The Autism Advantage at Work: A Critical and Systematic Review of Current Evidence

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Abstract

Background: Despite difficulties entering the workforce, people on the autism spectrum are often successful. Furthermore, they are suggested to bring unique abilities (e.g., attention to detail, tolerance for repetitive tasks) related to the repetitive and restrictive behaviours and interests (RRBI) diagnostic domain, that may be advantageous in employment.

Aims: This critical and systematic review examined evidence supporting the superior workplace performance of employees on the autism spectrum, particularly regarding the RRBI domain.

Method and Procedures: A systematic review (PRIMSA guidelines) evaluated empirical peer-reviewed studies that assess employees on the autism spectrum's performance in the workplace or on work-specific tasks. Nine databases were searched, with additional papers identified from reference lists and consultation.

Outcomes and Results: Two quantitative and four qualitative papers met criteria. Results reflect themes; attention to detail, tolerance of repetitive tasks, special/circumscribed interests, other RRBI related advantages/concerns.

Conclusions and Implications: Due to the nature and quality of the identified studies there is currently no strong evidence supporting or negating a workplace autism advantage. This review highlights the need for more research and urges constraint in utilising stereotypes that may not apply to all on the autism spectrum, arguing an individual differences approach to supporting autism strengths at work.

What this paper adds?

Individuals on the autism spectrum are said to bring unique strengths associated with the RRBI domain (e.g., attention to detail, tolerance for repetitive tasks), argued to represent an

autism advantage in employment. However, as this paper shows, most of the claims are based on anecdotes, clinical opinion, or experimental tasks, not ecological evidence investigating workplace performance or performance on work tasks. Furthermore, these claims seem predicated on a stereotypical view of autism, not taking into account the heterogeneity of strengths, interests and abilities of people on the autism spectrum. Given that a number of employment programs and opportunities are based primarily on the advantage argument, this paper highlights the need for more employment based research, and recommends an individual differences approach to autism employment that recognises the unique individual strengths and abilities people on the autism spectrum bring to the workplace.

Keywords

Autism spectrum disorder; repetitive and restrictive behaviours and interests (RRBI); workplace performance; autism advantage; talent

The autism advantage at work: A critical and systematic review of current evidence

1. Introduction

People diagnosed with Autism Spectrum Disorder (ASD; hereafter 'autism') are underrepresented in the labour force; only 27% are employed in Australia (Australian Bureau of Statistics, 2019), 55% of young people in the first 6 years post high school are unemployed in the United States (US) (Shattuck et al., 2012), 80% of people on the autism spectrum[1] are estimated to be unemployed world-wide (Ki-moon, 2015). When employed, people on the autism spectrum tend to be underemployed or working in positions under their formal level of education and below their skill level (Hedley, Uljarević, Cameron, et al., 2017; Romoser, 2000; Shattuck et al., 2012). Programs aimed at supporting people on the autism spectrum in employment have shown some success in enabling them to obtain and maintain employment (Hedley, Uljarevic, Bury, & Dissanayake, 2019; Hedley, Uljarević, Cameron, et al., 2017), and there is some preliminary evidence that targeted support reduces job related challenges (Hedley et al., 2018). However, beyond success, others have argued that autism traits (e.g., attention to detail) may present as particular strengths to certain job roles and tasks (e.g., Austin & Pisano, 2017; Smith, Belcer, & Juhrs, 1995).

Within the media (Cook, 2012) and non-government organizations (UNRIC, 2015), as well as in research literature (Austin & Pisano, 2017; Baron-Cohen, 2012; Baron-Cohen et al., 1997; Baron-Cohen et al., 2009), there has been strong advocacy promoting the narrative that individuals on the autism spectrum bring unique talents to employment—talents that represent an "autism advantage". While there has been some suggestion that the social challenges associated with the autism diagnosis may produce more focused and diligent employees who are unencumbered by social or relational distractions (see Koperlson, 2015 for a critique), this position seems premised on a stereotypical view of social motivation within autism that does not take into account the heterogeneity of autism, nor does it account

for the possible negative outcomes a lack of social connection can have in the workplace (e.g., mental health; Hedley, Uljarević, et al., 2018; Hedley et al., 2019). Rather than social challenges, it is the traits associated with the repetitive and restrictive behaviours and interests (RRBI) diagnostic criterion of ASD (American Psychiatric Association, 2013) that more frequently form the foundation of the autism advantage argument, specifically in regards to traits such as good attention to detail and preference for repetitive tasks (e.g., Baron-Cohen et al., 2009). However, rather than relying on systematic appraisal of current empirical evidence, the source of many of the references that address "the autism advantage" appears to be based on anecdotes (Cook, 2012), opinion formulated from diagnostic criteria and clinical experience (Smith, Belcer, & Juhrs, 1995), or from statements predicting advantage in the workplace based on the above average performance seen on isolated experimental tasks (Kirchner & Dziobek, 2014), rather than on systematic ecological research evidence.

While a strength-based perspective is essential to better support and encourage workforce participation and inclusion of people on the autism spectrum, it is vital that these perspectives are supported by evidence. It is also important to acknowledge the pitfalls of assigning global strength or advantage to a distinctively heterogeneous group, in particular the unintended implication that people on the autism spectrum need to prove themselves above that of their peers who are not on the autism spectrum (Bury, Hedley, Uljarević, Dissanayake, & Gal, 2019). However, people on the autism spectrum are already being marketed to potential employers based on stereotypical strengths (Kopelson, 2015; Walters, 2011), and autism employment programs have been established based on the assumption that employees on the autism spectrum will *demonstrate* specific traits in the workplace, such as attention to detail and tolerance of repetition (Austin & Pisano, 2017). It is therefore essential for long-term outcomes, sustainability, and we would argue, for the wellbeing of the

employee, that these programs are based on evidence and thus realistic expectations of the employed individual.

This critical and systematic review is therefore an essential first step towards ascertaining the current state of knowledge concerning the autism advantage in employment, particularly as it relates to the RRBI domain and, more importantly, identifying key knowledge gaps that can guide future research and practice. An accurate understanding of autism strengths in employment is essential to best utilise and support these strengths going forward. In the proceeding sections we synthesise the research base to first review the current understanding of RRBIs, their potential for supporting an "advantage", and the strengths and challenges RRBIs present in the workplace. Our review focuses on the RRBI domain, and cognitive profiles associated with this domain, because, as indicated above, this has been identified as the area where people on the autism spectrum are most likely to show strengths in the workplace. In contrast, the social communication domain is generally identified as an area requiring supports (e.g., Hedley et al., 2017, 2018). Finally, we present an individual differences approach to recognising and supporting the strengths associated with the autism diagnosis in the workplace.

2. What are restrictive and repetitive behaviours and interests?

Together with challenges in social interaction and communication, restricted repetitive and stereotyped behaviours represent the core diagnostic features of ASD (American Psychiatric Association, 2013). While RRBIs can vary in their frequency, intensity, variability and severity (Gal, 2011; Wilkes & Lewis, 2018; Yerys, 2015), they represent a heterogeneous group of behaviours characterised by repetition, rigidity, and invariance, that are often inappropriate in either the place or context in which they arise (Bodfish, Symons, Parker, & Lewis, 2000; Leekam, Prior, & Uljarevic, 2011; Yerys, 2015).

A number of factor analytical studies conducted on a variety of interview and questionnaire measures including the Autism Diagnostic Interview-Revised (ADI-R; Bishop et al., 2013; Lam, Bodfish, & Piven, 2008; Richler, Huerta, Bishop, & Lord, 2010), the Repetitive Behaviour Questionnaire-2, the Repetitive Behaviors Scale-Revised and the Childhood Routines Inventory-Revised (Barrett et al., 2015; Evans, Uljarević, Lusk, Loth, & Frazier, 2017; Georgiades, Papageorgiou, & Anagnostou, 2010; Honey, McConachie, Randle, Shearer, & Le Couteur, 2008; Lidstone et al., 2014) have most commonly identified Repetitive Sensory Motor Behaviours, Insistence on Sameness, and Circumscribed Interests (Honey et al., 2008; Lam et al., 2008).

RRBIs are not unique to autism, and occur across a range of other classified disorders (e.g., Obsessive-Compulsive Disorder, Attention-Deficit Hyperactivity Disorder), as well as during normative development, where they are transient and serve adaptive functions (e.g., motor development and maturation; Sprague & Newell, 1996; Thelen, 1979; Wolff, 1968). However, amongst children on the autism spectrum, repetitive sensory motor behaviours are maintained through social (e.g., attention, task avoidance) or automatic (e.g., self-stimulatory, distraction from adverse physical stimuli) reinforcement (Cunningham & Schreibman, 2008; Rapp & Vollmer, 2005). Similarly, during normative development, insistence on sameness has been linked to normative fears and anxiety, and are suggested to serve as an early form of self-regulation (Evans, Gray, & Leckman, 1999; Evans et al., 1997; Uljarević, Arnott, et al., 2017; Uljarević & Evans, 2017) and reduce as more mature forms of self-regulation develop (Evans et al., 1999). However, in autism, due to developmental delays in a range of areas (e.g., cognitive control, executive functioning; Hill, 2004), which themselves have been linked to insistence on sameness (Leekam et al., 2011; South, Ozonoff, & McMahon, 2005; Tregay, Gilmour, & Charman, 2009; Uljarević, Richdale, Evans, Cai, & Leekam, 2017), these behaviours tend to remain relatively stable over time (Esbensen, Seltzer, Lam, &

Bodfish, 2009), limiting the opportunity to develop more flexible or age appropriate forms of regulation.

Taken together, repetitive sensory motor behaviours, insistence on sameness and circumscribed interests collectively and individually can represent significant challenges to functioning of people on the autism spectrum and those who support them (Harrop, McBee, & Boyd, 2016; Leekam et al., 2011). They may also reinforce the other major autism diagnostic domain; social interaction. While each of these diagnostic criteria can result in problems in participation, the interaction between them may cause a cumulative effect. For example, RRBI such as stereotyped movement, due to their age or situation inappropriateness, may be socially stigmatizing (Cunningham & Schreibman, 2008). This may affect social interaction, in turn contributing to social withdrawal in order to be involved with RRBI in privacy, thus avoiding social negative responses.. Furthermore, the restrictive nature and the intense need to perform RRBIs may limit social repertoire or interaction (Attwood, 2003; Klin, Danovitch, Merz, & Volkmar, 2007) and inhibit the ability to access and attend to formal education or employment, or reduce the opportunity for situations conducive to developing more flexible, functional and elaborate cognitive and social abilities (Leekam et al., 2011).

Some people on the autism spectrum associate aspects of RRBIs with supporting well-being (e.g., circumscribed interests; Mercier, Mottron, & Belleville, 2000), or believe RRBIs function to regulate strong emotions (e.g., anxiety, anger; Joyce, Honey, Leekam, Barrett, & Rodgers, 2017; Rodgers, Glod, Connolly, & McConachie, 2012). However, as noted above, although the utilisation of such behaviours might be effective in the short-term, in the long-term it potentially limits the development of more adaptive behaviours, and thus may in turn reinforce anxiety (Uljarević, et al., 2017), and increase the reliance on RRBIs.

In addition to the RRBIs detailed above, hyper- or hypo-reactivity to sensory input comprise the fourth RRBI domain, characterised by extreme or indifferent responses to sensory information (e.g., tactile, vestibular and proprioceptive; American Psychiatric Association, 2013). Heterogeneous in nature (Ben-Sasson et al., 2007; Leekam, Nieto, Libby, Wing, & Gould, 2007; Uljarević, Baranek, et al., 2017), sensory concerns can have significant impact on daily functioning directly (Smith & Sharp, 2013), or may be related to or engender other RRBI's directly (Gal, Dyck, & Passmore, 2010), or through anxiety (Lidstone, Uljarević et al., 2014).

The severity to which RRBIs interfere with daily functioning can negatively influence development, and the success to which people on the autism spectrum interact with the world around them. Research suggests RRBIs may reduce with age. For example, Esbensen et al. (2009) found lower levels of RRBIs in adults compared to children, and Shattuck et al. (2007) found a reduction in RRBIs across a 4.5 year period, with lower overall levels and a greater reduction of RRBIs during this time period for adults over adolescents. However, despite this potential for a reduction in RRBIs over time, they remain a diagnostic criterion of autism across adolescence and adulthood, and continue to present challenges across older ages, including in the work environment.

3. An autism advantage?

Although RRBIs can undoubtedly provide challenges in education, employment and everyday life, some have argued that aspects of RRBIs can represent a strength or ‘talent’ unique to individuals on the autism spectrum. For example circumscribed interests are often cited as an intrinsic and extrinsic motivator for better outcomes in education (Gunn & Delafield-Butt, 2016; Goldfarb, Gal & Golan, 2019) and intervention (Harrop, Amsbary, Towner-Wright, Reichow, & Boyd, 2019); however, whether this presents a unique ability above that of individuals without autism is not clear. Furthermore, the applicability of some

circumscribed interests to education and employment, and the inflexibility in which they are often pursued, raises questions of their utility as motivators in some contexts.

Beyond motivation as it relates to circumscribed interests, autism is also characterised by profiles of uneven cognitive abilities that can lead to relative strengths in particular areas. Although not included in the diagnostic criteria, special isolated skills, sometimes referred to as savant skills when they exceed performance in the general population (although see Treffert, 1989 and Howlin, Goode, Hutton, & Rutter, 2009 for differences in 'savant; definition) are relatively common in autism, with estimates suggesting these skills may be present from between 28% to 42% of the population (Bennett & Heaton, 2012; Howlin et al., 2009). Special isolated skills are domain-specific abilities characterised by a relative higher performance in a clinical domain compared to the general adaptive or functioning level (Meilleur, Jelenic, & Mottron, 2015), and are often associated with the RRBIs (Happé, 2018; Happé & Vital, 2009). In a recent study Meilleur et al. (2015) found that 62.6% of their sample of people on the autism spectrum had at least one special isolated skill, including memory (52.5% of the sample), visuospatial (32%), reading (22.4%), drawing (17.5%), music (16.9%) and computation (16.7%).

Additionally, people on the autism spectrum have demonstrated higher domain-general performance, that is higher performance on non-verbal cognitive task (usually perceptual tasks; e.g., Wechsler's block design subtest) compared to their own general cognitive ability (Meilleur et al., 2015; Mottron, Soulières, & Dawson, 2013). These domain-general abilities can lead to perceptual peaks such as better visuo-spatial (Mottron, Bouvet, et al., 2013; Soulieres, Zeffiro, Girard, & Mottron, 2011) and pitch discrimination skills (Heaton, Williams, Cummins, & Happé, 2008; O'Connor, 2012).

Greater abilities in memory, visuo-spatial, or pitch discrimination may be beneficial for individuals on the autism spectrum in specific employment tasks (e.g., reviewing satellite

images, Chen, Leader, Sung, & Leahy, 2015; Rubin, 2016; music, Happé & Vital, 2009). However, as Meilleur et al. (2015) suggest, depending on the definition used, both domain-specific and domain-general skills can be inferior, equivalent or superior to individuals of comparable age who are not on the autism spectrum, and thus may represent strengths within individual cognitive profiles, not necessarily an advantage overall.

Baron-Cohen, Ashwin, Ashwin, Tavassoli, and Chakrabarti (2009) suggest that rather than a deficit, the non-social aspects of autism (e.g., "narrow interests; repetitive behaviour; and resistance to change/need for sameness"; p.1378) can represent talent, such as attention to detail. Attention to detail in this context has been attributed to a bias in the processing of information (e.g., weak central coherence, Happé & Frith, 2006) or a unique cognitive style (e.g., enhanced perceptual functioning, Mottron, Dawson, Soulières, Hubert, & Burack, 2006; hyper-systemising, Baron-Cohen et al., 2009), with some suggestion of sensory hypersensitivity leading to greater perceptual capacity (Brinkert & Remington, 2020) or visual acuity (Ashwin, Ashwin, Rhydderch, Howells, & Baron-Cohen, 2009; but see Bach & Dakin, 2009 for an alternate interpretation). Baron-Cohen et al. (2009) suggest that people on the autism spectrum show talent in "recognizing repeating patterns in stimuli", and suggests a hyper-systemising style of thinking (e.g., search for rules and consistency in stimuli) that leads to advantages like an excellent attention to detail. Examples of enhanced attention to detail amongst people on the autism spectrum in the broader research literature include enhanced visual search abilities (e.g., Kaldy, Giserman, Carter, & Blaser, 2016; O'Riordan, Plaisted, Driver, & Baron-Cohen, 2001; Plaisted, O'Riordan, & Baron-Cohen, 1998), superior performance on hidden figures tasks (Shah & Frith, 1983) and pattern recognition (Stevenson & Gernsbacher, 2013).

However, while this relative or superior performance is evident in the controlled laboratory environment, it is important to evaluate whether these skills translate to a "real

world" advantage (e.g., in the workplace). Importantly, the validity of the broader claim that people on the autism spectrum have specific skills that make them more suitable to certain types of employment than others needs to be determined, as it has the potential to place unnecessary pressure on individuals who may, in fact, not possess these "special skills" that facilitate enhanced job performance (Bury et al., 2019).

4. RRBIs as barriers and strengths in the workplace

Navigating the social requirements of job interviews and workplace interactions present significant barriers for individuals on the autism spectrum in accessing and maintaining employment (Chen, Leader, Sung, & Leahy, 2015; Mawhood & Howlin, 1999). However, once employed, the higher level RRBIs, such as insistence on sameness, rigid routines and rituals, also present challenges for maintaining employment and managing workloads. Employees with autism may require or have difficulties adjusting to set routines and rules, or difficulties managing changes in the work setting or tasks, or difficulty in seeing the 'bigger picture' (Hillier et al., 2007; Mawhood & Howlin, 1999; Müller, Schuler, Burton, & Yates, 2003). Together with the impact of the physical environment on sensory sensitives (e.g., fluorescent lights, movement in open office spaces, too much noise; Kirchner & Dziobek, 2014), workplaces can present a challenging environment for employees on the autism spectrum.

Despite the challenges, vocational placement and employment programs have had success supporting individuals on the autism spectrum to enter and maintain employment (Flower, Hedley, Spoor, Dissanayake, 2019; Hedley et al., 2018; Hedley, Uljarević, Cameron, et al., 2017; Hedley, Uljarević, & Hedley, 2017; Wehman et al., 2019). This has been achieved through various measures such as job coaches, job search assistance, assessment and placement, and on the job training and accommodations (Hedley, Uljarević, Cameron, et al., 2017; Hillier et al., 2007; Wehman et al., 2019). Evaluations of such

programs generally focus on the employment outcomes for individuals (e.g., gaining employment, increased working hours and wages; Hedley, Uljarević, et al., 2017). However, success is often couched in job descriptions that highlight specific skills (e.g., "repetitive tasks that require a high attention to detail and an intensive focus"; Wehman et al., 2014, p. 496), or strengths are reported via supervisor feedback, such as an admiration for their employees on the autism spectrum's reliability, honesty, and adherence to rules, or attention to detail (Hillier et al., 2007; Scott et al., 2017). It is not clear whether these skills encompass all or only some employees on the autism spectrum, or are comparatively different from employees who are not on the autism spectrum. However, it suggests that by supporting individuals on the autism spectrum in employment, that due to qualities unique to the autism diagnosis (i.e., RRBI), individuals on the autism spectrum can show skills that are advantageous to employers.

Similar suggestions, based on the nature of the autism diagnosis, have led to recommendations that individuals on the autism spectrum may prefer jobs that have limited social interaction, and are repetitive in nature —jobs "others find unpleasant" (Van Bourgondien & Woods, 1992, p. 229). In fact, some people on the autism spectrum themselves have suggested they can perform repetitive tasks without getting bored (Hurlbutt & Chalmers, 2004). In this instance, not only could a tolerance for repetitive tasks present an advantage to employers in staffing difficult to fill positions, but it may also lead to less errors in repetitive tasks. However, while people on the autism spectrum report preferences for repetitive or routine work (Müller et al., 2003), at a higher rate than individuals without autism (Gal, Landes, & Katz, 2015), some also want the nature of that structured work to be intellectually challenging (Müller et al., 2003). This suggests that while a tolerance or preference for repetitive work may provide an employment advantage for some individuals

on the autism spectrum, assessing the nature and preferences for such tasks is important to best employ this advantage (Gal et al., 2015; Gal, Meir, & Katz, 2013).

Beyond autism traits in general representing a vocational advantage by performing a role that may be hard to fill by the general population, RRBIs in autism in particular, have been linked to individuals performing some skills better than peers who are not on the autism spectrum. Drawing from the research that highlights strengths in systemised thinking and attention to detail (e.g., pattern recognition), has led companies to seek out people on the autism spectrum, especially in technology related roles (Austin & Pisano, 2017; Hedley et al., 2018; Hedley, Uljarević, & Hedley, 2017), where such analytic skills are valued. Furthermore, due to the intensity of focus and preoccupation some individuals on the autism spectrum give to their special interest, their broad depth of knowledge has been *argued* to be advantageous in employment (Attwood, 2003; Bross & Travers, 2017; Müller et al., 2003; Olney, 2000), and may even lead to extended knowledge in a professional area (e.g., physics, mathematics; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). In much the same way, aligning savant or special skills with employment is suggested to lead to an "autism advantage" in the workplace (Müller et al., 2003).

5. Systematic review of the evidence supporting an autism advantage in the workplace

Together, the described research suggests that given sufficient support, people on the autism spectrum may not only be successful at work, but may potentially outperform their peers who are not on the autism spectrum on certain tasks. However, as highlighted by the research cited above, evidence supporting the autism advantage tends to be based on clinical opinion, or from experimental studies conducted in a controlled environments, not with studies that measure work performance, or consider the impact social and environmental (e.g., sensory differences) challenges may have on the successful application of this advantage in the workplace. Given the implications these claims have to job alignment and

potential supports within the workplace, it is crucial to systematically appraise the currently available evidence supporting superior performance of individuals on the autism spectrum in the workplace, particularly in regard to RRBIs.

5.1 Method

In order to investigate the current status of the "real world" evidence supporting the autism advantage in the workplace, especially as it relates to RRBIs, we conducted a systematic review. Our review methodology was specified in advance and documented in a protocol in line with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Liberati et al., 2009).

5.1.1 Search strategy

We conducted a broad search across Scopus, PsycINFO, PubMed, ERIC, CINAHL, Proquest Research Library, Proquest Social Science, Medline, and Web of Science on the 8th of April 2018, with no beginning date limits set, and updated on the 9th of November 2018, and again 8th May 2020. Our search terms (Table 1) were derived from our specific aims, similar published reviews, and through consultation with colleagues in the field, with combinations of truncated terms searched across all fields (title, abstract, keywords). Additional articles not listed in the database search were identified through a review of reference sections from included articles and through correspondence with colleagues in the field.

[Enter Table 1 about here]

5.1.2 Inclusion and exclusion criteria

For articles to be included, they were (a) published in English, (b) empirical studies (regardless of their design), (c) published in peer-reviewed journals and (d) focused on

performance in the workplace or naturalistic approximations of work tasks. Articles required individuals with an ASD diagnosis (this included pre-DSM-5 diagnoses; autism, Asperger's disorder or pervasive developmental disorder not otherwise specified (PDD-NOS)), with or without an intellectual disability, who were 18 years or older at the time of the study.

Our review excluded conference abstracts and theses. In addition, laboratory-based studies that did not focus on specific work skills were excluded as the study aimed to determine whether there is evidence that superior skills shown in experimental research generalise to workplace or other employment settings. Initial restrictions on sample size and qualitative research were relaxed due to low numbers of identified papers, and systematic or meta-analysis review articles were not excluded; however, none were identified. Given the mix of qualitative and quantitative articles in the review the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018) was used to appraise the quality of research in included in this systematic review (Pace et al., 2012; Pluye, Gagnon, Griffiths, & Johnson-Lafleur, 2009). Overall, the papers met 60-100% of the quality criteria, with more detailed discussion of limitations in the following sections. Due to five of the six papers reporting outcomes that were subjective reports, rather than objective, blinded assessments, there was significant risk of bias.

5.1.3 Study Selection

Study selection was first completed in April 2018, then updated in November 2018 and May 2020. Figure 1 represents a detailed flow chart of the study selection. After the initial search, duplicates were removed first using EndNote's duplicate removal tool, followed by a manual search, then titles were searched and obviously irrelevant articles were removed. Next, abstracts of the remaining articles were reviewed for potential inclusion in the full review. Inclusion at this stage only required a focus on autism, and the potential for assessment of some aspect of work performance or skill.

[Enter Figure 1 about here]

5.2 Results

After the study selection process, we identified only two quantitative and four qualitative studies that directly addressed the research question of the autism advantage in employment (Table 2). Of the studies identified, two were conducted in the United States and the United Kingdom, with one each from Switzerland and Australia. For the employees on the autism spectrum with recorded employment (n = 89), available data suggests they were primarily employed in health care and social assistance (23.53%), retail/customer service (14.12%), education and training 12. 94%), professional, scientific and technical services (10.59%), information, media, and telecommunications (9.41%), other services (8.24%), accommodation and food services (5.88%), other (5.88%), manufacturing (4.71%), rental, hiring, and real estate (2.35%), public administration and safety (2.35%).

[Enter Table 2 about here]

5.2.1 Attention to detail

Amongst a broader survey, Scott et al. (2017) surveyed employers who employed an individual on the autism spectrum, and asked them to rate the work performance of this employee, and where possible, up to two non- autism employees' matched for commensurate job roles (e.g., tasks, skills, hours). Participants rated their employees (above standard, meets standard, below standard) across seven domains using single item measures (e.g., "How would you describe the employee's attention to detail?"). There were no differences in performance ratings between employees for 'quality of work', 'productivity', and 'following instructions'. Interestingly, employees on the autism spectrum were more likely than peers

not on the autism spectrum to be rated both above (37.3%) and below (15.7%) standard for 'completes work on time'. Of relevance to the current review, employees on the autism spectrum were significantly more likely to be rated above standard for their 'attention to details', with 54.9% of the employees on the autism spectrum rated above standard (non-autistic sample 19% above standard).

In an experimental study that replicated job tasks, Gonzalez, Martin, Minshew, and Behrmann (2013) measured attention to detail with a visual search task employing a naturalistic baggage search task. Across two sets of 160 trials (with high or low clutter in bags), 13 participants on the autism spectrum and matched controls were required to identify bags with contraband items (hit) or reject bags without contraband (correct rejection). Across both sets, there was no difference between groups in hit rate between conditions, though participants on the autism spectrum were significantly slower. For the correct rejection rate, there was no difference in speed across both sets, nor performance in the first set, however, the autism group's performance improved with the second set of trials, outperforming the non-autism group, whose performance reduced between sets (though not significantly).

Although not specifically focused on employment, in Smith and Sharp's (2013) qualitative study on sensory sensitivity, hypersensitivity emerged as a workplace advantage. One participant thought his pleasure in visually focusing on details helped his performance as a mechanic; another believed that his hypersensitivity to taste benefited him as a chef, by having more refined skills in identifying and matching flavours. Similarly, while not focused on employment, employed participants in Russell, Kapp, Elliott, Elphick, Gwernan-Jones, and Owens's (2019) qualitative study investigating the broader concept of 'autistic advantage' perceived that their attention to detail was an advantage at work (i.e., shop assistant, gardener), though could be problematic in certain contexts (i.e., time constraints).

5.2.2 Tolerance for repetitive tasks

Focused on visual search skills, Gonzalez et al. (2013) study indicates that the autism group's performance improved on the second set of 160 trials, while the non-autism group's performance decreased (though not significantly). These results suggest greater skills for sustained attention for longer time-periods on repetitive tasks in the autism group. Similarly, although tolerance for repetitive tasks was not a specific focus of any of the research, results from qualitative research investigating perceived reasons for employment success (Krieger, Kinébanian, Prodinger, & Heigl, 2012) and environmental factors impact on work performance (Pfeiffer, Braun, Kinnealey, Derstine Matczak, & Polatajko, 2017), showed that participants on the autism spectrum believed their work performance to be improved if work was clearly structured and defined, with consistent schedules or routines. However, some participants found job schedules to be stressful and reduced performance if they were too full, or had time constraints (Pfeiffer et al., 2017).

5.2.3 Special/circumscribed interests

Participants in Pfeiffer et al. (2017) believed that their work performance and job satisfaction improved for jobs that matched their specific skills and interests. Although not discussed in terms of performance per se, one participant in Krieger et al. (2012) believed that being able to transform his interest into employment led to career success early (University Professor, computer scientist), while the other participants in the study had a more difficult path in gaining success.

5.2.4 Other RRBI related advantages/concerns

While arguably measuring attitudinal factors rather than work performance, two of the performance areas of Scott et al. (2017) seem related to RRBIs. For example, perhaps reflecting a rigid adherence to the rules, employees on the autism spectrum were 6.21 times more likely to be rated as having above standard 'work ethic' (70.6%) compared to non-

autistic controls (30.1% above standard). However, participants were also more likely than their non-autistic peers to be rated below standard in regards to 'flexibility' (27.50% on the autism spectrum were rated below standard compared to 8.3% of those without).

Not surprisingly, not all information regarding RRBIs was positive. Sensory hypersensitivity was reported by participants on the autism spectrum to lead to reduced success in work performance (Krieger et al., 2012; Pfeiffer et al., 2017). Reducing sensory concerns in the environment, such as fluorescent lights, noise, movement, temperature, and the fear of being touched unexpectedly, were essential for participants to successfully ensure inclusion in the workplace (Krieger et al., 2012).

5.3 Discussion

Given the challenges individuals on the autism spectrum experience entering the workforce, understanding their strengths and how best to employ them is of significant importance. The aim of this systematic review was therefore to summarise the research findings that assess the influence of autism, with a specific focus on RRBIs, on work performance, that is, to assess the current evidence for an "autism advantage" in the workplace. Only six studies (two quantitative, four qualitative) that met the inclusion criteria were identified, incorporating 107 participants on the autism spectrum and 109 non-autistic controls. Overall, while there was some evidence supporting increased performance in areas associated with RRBIs and non-social aspects of autism in the workplace, the breadth and quality of the evidence was insufficient to provide clear support for the existence of an advantage in the workplace associated with core autism traits.

Studies that explored attention to detail were somewhat mixed in terms of design and findings. While most self-reports of those on the autism spectrum addressed difficulties due to sensory hyper-sensitivity, some participants believed that due to their sensory abilities, they were able to distinguish between details, which benefited their work performance

(Russell et al., 2019; Smith & Sharp, 2013). In the view of employers, attention to detail amongst employees on the autism spectrum was rated higher than their non-autistic colleagues (Scott et al., 2017); however, as 'attention to detail' was not operationalised in this study, it makes it difficult to determine how individuals on the autism spectrum displayed this particular skill. When the particular skill associated to attention to detail was operationalised in a visual search task (Gonzalez et al., 2013), the expected advantage in visual search (see Dakin & Frith, 2005) was not immediately evident, with individuals with and without autism performing equally well on both correct hits and rejection. However, individuals on the autism spectrum did improve their correct rejection rate with repeated trials, a finding that suggests an ability for sustained attention on a repetitive task more than an inherent advantage in visual search.

Tolerance for, or sustained attention to repetitive tasks, seems to be inadvertently supported by Gonzalez et al. (2013) for at least one of the tasks in their "real-world" bag screening task, a skill the authors argue is of benefit for employment wherein such tasks are employed. Beyond this study, tolerance for repetitive tasks was somewhat supported by qualitative reports which state that participants feel their performance improved for structured or routine work (although some struggled if work became too structured). However, what structured or routine work looked like, or the degree to which this improved performance, is difficult to assess from this research. Similarly, participants reported greater success, performance and satisfaction if their interests and skills were aligned with their employment, but what the nature of these skills entailed, and how they aligned was not always evident.

Overall, amongst the research included in this review, there were very few studies that directly compared workplace skills and performance of individuals on the autism spectrum to suitable controls. While qualitative research is useful to provide broader context, and the autism voice and perspective, controlled objective studies are necessary to quantify how

reported increased performance compares amongst individuals on the autism spectrum and with suitable controls. There was also a lack of specificity in terms of how concepts were operationalised, and how they related theoretically to the autism diagnostic criteria. Given that the majority of the identified papers did not include objective, blind assessment, there was also considerable risk of bias.

6. Future directions and supporting individual differences in the workplace

People on the autism spectrum are underrepresented and underutilised in the workforce (Ki-moon, 2015; Shattuck et al., 2012), which impacts their mental-wellbeing and financial independence (Hedley, Cai, et al., 2017; Hedley, Uljarević, & Hedley, 2017). While social difficulties and RRBIs associated with autism present clear challenges to gaining and maintaining employment, the non-social aspects of autism have also been suggested to present a potential strength in the workplace, even increasing workplace performance over and above that of peers not on the autism spectrum concerning certain tasks or occupations. However, the paucity of quality evidence in regard to strengths of individuals on the autism spectrum within the workplace, especially as they relate to RRBIs, should function as a beacon, highlighting a specific need for future research. To that end, it is important for future research to combine carefully designed, ecologically valid experimental tasks designed to assess mechanisms hypothesised to subserve distinct RRBIs domains and to underpin potential advantage that these RRBIs might bring to the workplace.

Given a range of different theoretical accounts of RRBIs put forward across both non-autism as well as autism specific literature (e.g., hyper-systemising, Baron-Cohen et al., 2009; executive dysfunction/cognitive control, Demetriou et al., 2018; predictive coding, Pellicano & Burr, 2012; altered reward processing, Kohls, Antezana, Mosner, Schultz, & Yerys, 2018; anxiety and intolerance of uncertainty management, Joyce et al., 2017; Uljarević et al., 2017), it is crucial to identify the specific mechanisms underpinning

particular behavioural domains. For example, while attention to detail can be a genuine strength, it could also, in some cases, be related to difficulties with particular aspects of executive functioning, which could, in turn, produce other common workplace challenges such as inflexibility and difficulty adapting to new routines (Müller et al., 2003; Scott et al., 2017). This is in line with the qualitative findings of Russell et al. (2019) who suggested that debate around advantages vs disadvantages may present a false dichotomy, whereby particular strengths (e.g., attention to detail), could also represent an area of support in certain circumstances (e.g., managing workload when there were time constraints). It is important then to not only investigate experimentally with work based tasks and areas that may provide advantage, but also with the types of supports that can best avail of this advantage, or undermine them (e.g., reducing perceptual load may increase distractibility; Brinkert and Remington, 2020; Remington, Swettenham, Campbell, & Coleman, 2009).

While this review did not find evidence to support, or refute an autism advantage in employment, critical reflection suggests that although potential avenues for advantage exist, these avenues may not necessarily be inclusive of all people on the autism spectrum, or across all situations. The vast heterogeneity cutting across both social and non-social aspects of autism, the plethora of mechanisms that may subserve particular domains, as well as the high rates of co-occurring conditions (e.g., ADHD, anxiety) may affect the ability for research to reliably show broad common abilities and advantages within the workplace. Rather than a trying to identify broad skills, we recommend that research continues investigating advantages in the workplace, but adopt an individual approach, rather than a disability approach.

An individual differences approach will better capture the full profile of strengths as well as support needs, and help situate them in work performance more generally. This will allow for a greater understanding of the nature of advantage in employment, which is critical

for guiding practice. For example, more accurate information concerning individual strength and support needs would, in turn, allow for greater personalized supports and matching between strengths and job tasks. Additionally, with the majority of employment research focused on individuals with an IQ in the normative range, it would allow for greater understanding of how employment strengths apply across the spectrum more broadly. In view of the uneven profiles of individuals on the autism spectrum, capturing individual special isolated skills (Meilleur et al., 2015) and maximising their potential through targeted placement and support could lead to greater success for all individuals on the autism spectrum.

It is also crucially important to acknowledge the noted diversity in the presentation of autism, both in terms of strengths but also support needs, given that over emphasising possible advantages may set individuals up to fail, or underutilise their own personal skills. For example, 'tolerance for repetitive tasks' is a fairly imprecise term, while performing more mundane repetitive tasks may suit some individuals on the autism spectrum, others prefer repetitive work that is structured, but presents some intellectual challenge (Müller et al., 2003). Furthermore, given that diagnostic criteria only requires two of the four types of RRBI for a diagnosis (American Psychiatric Association, 2013), others may dislike repetitive work all together. Taking an individualised approach to potential candidates (Bury et al., 2019; Van Bourgondien & Woods, 1992), and utilising assessment tools that provide a work profile that includes autism focused items (e.g., sensory needs; Gal et al., 2015; Gal et al., 2013), will help utilise individual strengths for optimal person-job fit, and better support sustainable and *meaningful* employment.

Furthermore, while it is important to better understand areas of advantage in employment, and what supports this advantage, it is important not to overlook how these factors fit in a more holistic understanding of work performance. Given the range of

individual and environmental factors discussed above that can influence performance, investigating more distal outcomes such as overall performance as an employee, are important for understanding and improving the employability of individuals on the autism spectrum more broadly.

There seems to be a movement in information and communication technology (ICT) fields of hiring people on the autism spectrum with specific skills in mind, with some reports from employers that their employees outperform expectations (Austin & Pisano, 2017). Such programs provide great opportunity for people on the autism spectrum to gain financial independence, a sense of purpose, and success. However, as this review has shown, much more research is needed that carefully examines the underlying assertions on which the above noted initiatives have been built. Importantly, the reliance on opinion and controlled experimental studies, as opposed to ecological research focused on work tasks, or in work environments, shows that there is an important gap in the research literature in identifying strengths in the workplace and how best to support them. To that end, this review has identified a number of important areas for future research to capitalise on, and calls for the need to not only quantify the strengths that individuals on the autism spectrum bring, but also to establish the optimal ways they can be used to engender successful employment.

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Conflict of Interest

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Note:

1. Recent research (Bury, Jellett, Spoor, & Hedley, 2020) shows no consensus on language preference amongst individuals with an autism diagnosis, but that *person on the autism spectrum* is least likely to offend, and is therefore safest if audience preference is unknown.

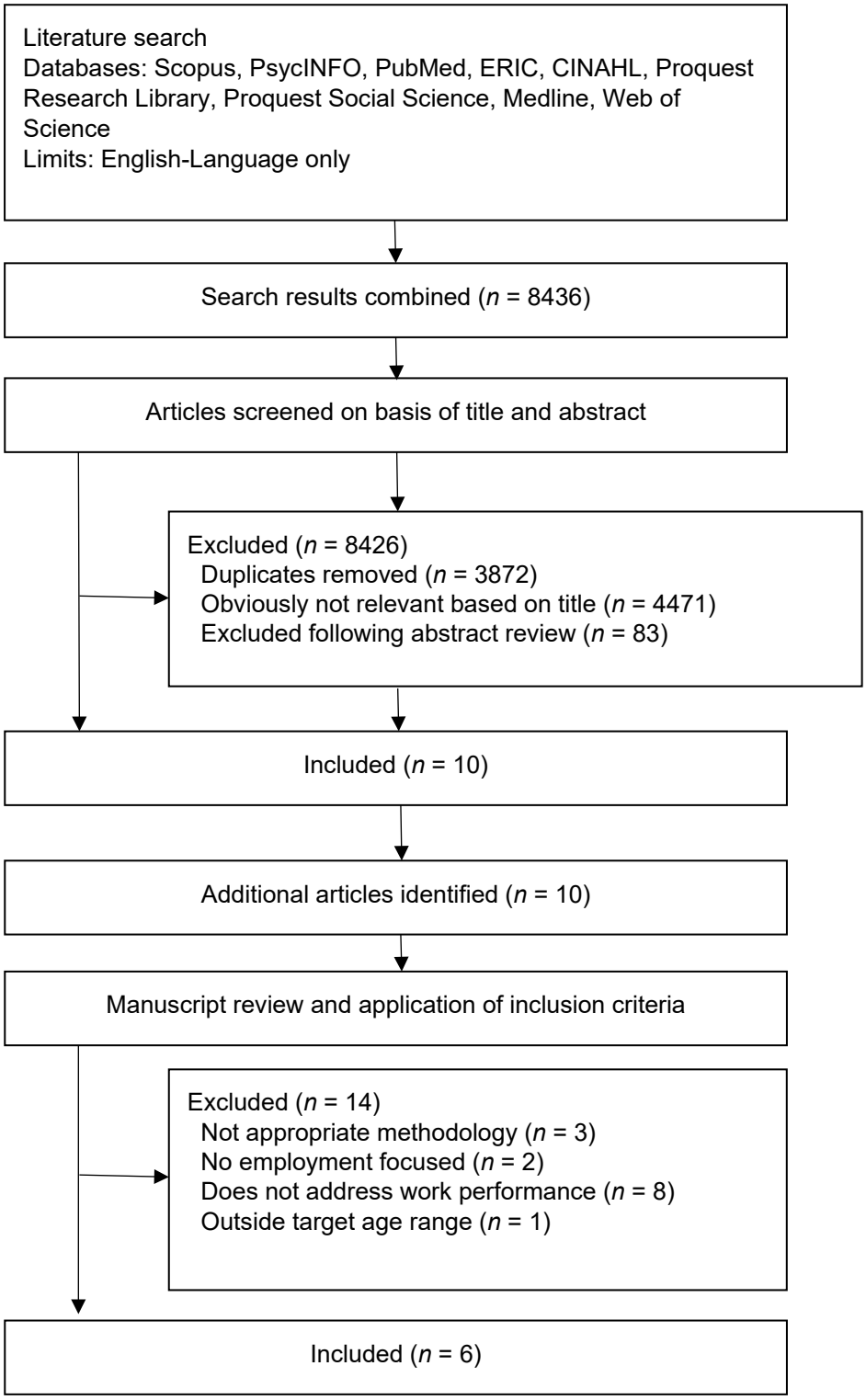

Figure 1. Search results at each stage of the systematic process.

Table 1. Search terms by domains.

Category	Search terms[a]
Population	Autis*, ASD, Asperger*, pervasive development* disorder*, spectrum disorder*, HFASD
Focus	Restricted repetitive behav*, RRB*, restricted interest*, obsession*, preoccupation*, sensory, hypersensitivity, hyposensitivity, special skill*, special talent, special ability*, savant
Domain	Adult, employ*, vocation*, work*, job performance, labor market, labour market

[a]Terms from each category were connected with 'OR' and between categories with 'AND'.

Table 2.

Papers identified in the systematic review investigating the autism advantage

Authors	Design	Sample [ASD] (*N*, age, gender, IQ)	Diagnosis	RRB Measure(s)	Study description	RRBs and employment related outcomes	Comments/interpretation
Krieger et al., 2012	Qualitative	N = 6 Male = 4 Age (Range = 30-45, *M*=36.83 *SD*=6.55) IQ not reported	AS	None	Narrative analysis – thematic and semi-structured interview.	Only individuals employed in last 18 months approached, to find contextual reasons for their employment "success".	This study provided some information that linking special interest to career leads to success, though no real information on how it matches, or the nature of the special interests. It also suggests that individuals with Asperger's reported finding comfort in their special interest during challenging times, though not if these challenges takeaway from interest.
Scott et al., 2017	Quantitative	ASD = 59 "Matched sample" non-ASD = 96 Gender, Age & IQ not reported	Employer reported employees who had Dx of AS or HFA	1 item- attention to detail	Employer survey	Attention to detail, flexibility, timely completion of work, work ethic, productivity, quality of work	Individuals with ASD demonstrated above standard workplace performance, compared to NT controls in attention to detail. More below standard for flexibility.
Gonzalez et al., 2013	Quantitative	ASD = 13 and matched control Male = 13	ASD-Confirmed by ADI, ADOS, Clinician opinion.	Performance on visual search task – luggage search: Hit rate (target present) and correct rejection rate (target	Experimental	No difference between accuracy across both sets for hit rates, though autism group significantly slower. No difference between groups for first set of correct rejection rate, but autism group significantly	This study showed no inherent advantage in visual search task, but that individuals on the autism spectrum outperformed non-autism group with practice. Evidence of sustained attention.

		Age = (*M*= 27.6, *SD* = 8.59). FSIQ = (*M* = 109.8, *SD* = 14.5; WASI)		absent) – across two sets of 160 trials		improved for second set, while control groups performance reduced (ns).	
Pfeiffer et al., 2017	Qualitative	ASD = 14 Male = 6 Age = (*M* = 40*, SD* = 13.8) IQ not reported	AS = 9, PDD-NOS =1, HFA = 4 RAADS-R to confirm diagnosis	None	Qualitative – microanalysis, axial coding	Perceptions of performance in relation to autism traits.	Participants perceived their best performance when job matched skills and interests, performance impeded by sensory concerns, and autism symptoms (specifically routines and schedules).
Smith & Sharp, 2013	Qualitative	ASD = 9 Male = 6 Age range = (25-49, *M* = 33.44, *SD* = 7.75) IQ not reported	All HFA/AS, formal diagnosis	None	Qualitative grounded theory analyses.	Participants mostly spoke of how unusual sensory experiences affect their lives.	Participants perceived that hypersensitivity improved work performance, focus on details (mechanic), and ability to differentiate taste (chef).
Russell et al., 2019	Qualitative	ASD = 24 Male - 17 Age ramge 21 – 65 (*M* = 38.50, SD = 12.88) IQ not reported	11 = AS, 13 = Autism Medical Records	None	Content and Thematic Analyses	Personal traits attributed to autism, their benefit in workplace, relationship and beyond.	Participants perceived that attention to detail aided at work with two examples (supermarket, gardener), but for the latter perfectionism associated with this could be problematic when there were time constraints.

	6 = employed

Note: FSIQ = Full Scale IQ; WASI = Wechsler Abbreviated Scale of Intelligence; AS = Asperger's Syndrome; PDD-NOS = Pervasive Developmental Disorder Not Otherwise Specified; HFA = High-Functioning Autism; ADI = Autism Diagnostic Interview, ADOS = Autism Diagnostic Observation Schedule, RAADS-R = The Ritvo Autism Asperger Diagnostic Scale – Revised