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Vincent, Jonathan ORCID logoORCID:
<https://orcid.org/0000-0001-6278-4670> and Ralston, Kevin ORCID
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Trainee teachers' knowledge of autism: implications for understanding and inclusive practice

Abstract

This current study draws on data from a large sample of trainee teachers in England to provide a long overdue baseline assessment of the knowledge of autism. It has particular import given the recent research that shows that 60% of autistic young people identified 'having a teacher who understands autism' as the main thing that would make school better for them. We find that, based on the Autism Awareness Survey, levels of knowledge were comparatively high among our n=326 respondents. However, whilst this is encouraging, our findings also point to an underestimation of knowledge, which indicates the need for additional resources and training to develop trainee teachers' self-efficacy and confidence in their pedagogical practice. Finally, in order to understand more about the gap between autistic children's experiences and teachers' understanding, this study signals a need to review autism knowledge scales to better reflect an experiential knowledge that goes beyond the clinical descriptors.

Keywords: *autism; knowledge; teaching; trainee; pre-service; inclusive practice*

Introduction

Autism is the most common type of identified need for pupils in English schools who have an education, health and care plan or statement of special educational needs (SEN). It is the primary need for 27% of these pupils – 31% of boys with a statement or EHC plan, and 16% of girls (Department for Education, 2017). Around 70% of autistic¹ children in England attend mainstream schools but based on survey data from 176 autistic young people, 2,573 parents and carers, and 308 teachers fewer than half of them report positive experiences (All-Party Parliamentary Group on Autism, 2017). The same report finds that, for 60% of young

¹ The term autistic children (rather than children with autism) is used throughout to reflect the identify-first preference indicated by autistic people (Kenny et al, 2016).

people and 70% of their parents, the main thing that would make school better for them is having a teacher who understands autism.

In response to such findings, this paper aims to provide a long overdue baseline assessment of the knowledge of autism amongst a sample of trainee teachers in England, drawing on the largest dataset of its kind to date. According to Harrison et al. (2016) the last study among education professionals in the UK, using a validated instrument, was two decades ago (Helps et al., 1999) and surveyed only 72 teachers and teaching assistants in the London area. The current study thus offers a useful litmus test of levels of knowledge and indicates where gaps may still exist, which has particular import given the Carter Review's (2015) recommendation that every new teacher has a basic understanding of autism.

Understanding autism in context

Autism is a lifelong neurodevelopmental disability. It is frequently associated with communication difficulties and the presence of rigid and repetitive behaviours, both of which can impact on social functioning (American Psychiatric Association, 2013). It can also be linked to difficulties in cognition, behavioural flexibility, emotional regulation, and altered sensory sensitivity with many autistic children experiencing over- or under-sensitivity to sounds, touch, tastes, smells, light, colours, temperatures or pain (Buckley, 2017; NAS, 2016; Remington and Fairnie, 2017). Until 2013 autism was described as a triad of impairments with variable intelligence quotient and language development leading to various subgroups including classic autism, atypical autism, pervasive developmental disorder, and Asperger's syndrome although following changes to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, 2013) and World Health Organization's International Classification of Diseases (ICD-11, 2018) these were collapsed into one autism spectrum disorder (ASD) diagnosis.

Today, autism is considered a common condition, with recent British epidemiological studies estimating prevalence at between 1% (Brugha et al., 2011) and 1.7% (Russell et al., 2014).

There is, however, substantial heterogeneity both between and within autistic individuals (Georgiades et al. 2013) with many presenting uneven profiles such as capacities in verbal fluency but difficulties in flexible thinking or even variant capacities in the same area, such as good long-term memory but poor short-term memory (Buckley, 2017). Thus an autistic spectrum is generally understood as a useful tool for reflecting the wide diversity and varying degrees of neurological differences across the population (Wing, 1988). According to Mandy (2018:1), ‘there is not a single autism, but rather there are hundreds, or even thousands, of ‘autisms’.

Whilst much of the literature uses pejorative terms such as ‘disorder, ‘deficit’ or ‘abnormality’ to describe autism, there is a growing body of research which seeks to frame it more positively in terms of individual ‘differences’ (Baron-Cohen 2015) and recognise the positive implications of an autism diagnosis as well as the difficulties (Janzen 1996; Remington and Fairnie, 2017; Soulieres et al., 2011). Van Hees et al. (2015:1684) identify such autistic strengths as ‘strong memory, focus precision and an eye for detail, dedication, the ability of putting one’s mind to a subject, analytical skills, remarkable powers of observation’. Whilst such a strengths-based reading of an autism diagnosis could potentially lead to more positive attitudes and outcomes for autistic learners, Russell et al. (2019) suggest that this tends to be moderated by three factors including: the social and environmental contexts in which strengths are played out; the extent to which the autistic traits can be controlled by the individual; and how these are understood and perceived by the autistic individual and others. It is therefore essential that teachers and educational practitioners have a secure knowledge of autism within the context of the school setting in order to recognise autistic pupils’ strengths and difficulties where they might arise.

Enhanced knowledge can lead to more inclusive practice

Evidence suggests that knowledge of autism is a salient predictor of practitioners' ability and willingness to provide inclusive learning opportunities to autistic students in both mainstream and special education settings (Baglieri & Shapiro, 2012; Busby et al., 2012; Segall and Matthews, 2012). Whilst a couple of recent studies demonstrate that teacher education students report accurate knowledge about most aspects of autism (Talib and Paulson, 2015; Blackwell et al. 2017), the literature more generally indicates that there is a gap in teachers' knowledge of autism (Able et al. 2015; Busby et al., 2012; Jung et al., 2011; McConkey and Bhlirgri, 2003; Segall, 2008). For example, in Segall & Campbell's (2012) study, of 196 education professionals surveyed mainstream teachers and headteachers responded that they did not know the answer to around seven of 15 items assessing current knowledge of autism. Moreover, some studies suggest the endorsement of inaccurate beliefs about autism, particularly with respect to aetiology (Brubaker et al, 2010) and children's abilities (Talib and Paulson, 2015).

More broadly, the evidence indicates that there is a correlation between knowledge and experience; where teachers had less exposure to autistic students, they tend to show lower levels of knowledge of autism and as a consequence lower self-assessed confidence in teaching autistic pupils (Haimour & Obaidat, 2013; Talib and Paulson, 2015). However, according to Blackwell et al. (2017) whilst many trainee teachers often have exposure to autism through personal or professional experiences, this does not necessarily translate into accurate knowledge grounded in established research or lead to more effective teaching practices for autistic students. In fact, Talib and Paulson's (2015) study among 211 undergraduate trainee teachers showed that even where participants reported largely accurate beliefs about autism, they did not feel competent about their abilities to cater for the needs of autistic students. This trend is also verified in the UK by the All-Party Parliamentary Group

on Autism (2017) which reports that of the 308 teachers surveyed, fewer than 50% of teachers felt confident about supporting an autistic child in their classroom. Thus, current evidence indicates a dual gap in practitioners' knowledge about autism and self-assessed confidence, with the outcome being uncertainty about their capacities to provide inclusive provision for autistic pupils in school settings (Busby et al., 2012; Jung et al, 2011).

Given that knowledge of autism, experience, and attitudes are interrelated (Segall and Campbell, 2012), it is suggested that the targeting of one area in training may have positive effects on the other domains. Although there is strong evidence of effective educational practice for autistic children including provision of early assessment, specific learning strategies, behavioural interventions, and social skills programmes etc (see Parsons et al., 2011) as well as an emphasis on SEN provision in Initial Teacher Training (Munday, 2016), there remain significant gaps. Findings in British studies (Guldberg et al., 2017b; Helps et al. 1999; Jones et al., 2008) as well as those based in other international settings (Able et al., 2015; Busby et al., 2012; Jung et al, 2011), report a lack of training among teachers working with autistic students. Thus, improved provision for trainee teachers is central to enhancing the levels of knowledge about autism and increasing practitioners' confidence and positive attitudes towards inclusive pedagogies for autistic pupils.

This is extremely important as research suggests that mainstream school settings place increasingly complex demands on autistic learners (Brede et al, 2017). For example, with enhanced knowledge about autism teachers may better understand difficulties with nonverbal communication and pragmatic language such as interpreting body language and nonverbal cues (Barnhill, 2014) and the challenges these can lead to in making and keeping friends (Bauminger & Kasari, 2000; Calder, Hill, & Pellicano, 2013) or preventing bullying (Sedgewick, et al. 2016). On a practical level, where teachers have more understanding about autism they might more fully appreciate potential sensory issues including hyper-reactivity to

stimuli including bright lights, loud noises, and strong odours. According to Fernández-Andrés et al. (2015) auditory filtering and hearing is one of the most affected sensory modalities in the classroom environment but Hanley et al. (2017) show how the presence of highly visual displays in classrooms can also make orienting attention much more challenging for autistic children compared to their non-autistic peers. Such environmental challenges can lead, for some, to sensory overloads where stimuli cause extreme physical and emotional distress as well as feelings of anxiety, despair, and the increase in 'restrictive and repetitive behaviours' which stem from a child's 'attempt to introduce order into their chaotic world' (Wing 2001:99).

Finally, one important environmental predictor of potential academic achievement for autistic pupils is where and how learning takes place, which is closely associated with knowledge of autism (Segall and Campbell, 2012). Based on a systematic review of the literature surrounding autism and academic achievement, Keen, Webster, & Ridley (2016) identify trends that indicate that autistic pupils with higher IQ scores (IQ 80-120) tended to do better on measures of academic achievement. Similarly, in comparing students across educational settings Kurth and Mastergeorge (2010) found that autistic students in inclusive settings tend to outperform others matched on IQ and adaptive behaviour in self-contained classrooms on reading, writing and math. Overall, such findings signal an urgent requirement to address the current gap in teachers' knowledge about autism and how best to improve academic opportunities and wider outcomes for these pupils.

Consequently, the present study aimed to address three research questions:

1. What is the overall level of knowledge about autism among trainee teachers in one higher education institution in England?

2. What is the relationship between respondents' self-assessed knowledge of autism and that demonstrated on the Autism Awareness Survey (AAS)?
3. Are demographics (sex, age, relationship to autism etc) associated with self-assessed knowledge of autism and responses to the AAS??

Methods

Procedure

The sample was derived from trainee teachers in the School of Education at one university in England. The response rate was 67% (n=326) of the total number of students enrolled on initial teacher training courses (n=485). Of those respondents who returned the survey 312 (96%) had complete information on the variables used in the analysis presented and this comprised the analytic sample. This sample is the largest on trainee teacher's knowledge of autism in the United Kingdom. Comparable studies are Talib and Paulson (2015), who surveyed n=211 teacher education students from a Midwestern university in USA and Blackwell et al. (2017) who drew on n=87 pre-service teachers from three universities in the United States. Harrison et al.'s (2016) review identified other studies using validated instruments to measure knowledge of autism among teachers and school staff with samples ranging from n=64 teachers in Greece (Mavropoulou and Padelidu, 2000) to n=391 general and special education teachers in Saudi Arabia (Haimour and Obaidat, 2013). British studies have also investigated this issue, for example Humphrey and Symes (2011) which surveyed n=53 teachers and managers in schools; however, they did not report the use of a validated instrument to assess knowledge.

Respondents were invited to participate at the end of a core lecture at the University. They were informed that their contribution was voluntary and all information collected during the course of the study would be kept confidential on password-protected databases, under the auspices of the university's ethical review board (180110_000013045_ED). Surveys were administered using the programme Qualtrics® enabling participants to complete the survey on mobile devices, tablets or computers. Analysis was undertaken using Stata 15®.

Measuring knowledge of autism

Harrison et al. (2016) report that to date, the most widely applied measure of autism knowledge is the *Autism Knowledge Survey* (AKS, Stone, 1987). This is a Likert-style questionnaire comprised of autism 'facts' used to score respondents' levels of knowledge. Harrison et al. (2016) confirm that the measure is unidimensional and has reasonable internal consistency (Cronbach's alpha = 0.66), stable reliability, and showed initial reasonable validity. Since 1987, the AKS has been updated to reflect new knowledge informed by respective Diagnostic and Statistical Manuals of Mental Disorders (APA, 2013). The first AKS revision occurred in 2007 (AKS-R, Swiezy, 2007) and has been used in several subsequent studies (Bauer et al., 2015; Hartley-McAndrew et al., 2014; Heidgerken et al., 2005). The Autism Awareness Survey (Tipton and Blacher, 2014), utilised in this current study, is an updated version the original AKS measure with adequate internal consistency ($\omega=0.60$) reported by Cage, Di Monaco and Newell (2018). Given the AAS's focus on knowledge derived from the DSM-5, there are limits regarding the extent to which it can be considered a measure of awareness of autism. Additional items related to practical knowledge, current pedagogical practice or attitudes towards autism could uncover more sensitised dimensions of autism not captured by the clinical descriptions. Nevertheless, the AAS was perceived as being a useful validated tool for providing a much-needed baseline measure of this dimension of autism knowledge among trainee teachers.

The AAS consists of 14 forced choice Likert scale items ranging from disagree, somewhat disagree, neutral, somewhat agree, agree (see, Table 2). If a statement from the AAS was answered correctly by a respondent, with either an ‘agree’ or ‘disagree’ response, they score four points on the scale. Where the respondent was less sure, but answers in the correct direction, choosing a ‘somewhat agree’ or ‘somewhat disagree’ response, they score three points. For a neutral response they score two points, a ‘somewhat’ wrong response scores one point and a fully wrong response scores zero. In principle, scores can range from zero to 56. Respondents were also asked to estimate their own self-assessed knowledge of autism (SAK) using the statement: ‘indicate your level of knowledge about autism right now, with 0 representing no knowledge at all and 100 representing complete knowledge’. This approach enabled a comparison between an objective measure of knowledge about autism and trainee teachers’ subjective levels of knowledge. Similar approaches have been applied elsewhere, for example within the medical field, Nabi et al. (2008) asked respondents to score on a scale how knowledgeable they *felt* about the prevention and detection of different forms of cancer, which was then examined in relation to objective measures of knowledge.

[Table 1 – 90 words]

Background information on respondents was also gathered. The survey design reported by Tipton and Blacher (2014) was taken as a benchmark template and equivalent data were collected. The first three items gathered socio-demographic information about the participant, including sex, age and level of study (undergraduate or postgraduate). The sample included 266 female (85%) and 46 male (15%) trainee teachers. Respondents were offered a categorical selection of ages (18-20, 21-30, 31-40, 41-50, 51-60, 60+). The age of the sample was relatively homogenous, reflecting the age of students in teacher training. For this reason, only two age groups of 18 to 20 and 21 to 30 were included in the analysis. Respondents

included those from both Undergraduate primary (94%) and Postgraduate secondary (6%) courses.

The final survey items ascertained the respondent's relationship to a person with a diagnosis of autism (whether they self-identified as autistic; an immediate family member is autistic; an extended family member is autistic; they come into contact with autistic persons through social networks; or through professional experience; or have no relationship to autistic persons). This classification was collapsed to three categories for analysis (see Table 1). In response to the survey 56 people from the complete case sample (18%) reported having an individual within their immediate or extended family with autism. This included one person who self-identified as autistic. Over half the sample (160) had experience of autism through work/social networks. One of the main variables of interest in Tipton and Blacher's (2014) article was a question asking whether autism is increasing or not. This was considered to indicate awareness of the prevalent media message about the rise in autism diagnoses (Blair, 2016; Camarata, 2018), increasingly communicated through some form of social media (Aboukacem and Haas, 2018; Mitchell et al., 2016). This was also included here as a 'yes' (81%), 'no' (19%) dichotomy.

Bivariate analysis of key variables was undertaken using chi-square, ANOVA and t-tests (Agresti et al. 2017). Multivariate OLS regression models were also used to assess associations with outcome variables, the AAS and self-assessed knowledge of autism measures (Kohler and Kreuter 2009). These outcomes were initially modelled in a base model controlling for sex, age-group, and undergraduate/post-graduate education level. Variables of interest were separately added to this base model. These comprised, the variable identifying the level of contact to a person with autism and the variable indicating knowledge of whether autism is increasing in the UK. The measure of self-assessed level of knowledge

of autism was also included in the model with AAS as the outcome. A final model including all factors together was estimated for both the AAS and SAK outcome variables.

Categorical variables were modelled using dummy category coding. Sex was included as a binary male/female variable with men set as the reference category. The 18 to 20 age group was set as the reference category in modelling. Undergraduate was set as the reference category for the level of university study. The binary variable denoting whether autism is increasing or not was included with the 'yes' category the reference in modelling. Those who identified as autistic, or who have an autistic family member was set as the reference category and compared with categories of whether an individual has social/professional contact with a person with autism and a category denoting no contact with autistic people.

Results

In the first instance, results are presented as descriptive and bivariate analyses. A systematic modelling analysis of the relationship between self-assessed level of knowledge of autism and actual knowledge of autism is then outlined (see Appendix for a full breakdown of results).

Overall levels of autism knowledge

The mean score of the self-assessed knowledge (SAK) measure for the sample was 38 (SD 19.8) with scores ranging from zero to 100². The Autism Awareness Survey (AAS) scores ranged from 27 to 55³ with a mean of 43 (SD 4.6). A mean of 28 (the mid-point of the scale range) would be equivalent to all neutral responses or as many correct as incorrect responses,

² One individual self-assessed as having zero knowledge of autism, whilst another self-assessed as having complete knowledge of autism, scoring 100. The individual self-assessing as zero scored 39 on AAS, the individual self-assessing as 100 scored 38 on AAS.

³ The individuals who score 27 and 55, at the extremes of AAS, both scored 60 on the SAK measure.

the sample score statistically significantly higher than this ($t(310)=58$ $p=.000$) indicating a positive level of correct knowledge. This compares favourably with Tipton and Blacher's (2014) general university sample whose scores ranged from 17 to 55, with a mean of 38.5 (SD = 5.9). The most startling finding from the survey is that trainee teacher's self-assessed knowledge (SAK) of autism bears little comparison with their actual knowledge of autism as measured by the AAS scale. The bivariate correlation between the AAS and the SAK measure is very small and non-significant ($r(310)=.08$, $p=.13$).

[Table 2 – 225 words]

The two AAS statements identified as most correct were, *there is one intervention that works for all children with autism* (correct response 'disagree' = 96% $n=299$) and *children with autism can grow up to live independently* (correct response 'agree' = 95% $n=295$). The two most incorrect statements were *autism runs in families* (correct response 'agree' = 27% $n=84$) and *autism is an emotional disorder* (correct response 'disagree' = 61% $n=190$). Respondents were asked whether they thought autism is increasing, which 253 (81%) correctly identified to be the case. Interestingly, Tipton and Blacher's (2014) study reported an association between those who identify autism as increasing and those who erroneously believe that vaccines cause autism. However, this was not the case here, where those who *did not* think autism was increasing (an incorrect response) were more likely to *correctly* identify that vaccines did not cause autism ($\chi^2(3)=17$, $p=.001$).

Autism in self and family

Those with an autistic family member scored significantly higher on the AAS scale than those with no relationship to autism ($F=(2, 309)5$, $p=.007$). The difference in score on the AAS scale between the groups is small at around two points. By contrast, there is a large and significant difference in self-assessed knowledge of autism by the level of an individual's

relationship to a person with autism ($F=(2, 309)_{23}$, $p=.000$). Where a respondent had an autism diagnosis, or had direct experience through a family member, then on average they recorded a far higher self-assessed knowledge ($\bar{x} = 48$, SD 19) of autism than those who report no experience of autism, ($\bar{x} = 28$, SD 17) or only professional/social contact with autism ($\bar{x} = 40$, SD 19).

Demographics

The sample of teachers in this study is relatively homogenous in education and age. There were no significant bivariate associations found between the demographic factors and level of knowledge in autism, or by whether people believe autism is increasing (see Appendix table a1). Although there are no bivariate associations between demographic factors and AAS, the modelling analysis below does reveal a significant relationship between sex and AAS.

Modelling knowledge and self-assessed knowledge of autism

Sex and whether people believe autism to be increasing was found to be significantly associated with the AAS outcome. The contrast between males and females was consistently significant across models (see Appendix Table a2). Females score on average 1.5 ($p=.045$) points higher on AAS net of the other factors controlled in the full model. A significant contrast between those who have an autistic family member and those with no wider experience of people with autism ($\beta=-1.9$, $p=.01$) was reported in the base model adjusting for age, sex and education. This contrast was no longer significant however, in the model including all variables ($\beta=-1.5$, $p=.06$).

Following Tipton and Blacher (2014), we used the question regarding whether autism is increasing as a proxy to indicate some awareness of a prevalent media message regarding a rise in the diagnosis of autism. The results here suggest that there is a significant contrast

between those who believe autism to be increasing and those who do not ($\beta=2.1$, $p=.001$). Those who do not believe autism to be increasing score higher on AAS. This contrast remains significant in the model containing all variables ($\beta=1.9$, $p=.003$). This is a counter intuitive result because those who do not believe autism to be increasing are incorrect. It is therefore initially surprising that they score more highly in knowledge of autism. It may be that people who respond 'no' here believe the level of autism in the population to be steady whilst it is the level of diagnosis, rather than level of autism, that has increased.

The results of the models of the AAS outcome contrast with models of the self-assessed knowledge measure (Appendix Table a3). In modelling self-assessed knowledge of autism the only significant predictor was the variable measuring the level of relationship an individual has to a person on the autistic spectrum. This factor was not significantly associated with the AAS measure in the equivalent models. This result indicates that those with experience of autism, through work or social networks, score significantly lower ($\beta=-8.4$, $p<.01$, lower confidence interval -14, upper confidence interval -2.5) on self-assessed knowledge than the autism in family or self, reference category group. There is around an eight-point difference between the categories. Those with no experience of people with autism score lower again, around a 20 ($p<.001$, lower confidence interval -26, upper confidence interval -14) point difference between this category and the reference category. This model also provides the most explanatory power ($F(6, 305)$ $r^2 = .13$ $p<0.00$) all other models are more limited in their explanatory power.

Overall *sex* and *belief autism is increasing* are significantly associated with the AAS scale. The level of relationship to a person with autism is significantly associated with self-assessed knowledge of autism. Self-assessed knowledge of autism, however, has no association with actual knowledge of autism as measured by the AAS scale. This is evident in both modelling ($\beta=.005$ $p=.7$) and the very small correlation between the variables.

Discussion

These data make a new contribution to the field by offering a useful baseline assessment of knowledge of autism from among the largest sample of trainee teachers in the UK using a validated instrument. Although our study was limited to just one School of Education at one institution in England, our findings indicate that trainee teachers do not suffer from a gap in knowledge about the basic characteristics of autism. This is important as it contrasts with the majority of other comparable research in the field among trainee teachers and educational professionals (Able et al. 2015; Busby et al., 2012; Haimour and Obaidat, 2013; Helps et al., 1999; Jung et al., 2011; Mavropoulou and Padelidiadu, 2000; McConkey and Bhlirgri, 2003; Segall, 2008; Segall and Campbell, 2012).

Our findings more closely align with those of Talib and Paulson (2015) and Blackwell et al. (2017) which also report accurate beliefs about the basic characteristics of autism among teacher education students. Given that the majority of literature reporting gaps in autism knowledge using validated instruments were published before 2015, it could be inferred that trainee teachers and educational practitioners are becoming more informed about autism. This could be as a result of greater exposure to information through social media and the accessibility of mobile technology (Aboulkacem and Haas, 2018; Mitchell et al., 2016). That notwithstanding, these studies appear to indicate a positive trajectory.

As knowledge of autism is a predictor of teachers' ability and willingness to provide inclusive learning opportunities to autistic students (Baglieri & Shapiro, 2012; Busby et al., 2012; Segall and Campbell, 2012), the positive AAS scores from our sample ought to be welcomed as a sign that the teachers of tomorrow understand some of the basic diagnostic information related to autism and its implications for children, families and learning. This is

particularly relevant where higher levels of knowledge might lead to better access to early screening, accurate identification and early referral of children for a diagnostic assessment (Dillenburger et al., 2016) alongside the inclusion and success of autistic pupils in mainstream schools (Keen, Webster & Ridley, 2016; Kurth and Mastergeorge, 2010). However, instruments such as the AAS do not tell the whole story and neglect educational professionals' knowledge of practical strategies and the lived experiences of autistic people and their families (APPAG, 2017). This was reflected most acutely in relation to the data related to those with direct connection with autism.

Degrees of contact with a person with autism significantly predicted higher levels of self-assessed knowledge of autism. Interestingly, this was not also associated with correct knowledge of autism, based on AAS. It seems, therefore, that those who have more contact with autism tend to feel more confident but somewhat remarkably do not 'know' more than others. Similar trends are also reported by Gillespie-Lynch et al. (2017) where those with an autistic family member did not differ significantly in their answers to others with less relational contact with autism. As per their study and others, we could also conclude, that the self-assessed knowledge of autism they feel confident of might be derived more from their lived experiences rather than a formal set of diagnostic criteria (Guldborg, 2017a; Guldborg et al, 2017b). In this sense there appears to be a gap between knowledge and understanding, where the former can be assessed by instruments such as the AAS but the latter relates more sensitively to the practical everyday experience of autism. Such a proposition has implications for the content validity of autism knowledge scales, which are largely based on the American Psychiatric Association's medical criteria for autism as set out in the Diagnostic Statistical Manual (Harrison et al, 2017). Further research into knowledge of autism among different populations ought to consider broadening 'knowledge' to comprise a wider range of perspectives, including those of autistic people and their families, who

typically give greater emphasis to situational knowledge and tend to describe it in terms of diversity over pathology (Gillespie-Lynch et al., 2017; Author 1 et al, 2017). It seems reasonable to suggest that doing so could enable us to learn more about what professionals and practitioners know and the training they require to better meet the needs of autistic children in schools (APPGA, 2017; Guldberg, 2017a).

Although teachers scored highly in their knowledge of autism they tended to under-estimate their knowledge, self-assessing as having a far lower levels of knowledge than they actually demonstrate. This resonates with other findings in the literature. For example, Segall's (2008) study suggests that general education teachers tended to profess a lack of knowledge, rather than an endorsement of incorrect knowledge based on a validated autism knowledge scale. Other research indicates that even when trainee teachers' knowledge of autism was largely correct this did not always translate into feelings of competence in supporting autistic students' learning in schools (Blackwell et al, 2017; Busby et al., 2012; Jung et al, 2011; Talib and Paulson, 2015). One explanation for this seeming lack of confidence in knowledge may be related to the Dunning–Kruger effect (Dunning, 2011, Kruger and Dunning, 1999). It shows that top performers are frequently inaccurate in self-assessing their knowledge and typically display underestimation. Ehrlinger et al.'s study (2008) reported that top performers misestimated their performances against their objective performances by roughly 6 percentile points and Schlösser et al. (2013) report underestimations of performance by roughly 10–14 percentile points. It could thus be argued that our sample of trainee teachers, precisely because of their high levels of awareness of autism, have underestimated their actual knowledge.

Finally, it was pleasing that our data based on the AAS replicated that of Cage, Di Monaco, and Newell (2018) and Tipton and Blacher (2014) with respect to interventions for autistic children. The top answer shared by all three studies was the (incorrect) statement that 'there is one

intervention that works for all children with autism'. This suggests that whilst trainee teachers, in our case, might not necessarily feel confident about how to support autistic children in their classrooms, 96% of them recognise the need to treat each child according to their individual challenges, needs, talents, and skills. As with other studies (Blackwell et al, 2017; Busby et al., 2012; Jung et al, 2011; Guldberg 2017a; Talib and Paulson, 2015), our findings confirm the requirement in the UK to extend resources including autism training provision for trainee teachers in order to further develop their knowledge of autism but, more importantly, enable them to best support and develop their autistic pupils.

Limitations and future research

There are obvious limits to what can be claimed based on this research. Firstly, whilst our study draws on a reasonably large sample of trainee teachers in the UK, it was conducted at just one university in England. In order to gain a clearer view of just what this group know about autism future research could replicate this study in other teacher training institutions to gain a more representative sample. Secondly, whilst Tipton and Blacher's (2014) AAS instrument has been validated and is recognised as being a relatively robust measure of knowledge of autism derived from the wider autism literature and particularly the DSM-5 (2013), the content is open to critique and subject to change (Volkmar and McPartland, 2014). There are other instruments that could have been used (see Harrison et al, 2017b) which may reflect more up-to-date knowledge. Moreover, the AAS and instruments like it reflect only medical knowledge of autism and as Gillespie-Lynch et al. (2017) suggest, these would benefit from being informed by autistic voices and experiences. Finally, whilst it was useful to compare trainee teachers' self-assessed autism knowledge (SAK) against the validated knowledge of autism captured in the AAS, there is scope to develop enhanced

measures that offer a more comprehensive measure of this. Moreover, it would be useful for future research to include additional items related to self-efficacy and sense of competence in relation to their professional knowledge of autism and pedagogical practice with autistic pupils.

Conclusions

This study offers the first baseline assessment of knowledge of autism using a validated instrument from among the largest sample of trainee teachers in the UK. It demonstrates that trainee teachers' levels of knowledge about the basic characteristics of autism were high in contrast to the majority of other comparable literature in the field (Able et al. 2015; Busby et al., 2012; Haimour and Obaidat, 2013; Helps et al., 1999; Jung et al., 2011; Mavropoulou and Padeliadu, 2000; McConkey and Bhlingri, 2003; Segall, 2008; Segall and Campbell, 2012). This is important as evidence suggests that knowledge of autism is a predictor of teachers' positive attitudes towards inclusion of autistic students and the potential to recognise their strengths (Busby et al., 2012; Russell et al., 2019).

We suggest that our findings, in conjunction with other more recent studies such as Talib and Paulson (2015) and Blackwell et al. (2017), indicate a positive shift in autism awareness more generally among trainee teachers, potentially based on the increase in mobile technology and access to information through social media. However, whilst our findings are encouraging, we acknowledge that instruments like the AAS only explore one avenue of knowledge and do not reflect the professional and personal knowledge that many practitioners possess as a result of supporting the educational progress and development of autistic children and, therefore, claims about levels of 'knowledge' ought to be viewed somewhat tentatively. On this basis we make the case for a review of knowledge of autism scales and the development

of validated instruments which assess teachers' pedagogical knowledge as well as knowledge of autism derived from clinical descriptions.

Finally, our findings point to a lack of confidence and an underestimation of knowledge, which indicate the need for additional resources and training to develop trainee teachers' self-efficacy and feelings of competence in their practice (Mundy, 2016). This is especially important given the challenges that autistic children report in schools (APPGA, 2017) but also with respect to the role that classroom teachers play in identifying learning needs and providing opportunities for these pupils to succeed.

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