021). The work readiness inventory (WRI): A measurement model to assess graduates' work readiness in higher vocational educations. *Advances in Social Science, Education and Humanities Research*, *544*, 305–310. (Proceedings of the International Conference on Applied Science and Technology on Social Science (ICAST-SS 2020)). https://doi.org/10.2991/assehr.k.210424.059

Suchart, S., Lersilp, S., & Pongsaksri, M. (2015). Development of a basic work skills assessment tool for adolescents with autism. *International Journal of Child Development and Mental Health (CDMH)*, *3*(2), 7–14.

Sullivan, G. M. (2011). A primer on the validity of assessment instruments. *J Grad Med Educ*, *3*(2), 119–120. https://doi.org/10.4300/JGME-D-11-00075.1. Erratum in: J Grad Med Educ. 2011 Sep;3(3):446

Tavakol, M., & Dennick, R. (2011). Making sense of cronbach's alpha. *Int J Med Educ*, *27*(2), 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Taylor, J. P., & Whittenburg, H. N. (2024). Introduction to the special issue: Examining the impact of pre-employment transition services. *Journal of Vocational Rehabilitation*, *60*(2), 163. https://doi.org/10.3233/JVR-240003

Taylor, J. P., Whittenburg, H. N., Rooney-Kron, M., Gokita, T., Lau, S. J., Thoma, C. A., & Scott, L. A. (2022). Implementation of Pre–employment transition services: A content analysis of workforce innovation and opportunity act state plans. *Career Development and Transition for Exceptional Individuals*, *45*(2), 60–70. https://doi.org/10.1177/2165143421993027

Tremblay, G., Paquette, G., & Desrosiers, F. (2012). Expérimentation du Profil de réadaptation et d'adaptation en contexte de travail pour les personnes ayant une déficience intellectuelle (PRACT-PDI). *Centre de réadaptation La Myriade*, 119. https://www.laressource.ca/images/ressources/experimentation_du_ profil_de_readaptation_et_dadaptation_en_contexte_de_travail_pour_les_personnes_ayant_une_deficience_intellectuelle_praci-pdi.pdf

Van Ruitenbeek, G., & Zijlstra, F. R. H. (2019). The development of an instrument to measure the work capability of people with limited work capacity (LWC). *Journal of Occupational Rehabilitation*, *29*(14), 163–174. https://doi.org/10.1007/s10926-018-9774-x

Van Ruitenbeek, G., Zijlstra, F. R. H., & Hülsheger, U. R. (2023). Workplace learning and development of people with limited work capacity. *Applied Psychology*, *73*(3), 963–989. https://doi.org/10.1111/apps.12459

Vincent, C. (2024). WRAP-ASD çA questionnaire to establish the profile of rehabilitation/adaptation in the work context for autistic people. Cirris - Centre interdisciplinaire de recherche en réadaptation et intégration sociale. https://www.cirris.ulaval.ca/en/produits/pract-ptsa-a- questionnaire-to-establish-the-profile-of-rehabilitation-adaptation-in-the-work-context-for-autistic-people/

Vincent, C., Mercure, F., Dumont, F., Lemieux, M., Caouette, M., Letscher, S., Boucher, N., Julien-Gauthier, F., & Bertrand-Ouellet, J. (2023). Intersectoral development of an evaluation tool for the socio-professional rehabilitation process adapted to people with autism. In D. Archambault, & G. Kouroupetroglou (Eds.), *Assistive technology: Shaping a sustainable and inclusive world* (pp. 311–326). IOS Press. https://doi.org/10.3233/SHTI230637

Wehman, P., Schall, C., McDonough, J., Sima, A., Brooke, A., Ham, W., Whittenburg, H., Brooke, V., Avellone, L., & Riehle, E. (2020). Competitive employment for transition-aged youth with significant impact from autism: A multi-site randomized clinical trial. *Journal of Autism and Developmental Disorders*, *50*(6), 1882–1897. https://doi.org/10.1007/s10803-019-03940-2

Whittenburg, H. N., Avellone, L., Taylor, J. P., Park, S., Poppen, M., Castruita Rios, Y., & Tansey, T. (2024). State-level characteristics and trends in pre-employment transition service delivery to students with disabilities. *Journal of Vocational Rehabilitation*, *60*(2), 163–197. https://doi.org/10.3233/JVR-240003

Wittevrongel, K., Mitchell, W., Hébert, M. L., & Nicholas, D. B. (2021). Acceptability of employment readiness measures in youth and young adults on the autism spectrum: A mixed-methods study. *Disability and Rehabilitation*, *44*(3251), 1–13. https://doi.org/10.1080/09638288.2021.1902578