

Networked learning: an opportunity to enhance the learning opportunities for students with high functioning autism or Asperger's Syndrome?

Jane Davis

Department of Education, University of Strathclyde, jane.davis.2015@uni.strath.ac.uk

Abstract

The purpose of this paper is to consider whether or not networked learning has the potential to enhance learning opportunities for students with high functioning autism or Asperger's Syndrome, through reflective consideration of the cognitive theories associated with a diagnosis of autism spectrum disorder and Passey's (2014) key constructs of learning. In so doing, the paper initially provides a clarification of the criteria for a diagnosis of autistic spectrum disorder, and the problematic issues associated with concepts of high functioning autism. It then presents psychological theories of the autism spectrum and discusses a range of associated characteristics that may prevail when an individual has high functioning autism or Asperger's Syndrome. The paper briefly explores the way in which educational practitioners seek to achieve inclusion for students with high functioning autism or Asperger's syndrome and the ways in which these students may, nonetheless, be implicitly excluded from the academic route that their measured intelligence quotient suggests might be possible. The paper then considers key conceptual lenses that provide insight into constructs of learning, highlighting the way in which the application of such lenses might require adaptation in the light of the cognitive theories of autism. It briefly presents some of the ways in which technology is currently and predominantly used to ameliorate some of the impairments associated with autism and then looks to consider the extent to which various forms of networked learning might extend the academic learning capability of individuals with high functioning autism. The paper also discusses the way in which co-morbidities of autistic spectrum disorder may exacerbate the learning barriers of students with high functioning autism or Asperger's Syndrome and impact upon the affordance that such environments might offer to those students. The paper concludes by proposing suggestions for further research. It also suggests potential development activity that could support a better understanding of the ways in which networked learning might be adapted to support not only students in higher education, but also for those studying at secondary level for whom mainstream or special schooling remains problematic. It further considers the ways in which education research practitioners might engage with autism charitable organisations, international practitioners and clinicians in the field of autism spectrum disorders.

Keywords

High functioning autism, Asperger's Syndrome, psychological theories of autism, cognitive theories of autism, networked learning.

Introduction

This study is situated in the in the United Kingdom (UK), and has been undertaken in a period of putative widening of access to higher education following removal of the government-imposed cap on student numbers. Knott and Taylor (2014) report that the population of students who declare a disability on entry to UK higher education stands at 8% of the undergraduate student population; the data tables for 2013/14 first year entry to publicly funded higher education in the UK, as provided by the Higher Education Statistics Agency (HESA), provide an updated figure of 10.7%, though this may include those diagnosed with a disability in the very early stages of their study. It is significant that the percentage of students with autistic spectrum disorder (ASD) is reported by HESA as being 0.37%, particularly since Knott and Taylor suggest that, even at their point of writing, the numbers of registered numbers with ASD had increased at a similar rate to the trend for those registered with a disability. Postgraduate statistics presented via HESA provide even more dramatic statistics with just 0.15% of first year students studying at postgraduate level registering with a declaration of ASD. Thus,

whilst institutions are obliged to make reasonable adjustments for students and staff with disabilities, and there is recognition of a need to provide students with ASD with support, I would suggest that the relatively tiny numbers of such students registering at many universities make provision of often highly specialist adjustment intangibly problematic. Certainly a fuller review of the study locations and aspirations of students with high functioning autism (HFA) and Asperger's Syndrome (AS), though outside the remit of this paper, would further inform this discussion. Knott and Taylor assert "Although it is recognised that students with AS will require non-traditional support (Macleod & Green, 2009), institutions tend to lack knowledge of autism spectrum conditions and thus lack understanding of the kinds of adjustment that are appropriate (Taylor, 2005)".

The nature of ASD

Individuals who are diagnosed as having ASD are understood to have been identified to have characteristics which can be associated with the *Triad of Impairments*: impairment of social interaction, impairment of social communication and impairment of social understanding and imagination (Wing & Gould, 1979). Whilst no two individuals with ASD will be the same, there is a range of characteristics that fall within the overarching descriptor of the Triad of Impairments and that lead to the notion of a spectrum of deficit or difference in the context of the 'normally developed' or *neurotypical* individuals that are the majority inhabitants of the social world. Those with ASD frequently have issues with social skills - understanding, empathising and/or decoding the behaviours and intentions of others; issues with communications, such as appropriateness of interaction, mutism, slow cognitive processing speeds that impede dialogue, and perfectionism; issues mixing with others due to lack of confidence, lack of desire or hyper/hyposensitivity; intense interests, rituals, rules and repetitive behaviours; and learning disabilities or other co-morbidities such as obsessive compulsive disorders, anxiety, or epilepsy. This list is neither exclusive nor complete and not all those with ASD will exhibit all the listed characteristics.

The description *high functioning* is assigned to those individuals with ASD whose intelligence quotient (IQ) is tested as average or above average (100+). Those with a diagnosis of Asperger's Syndrome will also be recorded as having IQ test results of 100+. However Ozanoff et al.(1991a) propose, following empirical research, that neurophysical measures indicate that those with HFA are likely to experience greater impairments in the areas of social responsiveness and communication, and may engage in a more restricted range of activities than would those with AS. Sanosti and Sanosti (2012) assert that individuals with AS are high functioning but not vice versa. For example, whilst a student with AS may look for social interaction, another with HFA may prefer to "pursue solitary interests" (Beardon, Martin & Woolsey, 2009 p.35). Ozanoff et al.(1991a) also suggest that individuals with AS are likely to have a lower mental age than their peers with HFA, though they often have well developed language and are more likely to be able to engage with the perceptions of others. They suggest that both groups are likely to have further impairments consistent with ASD, such as difficulties with planning, monitoring, and organising. Sanosti and Sanosti (2012) note that, due to their higher IQ, students with HFA or AS may appear to have the ability to attend mainstream education, "despite significant difficulties in social interactions" (p.917). Benford and Standen (2009) purport that the needs of those with HFA or AS often go unrecognised, asserting "Hence their social exclusion may be compounded by an underestimation of their needs and a lack of support services" (p.3). Consideration of cognitive theories of autism support this perspective and suggest a wide range of impairments that may be invisible to tutors and which, nonetheless, may result in apparently unorthodox behaviour within the learning environment.

Cognitive Theories of autism

Since the initial conceptualisation of autism (Kanner, 1943), a range of psychological theories have been put forward, not seeking to ascertain the causality of the condition but to help to explain its nature and develop understanding, thus informing efforts to support those who struggle with associated impairments. These take the form of *affective theories* of autism, which propose innate difficulties with emotional relations and perceptions, and *cognitive theories*, which are based upon the proposition that central elements of ASD exist due to cognitive deficit. These theories "imposed a developmental psychological perspective on research and became hugely influential for both researchers and practitioners" (Rajendran & Mitchell, 2007). It is these cognitive theories to which I wish to draw attention. I propose that consideration of these theories is vital when engaging with the development of learning experiences for those with HFA and AS. Three of the most widely known of the cognitive theories are: Theory of Mind (Baron-Cohen et al., 1985); Weak Central Coherence (Frith, 1989); Deficit in executive function (Ozonoff et al.,1991b).

The theory presented by Baron-Cohen et al. (1985) that those with ASD have a deficit in theory of mind suggests an absence or delayed development in the awareness or understanding of the mental states of others. This is not an uncontested theory and further empirical research and theories such as the Enactive Mind hypothesis (Klin, Jones, Schultz, & Volkmar, 2003) have presented reconceptualisations of the original theory, suggesting that those with ASD exhibit difference when compared with the neurotypical population in the extent to which they look for, perceive or engage with social meaning. Nonetheless the key premise that those with ASD have a difference in the understanding of the mental states of others remains intact. Rajendran and Mitchell (2007, p. 231) propose:

Although the research output from theory of mind/belief attribution studies is waning (both in typically and atypically developing populations), the legacy of this theory, especially in autism, is both undeniable and irrepressible; the essential clinical picture that individuals with autism have difficulties understanding both their own and others' mind seems unquestionable.

The theory that those on the autistic spectrum have Weak Central Coherence was proposed by Uta Frith (1989) and suggests a reason for the spiky profile often generated by those with ASD during IQ tests (Frith & Happé, 1994). The theory suggests a bias in the information processing ability of individuals with ASD (Happé, 1999; Rajendran & Mitchell, 2007). The bias involves a tendency towards closer attention to individual modules of information than is seen in neurotypical individuals and a difficulty in perceiving the bigger picture through bringing together potentially related elements. Frith and Happé (1994, p.128) do not claim that this is a universal response to the impairments of ASD but suggest that this theory be used as “a useful framework for thinking about autism in the future”.

Ozonoff et al. (1991b, p.1083) describe Executive Function as “the ability to maintain an appropriate problem-solving set for attainment of a future goal; it includes behaviours such as planning, impulse control, inhibition of prepotent but irrelevant responses, set maintenance, organized search, and flexibility of thought and action”. A deficit in Executive Function is not exhibited only with those who have ASD, but also in those with “prefrontal cortical dysfunction” as well as conditions such as Tourette’s syndrome (Ozonoff et al., 2004 p.1016).

Rajendran and Mitchell (2007) suggest that the combination of the cognitive theories outlined above provides greater potency than any one alone. None of the theories is absolute; all exist as a spectrum of deficit within the context of a disorder (or difference) that in itself lies on a spectrum. Notably there is a difference in the degree to which these theories appear applicable to individuals with HFA and AS. Ozonoff et al. (1991a) concluded that those with HFA have greater levels of impairment that are associated with a deficit of Theory of Mind; similarly, whilst deficits in executive function appear universal to all with ASD. However, those with HFA are more likely to be impacted by differences in executive function than those with AS. Despite these differences, each cognitive theory has merit and can provide important clues to the ways in which those with ASD can be supported in accessing learning activity.

The nature of learning

Passey (2014) suggests, “learning is a wide conceptual term encompassing very many specific and distinctive elements and processes” (p.9). His subsequent presentation of five lenses through which learning can be contemplated provides a useful framework for consideration of differences in learner attitudes, behaviours and competences. Passey (2014, p.9) proposes the following constructs:

Neurobiological (the way the biological structure enables learning); Cognitive (processes that occur internally that constitute ways of learning), Emotional (approaches that we individually take in understanding and being involved in our own learning, and short and long-term interests we take in that learning); Social (the ways that learning occurs in different social settings and circumstances); Societal (long-term interests and opportunities that drive our commitment to learning).

Consideration of these constructs in the context of the three cognitive theories of autism, as outlined above, suggests immediately a difference or even deficit when those with ASD are faced with joining the learning activities of the wider neurotypical population. For those with ASD, the neurobiological, cognitive and societal constructs proposed by Passey must be viewed in the context of potential deficits in executive function and with an awareness of the possible impact of weak central coherence. He writes, “Learning is concerned at a more neurocognitive level with ways that knowledge, ideas and experiences are brought to and held in mind, allowing these to be integrated with other knowledge” (Passey, 2014 p.14), a statement which, when juxtaposed against the modular information processing tendencies associated with weak central coherence, highlights immediate

areas of difficulty and stress for students with HFA and AS. Passey also discusses “Metacognitive concerns” (p.21) which he presents as the development of wider and deeper learning. He presents features such as engaging with the “bigger picture” (p.21), being able to transfer learning between context and timescale and being able to reflect and monitor. Again deficits in central coherence and executive function may make such metacognitive development challenging – and the student with HFA or AS may well be in need of significant support in understanding and structuring such capabilities. Social and societal aspects of learning, such as that expected when learning within a community or when working towards social goals, are likely to be impacted by impaired theory of mind and executive function respectively.

At the more practical level, Beardon, Martin and Woolsey (2009) in researching the university experience of students with ASD write that half their participants reported difficulty despite having access to a range of support structures. Beardon et al. highlight the barriers to learning faced by those on the high functioning end of the spectrum including issues with social relationships, group work and the use of common student spaces; the way they perceive academic demands and deal with issues such as perfectionism, excessive attention to detail, and associated problems with time management; organisation concerns such as dealing with the structure of the course and of modules, the need for clarity of direction (concrete rather than abstract), planning and self-management and specificity of reading requirements. It should be noted that more than half of the original set of invitees to their research had dropped out of the university experience and thus their data set was small; nonetheless there is a strong association with issues arising from the deficits outlined in the three cognitive theories presented.

Passey (2014) recognises that for learners with cognitive challenges (including ASD) the level of qualification being attained and the speed at which they are gained is impacted. He writes, “Digital technologies have been used in a variety of ways to support learners with specific cognitive needs” (p.106). It is my assertion that such technology is more commonly used to address the skill development of such students and that the capacity for suitably supporting students with high IQ but the cognitive deficits associated with HFA and AS has not been appropriately developed.

The use of technology to support learning for students with ASD

Porayska-Pomsta et al. (2011) consider the development of technology to support individuals with ASD as a relatively new, though rapidly developing field in line with emergent technologies that will permit multi-modal access. In particular they reference examples of computer-assisted learning (CAL) that serve to develop the skills of young people on the autism spectrum, “delivering effective socio-cognitive intervention” (p.2). They recognise that in developing technology enhanced learning environments (TEL) to support individuals with ASD, there is a dependency upon “existing theories and practice both in clinical and education settings” (p.3), despite the diverse nature of practice, potentially contradictory perspectives and value judgements of clinicians and practitioners across a range of settings. Porayska-Pomsta et al. nonetheless assert that development of TEL for autism needs multidisciplinary input in support of education practitioners, including representation from developmental psychology, those with expertise in human-computer interaction, and education psychologists.

Burke, Kraut and Williams (2010) highlight characteristics of computer-mediated communication (CMC) that particularly and potentially make this a useful medium for individuals on the autistic spectrum, though again, their reflections are not on its use for academic means but for skill development and enhancement of communication. Positive features of CMC mentioned include the reduced sensory bandwidth when compared with face-to-face interaction and opportunities for beneficial lurking; the increased structure of a text-based environment, though text conversations themselves may lack structure; the potential of increased processing time during asynchronous communications; the greater availability of the learning environment; the potential for shared interests within specialist forums. Benford and Standen (2009) concur that the potential complexities of communication are lessened through asynchronous on-line media, and thus the individual with ASD gains a greater degree of control. Both Burke et al. (2010) and Benford and Standen (2009) see drawbacks in Internet developments that move towards greater synchronicity and expectations of video streaming or conferencing. Burke et al. write of their concerns as including: the synchronous and often rapid fire environment of chat rooms; issues of thread management and windows management; the use of non-conventional spelling or grammar; and the nature of some activities that retain cognitive difficulty regardless of medium (for example devising a plan or providing directions). Burke et al. also report that participants in their empirical research used a range of social media and yet, for the majority, this was for engagement with those they knew and trusted off-line. Issues recorded included histories of being bullied, wariness of new contacts, stories of e-predators and

concerns about e-safety. Cognitive inflexibility was perceived as inhibiting participants from making evaluations of risk and value; participants reported that they could not figure out the rules of participation.

Networked learning embraces many of the resources and formats of CAL, CMC and TEL and yet has a central philosophy of social practice, of interconnectivity between tutors, students and resources (Jones, 2008). It has been most widely used in the realms of higher education and thus, ostensibly has the potential to support the academic attainment of those with HFA or AS. Indeed, the political drive for widening participation in the UK, and beyond, has increasingly led to programmes of study delivered through or within on-line or virtual learning environments (VLEs). Ryberg and Larsen, 2008 p.105) bring to the fore the importance of learning communities in this context:

Within educational research there has been a particular focus on fostering ‘online communities’ or ‘virtual communities’ focused on supporting and nurturing online discussions within bounded spaces (Dirckinck- Holmfeld et al. 2004; Ponti & Ryberg 2004; Jones et al. 2006).

Such networked learning communities are perceived as providing a range of learning experiences and opportunities; they engage with all five learning constructs highlighted by Passey (2014) invariably within a bounded and formal virtual place, and place an emphasis on metacognition.

Whilst the use of a VLE provides learning institutions with the potential means to support those members of the learning community who have HFA or AS, the invisible nature of cognitive deficits can become problematic for all members of the community. Jones (2015) asserts, “Learning always involves the brain and body of the person but it is not an individual process. It has a relational character, interrelated with the social and material world in which the person is located” (p.49). With the perceptual location of neurotypical and autistic individuals in differently conceived and constructed social worlds, the social and neuropsychological forces impacting upon each will differ, leading to potentially misconstrued behaviours or actions. Unexpected, impulsive or inappropriate reactions to stimuli from those with HFA or AS, perceptions of tutors and peers that there is excessive lurking on the part of individuals with undisclosed or misunderstood ASD, lack of explicit organisational adaptation, lack of trust (in peers or tutors), and lack of apparent engagement with academic requirements on the part of students with HFA or AS are all examples of behaviours that can become problematic in the virtually mediated networked learning environment. A lack of comprehension of the cognitive struggles of students with ASD, in the context of academic endeavour, can exacerbate the balance of power within the community and disturb learning symmetries (Dillenbourg, 1998) within the networked learning community. As Ferreday and Hodgson (2008, p.641) note, “without reflexivity on the processes of participation enacted, it is easy to find examples of participation that are for some participants anything but emancipatory and are, however unintended, experienced as an unjust/unfair exercise of domination and power”.

Ryberg and Larsen (2008) put an emphasis on “meaning making” processes in terms of networked learning communities. They write (p.112):

Though all networks may share similar underlying structures, we have tried through the analysis, to describe the ways that the social rules and practices for such networks might be very different and that the representation of the structural properties might not fully reflect the meaning-making processes or views of the participants. We have argued that, though some nodes [on Arto] might appear to be central nodes or strongly tied with others, this does not necessarily reflect the participants’ understanding of what would constitute central or influential nodes.

Whilst the structural similarity of on-line environments may prove to support engagement to some degree, the conceptualisation of making connections and thus sharing meaning-making processes is likely to be problematic for those members of the community with ASD since social and relational aspects of engagement in any networked learning environment will be challenged by deficits of theory of mind, particularly for those students with HFA.

Where virtually mediated networked learning takes place or extends outside the VLE, the chaos of unbounded spatial interrelationships and processes across social media (Massey, 2005; Davis et al., forthcoming) has the potential to enhance learning opportunities and support the interaction of landscapes of practice (Wenger-Trayner & Wenger-Trayner, 2015). However, this chaotic space moves learners with ASD away from the potentially helpful notion of structured interaction inherent to the formality of an institutional environment, being reliant on social processes, interactions and the shared experience of meaning making – all of which being likely to prove problematic. The difficulties experienced within the bounded environment are exacerbated in the

open space, where expectations of collaborative learning remain. However, if the chaotic nature of the space releases individual learners from formal expectation, there exists a potential for the strengthening of close ties (Granovetter, 1973) that may have already developed for the student with ASD and the opportunity to gain a range of weak but valuable ties to support learning. Ryberg and Larsen (2008) assert that the frequency of interaction does not necessarily indicate the strength of ties to those interacting. They query the notion of a metric assessment of weak and strong ties, asking (p.106), “How do we establish whether a relation is strong or weak? .. Would it be necessary to incorporate analytically other measures apart from the structural strength of a relation; such as the ‘strength’ of meaning people give to the relation”. Students with HFA and AS find interaction with close associates more straightforward (Burke et al., 2010) and thus tend towards more frequent interaction with these ‘ties’. Yet the development of weak ties, say through less socially demanding social media (for example Twitter), could provide an opportunity for these students to more effectively further their learning without the risks entailed in the development of new interpersonal relations. Thus weak ties could become more meaningful in terms of strength of learning opportunity. However, when engaging in this more ethereal network in the context of formal higher education, the natural tendency or bias towards a focus on detail could, combined with high levels of perfectionism, lead the student with HFA or AS to attempt to assimilate and present a spectrum of understanding beyond that intended by stated module learning outcomes; this focus then leading to problems with measurable academic performance in the traditional sense. Mentor or buddy-based support, for the development of ties of variable strength but with valuable outcome could provide a wealth of learning potential for those with HFA and AS. Furthermore, removing some of the barriers to interaction within the wider networked learning community, through the support and agency of a trusted buddy already familiar with the networked learning community would potentially support more flexible engagement with an otherwise conceptually daunting arena; a support technique used outside the field of education.

Jones (2015, p.48) suggests, “One of the strengths of networked learning is its flexibility in allowing for different ways to think about learning”. I propose that a greater awareness of cognitive theories of autism, and further engagement with clinicians and ASD practitioners could support educationalists in the consideration of the ways in which techniques used to support those with HFA and AS in their journeys towards independent living could be applied in the virtual learning context.

Looking into the future and extending opportunity

This paper suggests that the concept of networked learning does indeed provide an opportunity to enhance the learning opportunities for students with high functioning autism or Asperger’s Syndrome, though it remains unclear as to whether this will improve their opportunities in terms of access to and attainment in higher education.

Further research will be necessary, extending the work undertaken by Beardon et al. (2009) into the realms of networked learning if educationalists are to be better placed to understand the impact of ASD impairments for high functioning students. Such a proposal is in itself fraught with difficulty since student involvement and feedback is crucial: The cognitive impairments are often less evident in AS than in HFA - and it is students with HFA for whom language and communication can be problematic – often to the extent of mutism. Neither has this paper addressed the co-morbidities of ASD. These can include sensory processing disorder, obsessive-compulsive disorder, epilepsy, anxiety and depression – to name but a few. It would be important to ascertain the degree to which these co-morbidities exaggerated the impact of existing barriers to higher levels of study. The research would also need to include a wide range of clinicians and practitioners, plus representation from parents, carers and representatives from autism charities and support groups. This would not be a trivial study. Burke et al. (2010 pp.2-3) write:

Autism research often focuses on children, when interventions may have the greatest impact on skill attainment... with a lack of formal support and the growing use of the Internet for informal support, it makes sense to study how adults with ASD use these naturally occurring social systems online. However few studies exist.

As the prevalence of autism appears to grow, this research will become increasingly important for the well being of and potential economic contributions from one individual out of every hundred in our population; even these statistics are uncertain as indications of prevalence depends on the diagnostic process and many individuals have hitherto gone undiagnosed. In the absence of further research, it is for practitioners in networked learning to consider the ways in which their networked learning environments could be developed to provide a more inclusive learning place for students with HFA and AS. This proposal is neither simple nor inexpensive since, to

be effective, it would require the advice and guidance of a range of multidisciplinary practitioners as proposed by Porayska-Pomsta et al. (2011). In the meantime, a raising of awareness of the cognitive deficits of ASD and what these mean to students with AS and ASD becomes an important first step.

References

- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a “theory of mind?” *Cognition*.
- Beardon, L., Martin, N., & Woolsey, I. (2009). What do students with Asperger syndrome or high-functioning autism want at college and university?(In their own words). *Good Autism Practice (GAP)*.
- Benford, P., & Standen, P. (2009). The internet: a comfortable communication medium for people with Asperger syndrome (AS) and high functioning autism (HFA)? *Journal of Assistive Technologies*.
- Burke, M., Kraut, R., & Williams, D. (2010). Social use of computer-mediated communication by adults on the autism spectrum. Presented at the Proceedings of the 2010 ACM conference on Computer supported co-operative work, pp.425-434. Doi:[10.1145/1718918.1718991](https://doi.org/10.1145/1718918.1718991)
- Davis, J., Prescott, D., Avery, B. & Oberg, H. (forthcoming in 2016). *A doctoral Community of Practice: a spatial entity across social media* in (McDonald, J & Cater-Steel, A. Eds), *Implementing Communities of Practice in Higher Education - Dreamers and Schemers*, Springer
- Dillenbourg, P. (1999). What do you mean by collaborative learning? *Collaborative-Learning: Cognitive and Computational Approaches*, pp.1–19.
- Ferreday, D., & Hodgson, V. (2008). The tyranny of participation and collaboration in networked learning (pp. 5–6). Presented at the Proceedings of the 6th International Conference on Networked Learning 2008.
- Frith, U., (1989). *Autism: Explaining the Enigma*. Blackwell, Oxford.
- Frith, U., & Happé, F. (1994). Autism: Beyond “theory of mind.” *Cognition*.
- Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 1360–1380.
- Happé, F. (1999). Autism: cognitive deficit or cognitive style? *Trends in Cognitive Sciences*, 3(6), 216–222.
- Higher Education Statistics Agency (2015) Data Table 14 (13/14)
https://www.hesa.ac.uk/index.php?option=com_content&view=article&id=1897&Itemid=634
- Jones, C. (2008). Networked Learning – a social practice perspective. In *Proceedings of the 6th International Conference on Networked Learning* (pp.616-623).
- Jones, C. (2015). *Networked Learning*, Springer, Switzerland, doi: 10.1007/978-3-319-01934-5
- Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child*, 2, 217-50.
- Klin, A., Jones, W., Schultz, R., & Volkmar, F. (2003). The enactive mind, or from actions to cognition: lessons from autism. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences*, 358(1430), 345–360.
- Knott, F., & Taylor, A. (2014). Life at university with Asperger syndrome: a comparison of student and staff perspectives. *International Journal of Inclusive Education*, 18(4), 411–426.
<http://doi.org/10.1080/13603116.2013.781236>
- Massey, D. (2005). *For Space* [iBook version], London, Sage Publications.
- Ozonoff, S., Rogers, S. J. & Pennington B.F. (1991a). Asperger's syndrome: Evidence of an empirical distinction from high-functioning autism. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 32(7), 1107–1122.
- Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1991b). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 32(7), 1081–1105.
- Ozonoff, S., Strayer, D. L., & McMahon, W. M. (1994). Executive function abilities in autism and Tourette syndrome: An information processing approach. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 35(6), 1015-1032.
- Passey, D., (2014) *Inclusive technology enhanced learning: overcoming cognitive, physical, emotional and geographic challenges*, New York, NY; Routledge
- Porayska-Pomsta, K., Frauenberger, C., & Pain, H. (2012). Developing technology for autism: an interdisciplinary approach. *Personal and Ubiquitous Computing* 16(2):1-11. DOI:10.1007/s00779-011-0384-2
- Rajendran, G., & Mitchell, P. (2007). Cognitive theories of autism. *Developmental Review*, 27(2), 224–260.
<http://doi.org/10.1016/j.dr.2007.02.001>
- Ryberg, T., & Larsen, M. C. (2008). Networked identities: understanding relationships between strong and weak ties in networked environments. *Journal of Computer Assisted Learning*, 24(2), 103–115.
<http://doi.org/10.1111/j.1365-2729.2007.00272.x>
- Sansosti, J. M., & Sansosti, F. J. (2012). Inclusion for students with High-Functioning Autism Spectrum Disorders: Definitions and Decision Making. *Psychology in the Schools*, 49(10), 917–931.
<http://doi.org/10.1002/pits.21652>

Wenger-Trayner, B., & Wenger-Trayner, E., (2015) Systems conveners in complex landscapes. In Wenger-Trayner, E., Fenton-O'Creevy, M., Kubiak, C., & Wenger-Trayner, B. (Eds.) *Learning in Landscapes of Practice*, Abingdon, Oxon: Routledge.

Wing, L. & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Childhood Schizophrenia*, 9, 11-29.