Changing College Students' Conceptions of Autism:

An Online Training to Increase Knowledge and Decrease Stigma

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Abstract

College students with autism may be negatively impacted by lack of understanding about autism on college campuses. Thus, we developed an online training to improve knowledge and decrease stigma associated with autism among college students. Participants ($N = 365$) completed a pre-test, online training, and post-test. Women reported lower stigma towards autism than men. Participation in the training was associated with decreased stigma and increased knowledge about autism. Although participants exhibited relatively high baseline knowledge of autism, misconceptions were common, particularly in open-ended responses. Participants commonly confused autism with other disorders, such as learning disabilities. This study suggests that online training may be a cost-effective way to increase college students' understanding and acceptance of their peers with autism.

Keywords: Stigma associated with autism, Knowledge of autism, Online training, College students; ASD

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Improvements in the identification and treatment of autism have contributed to an increasing number of young adults with autism who are academically prepared to enter college (e.g., Van Bergeijk, Klin, & Volkmar, 2008). Despite the cognitive strengths of many individuals with autism, high school students with autism are less likely to enroll in college than students with all other disabilities except intellectual disability or multiple disabilities (Wei, Jennifer, Shattuck, McCracken, & Blackorby, 2013). Students with autism who do enroll in college may struggle with transitioning from high school to the less structured and more complex college environment (Adreon & Durocher, 2007; Kapp, Gantman, & Laugeson, 2011) and may often leave college without graduating (Sanford et al., 2011).

One key challenge that college students with autism may face is a lack of understanding of autism from other college students, professors, or staff. Bullying or exclusion of students with autism may make the college environment less hospitable to students on the spectrum (Gelbar, Smith, & Reichow, 2014). Indeed, a college student with autism who participated in a mentorship program developed by some of the authors of this report stated that one of the primary challenges he faced when transitioning into college "was ensuring that the staff and my fellow students were aware of and understood my disability."

To improve acceptance and understanding of college students with autism, we developed an online training about autism and tested it with students in psychology courses. The primary aim of this report is to evaluate this training, which has the potential to be a cost-effective method of increasing knowledge and decreasing stigma associated with autism on college campuses. Although stigma is a multifaceted and contested construct, it is commonly defined as a socially discrediting stereotype towards an attribute that causes those who have the attribute to be viewed as inferior (Goffman, 1963).

**Conceptions of Autism among College Students**

What constitutes accepted knowledge may shift rapidly, a key point to keep in mind when assessing knowledge of autism. When medical students in Britain were given a brief survey of autism knowledge over a decade ago, their responses indicated that they had limited knowledge of autism (Shah,

2001). However, scoring criteria for many of the items in the survey were not consistent with current research. For example, the "correct" answer for a question concerning how to characterize the IQ of most people with autism was in "the moderately to more severely retarded range." This flaw is not specific to Shah's measure; autism experts (the criterion for correctness) were more likely than teachers to agree that most children with autism are "mentally retarded" in an early version of the Autism Survey used in the current study (Helps, Newsom-Davis, & Callias, 1999).

Recent research suggests that college communities may be knowledgeable about certain aspects of autism, such as the need for individualized interventions, and less knowledgeable about other aspects, such as whether it "runs in families" (Gardiner & Iarocci, 2013; Tipton & Blacher, 2014). In the first peer-reviewed study to assess conceptions of autism among college students in the United States, students read a vignette describing a college student with characteristics (but not the label) of autism and then completed a measure of openness towards the individual in the vignette (Nevill & White, 2011). Students with a first-degree relative on the spectrum reported more openness towards the character in the vignette than their counterparts. Although no overall gender differences in openness were observed, males were more likely to report that they would be willing to hang out with the character in the vignette. This finding is surprising given that females often (e.g., Campbell, 2007; Chambres, Auxiette, Vansingle, & Gil, 2008), but not always (e.g., Swaim & Morgan, 2001), exhibit more accepting attitudes toward their peers with autism than males. No overall differences in openness differentiated students with heightened autism traits and those enrolled in science, technology, engineering and/or math (STEM) majors, who may be particularly likely to have autism (Wei et al., 2013), from their peers.

Using an online adaptation of the Autism Survey (Stone, 1987), Tipton and Blacher (2014) assessed the autism knowledge of students, faculty, and staff from a large university. The average score on the Autism Survey was indicative of more correct than incorrect responses (10.5 points above the mean). Participants with autism in the immediate family (12.8% of the sample) and women had slightly higher knowledge. Although 71.6% of participants stated that autism is increasing, those who believed

autism is increasing were also more likely to believe that autism is caused by vaccines. Thus, college communities may be knowledgeable about aspects of autism, but misconceptions remain common.

In another study conducted with college students, quantity of previous contact with autism was associated with openness towards autism. Gardiner and Iarocci (2013) examined associations between autism knowledge and openness towards a character in a vignette who exhibited symptoms (but not the label) of autism. Statistical analyses concerning autism knowledge were not reported. However, the authors stated that participants were generally quite knowledgeable about autism. Over 80% of participants stated that the character in the vignette did not make them afraid, that they would not mind living in the same building with the person, and that they would probably like him. In contrast, only 48.8% said that they would actually hang out with the person in their free time. Notably, a similar percentage of participants (47.8%) showed interest in volunteering with people with autism. Thus, college students may be accepting of people on the spectrum in terms of distant relationships, such as living in the same building, but far fewer college students may be interested in engaging more directly with people on the spectrum, by hanging out or volunteering with them. Given that stigma is often assessed by asking how willing participants are to engage with a type of person at varying levels of intimacy (Bogardus, 1933), these findings suggest that college students hold stigmatizing attitudes toward peers with autism.

Indeed, college students' responses after reading a vignette about an adult with autism (albeit not a fellow student) revealed that they endorsed greater social distance (stigma) towards the character in the vignette when he exhibited autism symptoms (Butler & Gillis, 2011). Although the inclusion of the label "Asperger's Disorder" did not affect stigma, only 59% of the sample indicated having any knowledge of Asperger's Disorder prior to the study. Thus, autism-related stigma may be associated to a greater extent with symptoms than with diagnostic labels. However, in a study with ten adolescents and young adults with autism, participants with more autistic symptoms reported having experienced *less* stigma than their peers with fewer symptoms (Shtayermman, 2009).

**Interventions to Change Stigma Associated with Autism**

Prior interventions intended to decrease stigma associated with autism have been conducted with children and adolescents. Children tend to exhibit more negative cognitive attitudes, affective attitudes, and behavioral intentions (desire to interact with people) toward children with autism than toward other children (Campbell, 2006; Campbell, Ferguson, Herzinger, Jackson, & Marino, 2004; Swaim and Morgan, 2001). In the first study to attempt to improve children's attitudes toward their peers with autism (Swaim & Morgan, 2001), a brief explanatory voiceover about autism, emphasizing the cause of autism, did not improve children's attitudes toward or desire to interact with a peer with autism shown in a video.

Research attempting to decrease stigma associated with other disabilities suggests that descriptive information emphasizing similarities between the person with a disability and the recipient of the information may be more effective at changing children's attitudes and behavioral intentions toward peers with disabilities than explanatory information (Campbell, 2006). Swaim and Morgan (2001) randomly assigned children to watch one of three videos of a child, accompanied with brief voiceovers: a "no autism" video, an "autism no information" video, and an "autism plus explanatory information" video. In the latter video, the explanatory information began with the phrase, "Robby has autism, which means that there is *something wrong with his brain*..." Although useful information about autism was also provided, emphasizing that a child with autism has a defective brain may not be the best way to decrease stigma. Indeed, the authors found that explanatory information failed to reduce children's tendency to report negative attitudes toward the child with autism, relative to the child without autism.

Using Swaim and Morgan's informational scripts, Campbell and colleagues (2004) randomly assigned elementary school students to watch a video of a child exhibiting autistic behaviors, with either descriptive information or descriptive and explanatory information provided. All participants also watched a video of a child who did not exhibit autistic behaviors. Again, children rated the boy with autism less favorably than the boy without autism. They also expressed less interest in engaging with him. Descriptive plus explanatory information improved behavioral intentions, relative to just descriptive information, but was more effective for girls than boys. Thus, a combination of descriptive and explanatory information may reduce stigma associated with autism among elementary school children.

When Campbell (2007) investigated whether the combination of descriptive and explanatory information was also effective with middle school students, he added a "no information" condition. Students watched a video of a boy exhibiting autistic behaviors and then were given one of four types of information about the potential "new student in the school" who they had seen in the video: "no information", "descriptive information", "explanatory information" or "descriptive plus explanatory information." Girls and those with more prior awareness of autism reported higher behavioral intentions to interact with the child with autism. Unexpectedly, "descriptive information" was associated with *lower* intention to interact with the child with autism than both "explanatory information" and "no information," which did not differ from each other or from the combined information condition.

Perhaps other types of information, such as directive guidance on how to interact with peers with autism, would more consistently decrease stigma. Silton and Fogel (2012) assigned children to watch one of four videos of a child with autism: "descriptive plus explanatory" information (adapted from Campbell), "descriptive, explanatory and peer strategies," "descriptive, explanatory and strengths associated with autism" or "all four types of information". Videos with peer strategies elicited enhanced behavioral intentions relative to the video with strengths. However, the length of the segment on peer strategies was substantially longer than that of segments containing other types of information.

Another study, tested the efficacy of a six-session anti-stigma intervention at an all-boys middle-school (Staniland & Byrne, 2013): The intervention group improved from pre-test to post-test (a week after the intervention) and follow-up (the next semester) in knowledge and attitudes towards peers with "high-functioning autism" (HFA). No changes in behavioral intentions towards peers with HFA were observed, despite the inclusion of explanatory, descriptive, and directive information, and contact with people with autism.  However, when a longer version of the intervention (which included incentives to engage in online learning) was tested with eighth grade girls, students showed improvements in knowledge, attitudes *and* behavioral intentions toward peers with HFA (Ranson & Byrne, 2014).

Although some of the aforementioned single-session (Campbell et al., 2004; Silton & Fogel, 2012) and multi-session (Ranson & Byrne, 2014) interventions were associated with decreases in stigma,

findings suggest that stigma associated with autism may be fairly resistant to change (e.g., Campbell, 2007; Staniland & Bryne, 2013; Swaim & Morgan, 2001). To the best of our knowledge, no prior research has attempted to decrease stigma towards autism among young adults.

**Aims of the Current Study**

The primary aim of the current study was to determine if participation in an online training about autism was associated with increased knowledge and decreased stigma towards autism. A secondary aim was to gain deeper understanding of college students' viewpoints about autism, especially concerning adults with autism. We hypothesized that stigma would be lower at pre-test among those with autism in the immediate family (e.g., nuclear relatives and/or themselves) and women (e.g., Campbell, 2007).

Prior research suggests that open-ended questions may yield more nuanced insights about understanding of autism than closed-ended scales. Qualitative coding of middle school students' ($N =$ 450) open-ended written definitions of autism revealed that the majority (71.3%) provided "accurate" definitions (Campbell et al., 2011). However, indicating that autism is a disability, in the absence of inaccurate information, was sufficient for a response to be considered "accurate." Few "accurate" responses identified core difficulties associated with autism: 8.2% of students referenced social problems, 8.4% of students referenced communication problems, and only 1.6% of students included restricted interests/repetitive behaviors in their answers. Around 15% of students provided "inaccurate" elements in their responses, such as by confusing autism with other disorders. However, we believe that a number of responses that the authors classified as "accurate" are in fact evidence of confusing autism with other disorders, such as "when a person or child cannot comprehend or think correctly…"

Based on these findings, we hypothesized that college students would rarely include restricted interests/repetitive behaviors in their definitions of autism and would frequently confuse autism with other disorders. Given that people may associate autism with dependency and being shut off from others (Huws & Jones, 2010), we expected participants to frequently associate autism with dependency and a lack of interest in social engagement. Given that media about autism often focus upon children (Jones & Harwood, 2009), we also expected many participants to define autism as child-specific.

**Method**

**Participants**

  **Recruitment.** This online study was approved by the Institutional Review Board of a large public university. An invitation to participate in the study was posted on the college subject-pool website; participation was one of a number of options students could select to satisfy a course requirement for an introductory psychology course or to obtain extra credit in higher-level courses. Participants were required by the Institutional Review Board to be 18 years of age or older. Therefore, potential participants who did not indicate that they were at least 18 years of age were excluded from all analyses. Participants who signed up for the study were immediately directed to click on a link to an online survey and autism training posted on SurveyMonkey, where they were asked to provide informed consent. All data collected were anonymous.

  **Participant characteristics.** A total of 365 participants completed the study, comprised of a demographic survey, pre-test, training about autism, and post-test. An additional 42 potential participants entered, but did not complete the entire study. Students who did and did not complete the study did not differ significantly from one another in terms of GPA. However, 13% of women, but only 7% of men, who started the training failed to complete it ($p = .034$). All analyses include only the participants who completed the entire study.

  Participants ranged in age from 18 to 55 with a mean age of 19.9 years ($SE = 4.4$). Women comprised 54.2% of the sample. The majority of participants were Caucasian/white (50.4%); other participants identified as Hispanic (18.4%), of African descent (14.0%), Asian (9.3%), of mixed ethnicity (6.3%), or Pacific Islander (.3%). While the majority of participants (91.2%) had not yet received any type of college degree, 4.4% had received an Associate's degree and 4.4% had received a Bachelor's degree. Fewer participants were currently enrolled in STEM fields (10.3% sciences, 3.8% information technology, 2.2% engineering, .8% math) than "helping professions" (17.7% psychology, 17.7% nursing, 10.4% education, 2.4% social work); 23.4% of participants were in other majors, such as business or liberal arts, 10.9% were undecided and .4% did not indicate their major. Over half of the participants

(56.5%) had a friend, nuclear family member, or extended family member with autism. Nineteen

participants stated that autism was in their immediate family. Sixteen of these participants, including one

who self-identified as autistic, had a nuclear family member with autism. Three additional participants

identified as autistic.

**Measures**

   Measures used in the current study included a demographic survey, a pre-test, autism training,

and a post-test that was identical to the pre-test.

   **Demographic survey questions.**  Participants were asked to indicate their gender, age, highest

level of education, ethnicity, major, GPA, and their personal experience with autism. Personal experience

with autism was assessed with the following question. "Please select as many of the following types of

relationships as you have had with people with autism spectrum disorders: yourself, your child, your

parent, your sibling, your spouse, your extended family member, your friend, your coworker, your

student, your fellow student, your acquaintance, or other."

   **Pre-test and post-test.** The pre-test and post-test were identical and occurred immediately before

and after the training respectively. They consisted of commonly used assessments of stigma and autism

knowledge, in addition to specific questions designed to assess key learning objectives of the online

training.

   *Measure of autism stigma.* An adapted version of the Social Distance Scale, a measure of stigma

(Bogardus, 1933), was used to assess stigma towards autism (see Appendix A). Social distance scales

consist of a series of questions about participants' willingness to engage with a given type of person (i.e.

someone with autism) at various levels of intimacy. Responses to the six items used to assess social

distance in the current study were scored from 1 (least stigma) to 4 (most stigma) and summed to create a

composite stigma score that ranged from 6 to 24. Social distance scales typically have good-to-excellent

internal consistency and construct validity, as evinced by positive associations between believing that

mentally ill people are dangerous and desired social distance (Link et al., 2004). The internal consistency

of the social distance scale used in the current study was α= .87.

***Closed-ended measures of autism knowledge.*** The primary assessment of autism knowledge used in the current study, the Autism Survey, was developed by Stone (1987), adapted by Heidgerken and colleagues (2005), and used in a recent study assessing college students' knowledge of autism (Tipton & Blacher, 2014). Given frequent changes in what constitutes an "accurate" answer to many questions about autism, we selected 10 items from previous versions of the scale that we believed to be accurate (see Appendix B). We added three items that were not in previous versions of the scale to capture frequent misconceptions about autism. Items were scored on a 5-point scale according to their degree of accuracy (from -2 to 2) and summed to yield a composite autism knowledge score that could range from –26 to 26. Higher scores are indicative of greater knowledge about autism. The internal consistency of this version of the Autism Survey was low, α= .50 with the original 10 items and α= .56 with the additional items. This is lower than the internal consistency reported in the paper establishing the psychometric properties of the scale, α= .66 (Campbell, Reichle, & Van Bourgondien, 1996). In addition, specific closed-ended questions were designed to assess knowledge of and attitudes toward autism (see Appendix C).

**Qualitative Coding**

Coding schemes for open-ended responses were developed using previous literature (e.g., Campbell, Morton, Roulston, & Barger, 2011; Huws, & Jones, 2010) and emergent patterns in the data. The first and last authors established reliability by double-coding 74 responses each from the pre-test and post-test (20% of the sample). Percent agreement for all codes was 95% or greater. After reliability was established, the first author coded the rest of the data.

Responses to the question, "What are autism spectrum disorders in your own words?" were coded into non-mutually-exclusive categories: "Developmental," "Restricted interests or repetitive behaviors," "Social-communicative difficulty" (any social challenge that was consistent with DSM-5 criteria), "Lack of social interest" (the misconception that autistic people are anti-social), "Timid" (anxiety, shyness or fear), "Language difficulties," "Behavior" (the term behavior without specifying the type of behavior), "Self-regulation difficulties" (such as anger), "Deficit" (any term signifying a lack of ability, such as disability, symptoms or disease), "Dependence" (a subcategory of deficit indicating difficulty living

independently or coping with daily life), "Different but not less" (for terms such as "unique" that suggest

that difference is not a deficit), "Systematic processing" (processing strengths), "A diverse spectrum"

(specifying differences in level, symptoms, or types of autism), "Etiology" (indicating a cause of autism),

"Brain" (a subcategory of etiology coded when participants mentioned the brain or neurology),

"Confusion with another disorder" (more consistent with a different disorder than with autism e.g., labels

or characteristics of Downs Syndrome, ADHD, learning disability, physical disability, personality

disorder, mental illness, or intellectual disability),  "Cognitive difficulties" (a subcategory of "confusion

with another disorder" used for responses such as "difficulty thinking" that suggested that autism is

synonymous with intellectual disability), and "Child-specific" (participants mentioned children but not

adolescents or adults in their response; such responses were suggestive of the misconception that only

children have autism). If participants provided a response that did not fit into any of the above categories,

it was coded as "Blank/don't know" or "Other."

A very similar coding scheme was used to code responses to the open-ended question, "What are

two challenges that adults with autism spectrum disorders face?" The following codes described above for

classifying definitions of autism spectrum disorders were used again:  "Social-communicative difficulty,"

"Lack of social interest," "Timid," "Language difficulties," "Restricted interests or repetitive behaviors,"

"Self regulation difficulties," "Dependence," "Confusion with another disorder," "Cognitive difficulties,"

"Blank/don't know" or "Other." Additional codes developed for this question included difficulty in the

following domains: "Employment," "Education," "Discrimination," and "Romantic relationships/starting

a family". Difficulty with "Romantic relationships" was considered a subcategory of "Social-

communicative difficulty."

**Autism Training**

The training consists of a 71-slide PowerPoint presentation in which students were introduced to

current research about autism across the lifespan.  Participants scrolled through the slides at their own

pace and were asked periodic "comprehension checks" which they had to answer in order to move on to

the next section of the training. Key points were illustrated with colorful images and/or supported with

written first-hand accounts by people on the spectrum (see Table 1 for the overall structure of the training

and Figure 1 for example slides). Topics highlighted in the training included changes in diagnostic criteria

between the DSM-IV and the DSM-5 (American Psychiatric Association, 2013), early signs of autism

(e.g., Yirmiya & Charman, 2010), how and when autism can be diagnosed (e.g., Lord et al., 1997; Luyster

et al., 2009), the increasing prevalence of autism diagnoses and factors that may contribute to this (e.g.,

Blumberg et al., 2013; Kim et al., 2011), ethnic disparities in autism diagnoses in the United States and

likely contributions of socioeconomic factors to these disparities (e.g.,  Durkin et al., 2010; Mandell,

Ittenbach, Levy, & Pinto-Martin, 2007), the higher prevalence of autism among males and the possibility

that diagnostic measures may be less effective in detecting autism in females (e.g.,  Baron-Cohen et al.,

2009), and how cultural factors including stigma may influence rates of diagnosis internationally (e.g.,

Elsabbagh et al., 2012; Kim et al., 2011). After introducing common traits observed among people with

autism and emphasizing that each individual with autism is unique (e.g., Wing, 1988), the training

discussed associations between giftedness and autistic traits in the general population (e.g., Vital, Ronald,

Wallace, & Happé, 2009), and the heterogeneity of intelligence in autism (e.g., Bölte, Dziobek, &

Poustka, 2009). After asking participants what causes autism, the training emphasized that there is no

single cause for autism, that multiple genes and environmental causes likely interact to cause autism (e.g.,

Volk et al., 2014), that many genes associated with autism are new mutations in the child rather than

inherited mutations (e.g., Sanders et al., 2012), and that cold/emotionally distant parents and vaccines do

not cause autism (e.g., Cox, Rutter, Newman, & Bartak, 1975; Price et al., 2010). Given recent press

coverage attributing violent crimes committed by a small minority of people on the spectrum to a lack of

empathy, we used first-hand accounts and images to illustrate how people with autism may have less

cognitive empathy, but more affective empathy than others (Smith, 2009). When discussing how to teach

people with autism, the training highlighted the importance of individualized interventions (e.g.,

Iovannone, Dunlap, Huber & Kincaid, 2003) and discussed effective ways to teach people with autism, as

described by an adult on the spectrum and another autism specialist (Grandin, 2002; Moreno & O'Neal,

2008). After introducing the types of challenges adults with autism report facing (e.g., Jones, Zahl, &

Huws, 2001), the training discussed the views of the neurodiversity movement, such as that autism is a minority identity that is an important part of human diversity like race or sexuality (e.g., Kapp, Gillespie-Lynch, Sherman, & Hutman, 2013), and emphasized that increasing numbers of young adults with autism are believed to be entering college and the workforce (e.g., Shattuck et al., 2014). The full training is available upon request.

The first author, who is an autism specialist, developed an initial draft of the training with the last author, who is an artist, based upon extant research about autism. The other authors, who include professors of psychology and education and an autism researcher who is also an autistic self-advocate, provided extensive revisions. An initial version of the training was piloted during the spring of 2013 with 287 participants from the university subject pool. Although this initial training was largely effective in terms of the types of knowledge that were assessed, widely used measures of stigma and knowledge were not used. In addition, the pilot training was less effective in teaching certain concepts than desired. For example, although the training taught many participants that there is only one autism spectrum disorder (ASD) in the DSM-5, other participants were confused by the inclusion of a detailed description of the DSM-IV and "learned" instead that there were five different types of autism in the DSM-5. To address weaknesses in the initial training, the authors revised the training for the fall of 2013 using pilot participants' responses as a guide.

**Analysis Approach**

Non-parametric tests are highly recommended for ordinal data such as the response scales employed in the current study (Jamieson, 2004). In addition, several variables exhibited excessive kurtosis and/or skew. Therefore, potential associations between demographic characteristics and knowledge and stigma during pre-test were examined using Mann-Whitney U analyses. Wilcoxon Signed-Ranks Tests were used to assess changes in composite measures of knowledge and stigma. Chi square analyses were used to analyze changes in binary variables. Because of the large number of analyses conducted and the resultant threat of Type 1 errors, only $p$ values equal to or less than .001 were considered statistically significant. Data were analyzed using SPSS Statistics version 20.

## Results

### Associations between Pre-test Characteristics and Demographic Factors

Women ($M$ = 10.63, $SE$ = .27) reported significantly less stigma than men during pre-test ($M$ = 12.04, $SE$ = .31; $Z$ = –3.489, $p$ < .001, $r$ = .18). Participants from STEM majors such as sciences, engineering, computer science and math ($M$ = 12.21, $SE$ = .58) exhibited a trend toward more stigma relative to participants from "helping majors" such as education, psychology, social work and teaching ($M$ = 10.60, $SE$ = .28, $Z$ = –2.588, $p$ = .01, $r$ = .14). Heightened stigma among STEM-related majors may be attributable to the high proportion of men in STEM-related fields, 38 men vs. 20 women, relative to 52 men vs. 129 women in "helping majors". The nineteen participants with autism in their immediate family ($M$ = 9.00, $SE$ = .99) exhibited a trend towards lesser stigma than their peers ($M$ = 11.36, $SE$ = .21, $Z$ = –2.478, $p$ = .013, $r$ = .15). No associations between demographic factors and knowledge of autism were observed. These findings support our hypothesis that stigma would be lower among women and those with autism in the immediate family, although the latter finding was marginal.

### Changes in Stigma and Knowledge

Consistent with hypotheses, stigma decreased from pre-test ($M$ = 11.27, $SE$ = .21) to post-test ($M$ = 10.67, $SE$ = .21, $Z$ = –5.120, $p$ < .001, $r$ = .27). Follow-up tests to assess changes in specific questions of the social distance scale revealed increased willingness to collaborate with and to marry/date someone on the spectrum after the training (Table 2). Nevertheless, stigma associated with having a romantic relationship with someone on the spectrum was higher than all other forms of stigma during both pre-test and post-test.

Also consistent with hypotheses, autism knowledge increased from pre-test ($M$ = 7.67, $SE$ = .30) to post-test ($M$ = 10.15, $SE$ = .35, $Z$ = –8.172, $p$ < .001, $r$ = .43). An identical pattern of results was observed with our composite measure of autism knowledge, irrespective of whether or not the new items we added to the scale were included in analyses. Follow-up tests to assess change in specific questions of the Autism Survey can be seen in Table 3.

Chi square analyses were conducted to assess potential improvements in the accuracy of responses to questions designed to assess learning objectives. More participants indicated that the DSM-5 defines autism in terms of one ASD during the post-test (73.4%) relative to the pre-test (10.4%; $\chi^2 = 295.06$, $p < .001$). Marginally fewer participants indicated that vaccines cause autism during the post-test (11.8%) relative to the pre-test (20.3%; $\chi^2 = 9.16$; $p = .003$). Marginally more participants attributed autism to new mutations in the child during the post-test (56.7%) relative to the pre-test (45.8%; $\chi^2 = 8.34$, $p = .004$). Marginally more participants recognized that white people are diagnosed more frequently than many other races in the U.S. during the post-test (84.4%) relative to the pre-test (74.9%; $\chi^2 = 9.47$, $p = .002$). Participants were more likely to report that autism is diagnosed more often among wealthier and more educated families in countries where richer people have better access to healthcare during the post-test (38.4%) relative to the pre-test (15.1%; $\chi^2 = 49.37$, $p < .001$). Participants were less likely to report that only people with autism have autistic traits during the post-test (29.7%) relative to the pre-test (42.6%; $\chi^2 = 12.60$, $p < .001$) and were more likely to report that autistic traits are associated with high intelligence during the post-test (43.7%) relative to the pre-test (25.0%; $\chi^2 = 27.35$, $p < .001$).

Despite the significant changes in closed-ended measures of autism knowledge discussed above, no significant improvements in open-ended definitions of "autism spectrum disorders" were observed. Participants' definitions of autism included similar types of errors to those observed in definitions provided by middle school students (Campbell et al., 2011). While college students identified social-communicative difficulties associated with autism more frequently than children had, they rarely mentioned restrictive and repetitive interests (see Table 4). Confusions with other disorders occurred in 23.3% of responses. Participants confused autism with cognitive difficulties in 14.0% of responses. Contrary to hypotheses, the misconceptions that autism is child-specific or defined by a lack of interest in engaging with others were infrequent (2.7% and 3.0% of responses).

As hypothesized, participants frequently indicated that adults with "autism spectrum disorders" struggle with dependence (26.8% of responses; see Table 5). Participation in the training was associated

with decreased frequency of mentioning dependence as a challenge facing adults with autism and

increased frequency of mentioning social-communicative difficulties.

### Discussion

This study demonstrated that a brief and inexpensive online training about autism was associated

with immediate increases in knowledge and decreases in stigma associated with autism among college

students. Larger effect sizes were observed in terms of changes in knowledge relative to changes in

stigma. A similar pattern of larger changes in knowledge than attitudes was also apparent in the anti-

stigma intervention conducted by Staniland and Bryne (2013), although behavioral intentions did not

change in that study. These findings, and the generally conflicted findings from previous anti-stigma

research, suggest that stigma is more difficult to change than knowledge.

Similarly, relatively high levels of baseline knowledge about autism as assessed with the Autism

Survey (7.6 on a scale from –26 to 26) were observed in the current study as in prior research with college

students (Tipton & Blacher, 2014). Participants' very strong endorsement of the statement that *people*

*with autism can go to college and marry* in the current study suggests that conceptions of autism may be

shifting toward recognition that people on the spectrum can be, and often are, independent and integrated

members of society. While dependence was commonly mentioned as a challenge faced by adults with

autism by participants during the pre-test, one of the few changes in open-ended responses observed in

the current study was a decrease in this association of dependence with adults with autism. Consistent

with the idea that college students recognize that autism occurs in their peers, autism was infrequently

defined as specific to children in open-ended responses.

Despite relatively high scores on closed-ended measures of autism knowledge, participants' open-

ended descriptions of "autism spectrum disorders" mirrored those provided by children in prior research

(Campbell et al., 2011) in that they were often vague, rarely referenced the restricted interests and

repetitive behaviors associated with autism, commonly referenced the brain, and often included

misconceptions about autism. College students frequently confused autism with other disorders, such as

learning disabilities. These misconceptions highlight the importance of including both open-ended and

closed-ended assessments in trainings about autism and suggest that such trainings should include information about how to distinguish autism from other disorders.

Despite strong disagreement in closed-ended responses to the statement that autism is always associated with low IQ, participants frequently, and erroneously, included cognitive difficulties in their definitions of autism. Although a significant change in the frequency of such misconceptions was not observed, the training was associated with greater understanding that autistic traits are often associated with giftedness and are not specific to people with autism. Given that a common misconception associated with autism is the belief that people with autism are unintelligent (Kennedy, Regehr, Rosenfield, Roberts, & Lingard, 2004), greater focus on the orthogonality of intelligence and autism is needed in future trainings (only one slide in the current training was devoted to demonstrating this concept).

The training was associated with improvements in understanding of the etiology and identification of autism. Consistent with previous research with college students (e.g., Gardiner & Iarocci, 2014), misconceptions about the etiology of autism, for example, that autism is caused by vaccines, were fairly common in our sample. Participation in the training was associated with a trend toward greater recognition that vaccines do not cause autism and a trend toward greater recognition that de novo mutations do contribute to the etiology of autism. Importantly, given recent changes in diagnostic criteria for autism spectrum disorder (ASD), the training was associated with improvements in participants' understanding of the DSM-5 definition of ASD. Participants learned which groups of people are most frequently diagnosed with autism and how societal inequalities may influence disparities in diagnosis. Understanding the contributions of economic disparity to autism diagnosis is important given that many doctors may believe that autism is more common among those of higher socioeconomic status (Heidgerken, Geffken, Modi, & Frakey, 2005).

In contrast, the inaccurate idea that there is only one intervention that works for all people with autism was less strongly contested during pre-test in our study than it had been in the study by Tipton and Blacher (2014), which suggests possible regional differences in conceptions of effective interventions for

autism. Despite efforts to emphasize that interventions for autism should be individualized, training was associated with a marginally significant *increase* in the misconception that one treatment serves all.

Stigma towards autism was relatively low in the current sample (11.27 out of 24), which is indicative of an average response of "somewhat willing" to engage with a person with autism. However, participants were less willing to engage in romantic relationships with people with autism than other types of interactions. Participants also often noted that romantic relationships were a challenge faced by adults with autism. This suggests that anti-stigma interventions might benefit from information about proposed strengths of romantic partners with autism (e.g., Del Giudice, Angeleri, Brizio, & Elena, 2010).

Women exhibited significantly less stigma towards people with autism than men. This is consistent with past work suggesting that being female may be the most powerful determinant of positive attitudes towards people with disabilities, relative to factors such as age, familiarity with people with disabilities, and parental attitudes (Rosenbaum, Armstrong, & King, 1988). However, gender differences in stigma towards autism observed in the current study contribute to a conflicted set of findings wherein females are sometimes (e.g., Campbell, 2007; Chambres, Auxiette, Vansingle, & Gil, 2008), but not always (e.g., Nevill & White, 2011; Swaim and Morgan, 2001), more open towards people with autism. Marginally significant associations between being enrolled in a STEM major and increased stigma might be due to the much higher proportion of men in STEM relative to "helping professions" majors. People with autism in the immediate family also exhibited a trend toward reduced stigma, which likely failed to reach statistical significance due to the small number of such participants.

**Limitations**

Inferences about efficacy are limited by the quasi-experimental nature of this intervention. Generalization and maintenance of skills targeted in the training were also not assessed. Behavioral intentions such as those captured by self-reported stigma may differ from enacted behaviors due to contextual factors. In addition, social distance scales may underestimate actual stigma due to effects of social desirability, which was not assessed in the current study. Indeed, assessing stigma immediately before and after an online training that endorsed positive attitudes towards autism (e.g., emphasizing how

autism contributes to human diversity) may have prompted participants to indicate lower social distance after the training due to the perceived social desirability of such a response. However, it is important to note that the majority of extant interventions to decrease stigma towards autism have assessed stigma immediately after a very brief intervention (Campbell et al., 2004; Campbell, 2007; Silton & Fogel, 2012; Swaim & Morgan, 2001). Neither the aforementioned immediate interventions nor multi-session interventions (Ranson & Bryne, 2014; Staniland & Bryne, 2013) have reported upon measures of social desirability. The lack of prior investigations of how social desirability may contribute to baseline differences between groups (such as gender differences) and to apparent changes in stigma with intervention is a flaw shared across current anti-stigma interventions for autism that should be remedied in future research.

Although the Autism Survey used in the current study is commonly used and allowed comparisons with previous research, its internal consistency was quite low. Recent research using this scale has not provided its internal consistency (e.g., Gardiner and Iarocci, 2014; Tipton & Blacher, 2014). An autism knowledge scale with better psychometric properties is needed and could be developed by attending to patterns of responses to a range of qualitative and quantitative questions about autism, such as those utilized here.

**Future Directions and Conclusions**

A multi-site study is needed to examine associations between characteristics of college communities and attitudes towards people with autism, both in the United States and internationally. Future research should examine associations between social stigma (such as that assessed in the current study), structural (or institutionalized) stigma, and internalized stigma experienced by college students with autism. Future studies should assess maintenance and generalization of learning, including whether the training is associated with changes in how students actually interact with their peers with autism. Mechanisms underlying changes in stigma and knowledge among college students should be examined using random assignment to anti-stigma interventions with different active ingredients, such as the type of informant, modality of instruction, or type of information offered (e.g., Morton & Campbell, 2008).

Given that direct contact with people with disabilities may be particularly effective in decreasing stigma, provided that the contact is of high quality (e.g., Rosenbaum, Armstrong, & King, 1986), future studies should compare the current type of knowledge-based intervention to a contact-based intervention wherein students without autism are paired with a peer with autism. Given growing perspective-taking abilities and openness to diversity in emerging adulthood (Balswick, King, & Reimer, 2005), and evidence that stigma associated with autism may be resistant to change among adolescents (Staniland & Bryne, 2014, but see Ranson & Byrne, 2014), a comparison of the effects of an anti-stigma program on adolescents and college students could elucidate potential developmental changes in the resistance of stigma to change.

This study demonstrates that online training may be an efficient and inexpensive way to decrease stigma and increase knowledge associated with autism among college students, with the potential to reach critical numbers of students and thus effectively alter community conceptions of autism. In-person trainings require skilled personnel to schedule and run sessions, space (which is often at a premium on college campuses) and must be run anew for each new group of participants. In contrast, online training can be used many times at no cost beyond the cost of the hosting site (in this case $300 a year on SurveyMonkey) and do not require space or trained personnel to run them.

College students who participated in the current study exhibited fairly high knowledge of autism and low stigma towards people with autism. They also recognized that people with autism are often independent and integrated members of society. However, they frequently confused autism with other disabilities and were relatively unwilling to engage romantically with people with autism. These findings suggest that awareness campaigns have increased understanding and acceptance of autism but that interventions such as the one evaluated in this report are still needed.

References

Adreon, D. & Durocher, J. S. (2007). Evaluating the college transition needs of individuals with high-functioning autism spectrum disorders. *Intervention in School and Clinic, 42,* 271-279.

American Psychiatric Association. (2013). *DSM 5*. American Psychiatric Association.

Balswick, T. O., King, P. E., & Reimer, K. S. (2005). *The reciprocating self: Human development in theological perspective.* Downers Grove, IL: InterVarsity Press.

Bogardus, E. S. (1933). A social distance scale. *Sociology & Social Research*, *17,* 265-271

Baron-Cohen, S., Scott, F. J., Allison, C., Williams, J., Bolton, P., Matthews, F. E., & Brayne, C. (2009). Prevalence of autism-spectrum conditions: UK school-based population study. *The British Journal of Psychiatry*, *194*(6), 500-509.

Blumberg, S. J., Bramlett, M. D., Kogan, M. D., Schieve, L. A., Jones, J. R., & Lu, M. C. (2013). Changes in prevalence of parent-reported autism spectrum disorder in school-aged US children: 2007 to 2011–2012. *National Health Statistics Reports*, *65*(20), 1-7.

Bölte, S., Dziobek, I., & Poustka, F. (2009). Brief report: The level and nature of autistic intelligence revisited. *Journal of Autism and Developmental Disorders*, *39*(4), 678-682.

Butler, R. C., & Gillis, J. M. (2011). The impact of labels and behaviors on the stigmatization of adults with Asperger's disorder. *Journal of Autism and Developmental Disorders*, *41*(6), 741-749.

Campbell, J. M. (2006). Changing children's attitudes toward autism: A process of persuasive communication. *Journal of Developmental and Physical Disabilities*, *18*(3), 251-272.

Campbell, J. M. (2007). Middle school students' response to the self-introduction of a student with autism: Effects of perceived similarity, prior awareness, and educational message. *Remedial and Special Education*, *28*(3), 163-173.

Campbell, J. M., & Barger, B. D. (2011). Middle school students' knowledge of autism. *Journal of Autism and Developmental Disorders*, *41*(6), 732-740.

Campbell, J. M., Ferguson, J. E., Herzinger, C. V., Jackson, J. N., & Marino, C. A. (2004). Combined

descriptive and explanatory information improves peers' perceptions of autism. *Research in

Developmental Disabilities*, *25*(4), 321-339.

Campbell, D. G., Reichle, N. C., & Van Bourgondien, M. E. (1996). The autism survey: An evaluation of

reliability and validity. *Journal of Autism and Developmental Disorders*, *26*(6), 621-634.

Campbell, J. M., Morton, J. F., Roulston, K., & Barger, B. D. (2011). A descriptive analysis of middle

school students' conceptions of autism. *Journal of Developmental and Physical Disabilities*, *23*(5),

377-397.

Chambres, P., Auxiette, C., Vansingle, C., & Gil, S. (2008). Adult attitudes toward behaviors of a six-

year-old boy with autism. *Journal of Autism and Developmental Disorders*, *38*(7), 1320-1327.

Cox, A., Rutter, M., Newman, S., & Bartak, L. (1975). A comparative study of infantile autism and

specific developmental receptive language disorder II. Parental characteristics. *The British Journal

of Psychiatry*, *126*(2), 146-159.

Del Giudice, M., Angeleri, R., Brizio, A., & Elena, M. R. (2010). The evolution of autistic-like and

schizotypal traits: A sexual selection hypothesis. *Frontiers in Psychology: Evolutionary Psychology

and Neuroscience*. doi: 10.3389/fpsyg.2010.00041.

Durkin, M. S., Maenner, M. J., Meaney, F. J., Levy, S. E., DiGuiseppi, C., Nicholas, J. S., ... & Schieve,

L. A. (2010). Socioeconomic inequality in the prevalence of autism spectrum disorder: evidence

from a US cross-sectional study. *PLoS One*, *5*(7), e11551.

Elsabbagh, M., Divan, G., Koh, Y. J., Kim, Y. S., Kauchali, S., Marcín, C., ... & Fombonne, E. (2012).

Global prevalence of autism and other pervasive developmental disorders. *Autism Research*, *5*(3),

160-179.

Gardiner, E., & Iarocci, G. (2014). Students with autism spectrum disorder in the university context: Peer

acceptance predicts intention to volunteer. *Journal of Autism and Developmental Disorders*, *44*(5),

1008-1017.

Gelbar, N. W., Smith, I., & Reichow, B. (2014). Systematic review of articles describing experience and supports of individuals with autism enrolled in college and university programs. *Journal of Autism and Developmental Disorders*, *44*(10), 2593-2601.

Goffman, E. (1963). *Stigma: Notes on the management of spoiled identity*. New York, NY: Simon and Schuster.

Grandin, T. (2002). *Teaching tips for children and adults with autism.* Fort Collins, CO: EUA. Retrieved from http://www.iidc.indiana.edu/?pageId=601

Heidgerken, A. D., Geffken, G., Modi, A., & Frakey, L. (2005). A survey of autism knowledge in a health care setting. *Journal of Autism and Developmental Disorders, 35*(3), 323–330.

Helps, S., Newsom-Davis, I. C., & Callias, M. (1999). Autism: The teacher's view. *Autism*, *3*(3), 287-298.

Huws, J. C., & Jones, R. S. P. (2010). 'They just seem to live their lives in their own little world': Lay perceptions of autism. *Disability & Society*, *25*(3), 331-344.

Iovannone, R., Dunlap, G., Huber, H., & Kincaid, D. (2003). Effective educational practices for students with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, *18*(3), 150-165.

Jamieson, S. (2004). Likert scales: How to (ab)use them. *Medical Education*, *38*(12), 1217-1218.

Jones, S. C., & Harwood, V. (2009). Representations of autism in Australian print media. *Disability & Society*, *24*(1), 5-18.

Jones, R. S., Zahl, A., & Huws, J. C. (2001). First-hand accounts of emotional experiences in autism: A qualitative analysis. *Disability & Society*, *16*(3), 393-401.

Kapp, S. K., Gantman, A., & Laugeson, E. A. (2011). Transition to adulthood for high-functioning individuals with Autism Spectrum Disorders. In M.-R. Mohammadi (Eds.), *A comprehensive book on autism spectrum disorders,* Chapter 25. www.intechopen.com.

Kapp, S. K., Gillespie-Lynch, K., Sherman, L. E., & Hutman, T. (2013). Deficit, difference, or both? Autism and neurodiversity. *Developmental Psychology*, *49*(1), 59-71.

Kennedy, T., Regehr, G., Rosenfield, J., Roberts, S. W., & Lingard, L. (2004). Exploring the gap between knowledge and behavior: A qualitative study of clinician action following an educational intervention. *Academic Medicine*, *79*(5), 386-393.

Kim, Y. S., Leventhal, B. L., Koh, Y. J., Fombonne, E., Laska, E., Lim, E. C., ... & Grinker, R. R. (2011). Prevalence of autism spectrum disorders in a total population sample. *American Journal of Psychiatry*, *168*(9), 904-912.

Link, B. G., Yang, L. H., Phelan, J. C., & Collins, P. Y. (2004). Measuring mental illness stigma. *Schizophrenia Bulletin*, *30*(3), 511-541.

Lord, C., Pickles, A., McLennan, J., Rutter, M., Bregman, J., Folstein, S., ... & Minshew, N. (1997). Diagnosing autism: analyses of data from the Autism Diagnostic Interview. *Journal of Autism and Developmental Disorders*, *27*(5), 501-517.

Luyster, R., Gotham, K., Guthrie, W., Coffing, M., Petrak, R., Pierce, K., ... & Lord, C. (2009). The Autism Diagnostic Observation Schedule—Toddler Module: A new module of a standardized diagnostic measure for autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *39*(9), 1305-1320.

Mandell, D. S., Ittenbach, R. F., Levy, S. E., & Pinto-Martin, J. A. (2007). Disparities in diagnoses received prior to a diagnosis of autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *37*(9), 1795-1802.

Moreno, S., & O'Neal, C. (2008). Tips for teaching high-functioning people with autism. *Indiana Resource Center for Autism, Autism Training Sourcebook*, 105-106. Retrieved from http://www.iidc.indiana.edu/?pageId=437

Morton, J. F., & Campbell, J. M. (2008). Information source affects peers' initial attitudes toward autism. *Research in Developmental Disabilities*, *29*(3), 189-201.

Nevill, R. E., & White, S. W. (2011). College students' openness toward autism spectrum disorders: Improving peer acceptance. *Journal of Autism and Developmental Disorders*, *41*(12), 1619-1628.

Price, C. S., Thompson, W. W., Goodson, B., Weintraub, E. S., Croen, L. A., Hinrichsen, V. L., ... &
    DeStefano, F. (2010). Prenatal and infant exposure to thimerosal from vaccines and
    immunoglobulins and risk of autism. *Pediatrics*, *126*(4), 656-664.

Ranson, N. J., & Byrne, M. K. (2014). Promoting peer acceptance of females with higher-functioning
    autism in a mainstream education setting: A replication and extension of the effects of an autism
    anti-stigma program. *Journal of Autism and Developmental Disorders*, *44*(11), 2778-2796.

Rosenbaum, P. L., Armstrong, R. W., & King, S. M. (1986). Improving attitudes toward the disabled: A
    randomized controlled trial of direct contact versus Kids-on-the-Block. *Journal of Developmental
    & Behavioral Pediatrics*, *7*(5), 302-307.

Rosenbaum, P. L., Armstrong, R. W., & King, S. M. (1988). Determinants of children's attitudes toward
    disability: A review of evidence. *Children's Health Care*, *17*(1), 32-39.

Sanford, C., Newman, L., Wagner, M., Cameto, R., Knokey, A. M., & Shaver, D. (2011). *The post-high
    school outcomes of young adults with disabilities up to 6 years after high school: Key findings from
    the National Longitudinal Transition Study-2 (NLTS2). NCSER 2011-3004.* Washington, DC:
    National Center for Special Education Research, Institute of Education Sciences. Retrieved from
    http://files.eric.ed.gov/fulltext/ED524044.pdf

Sanders, S. J., Murtha, M. T., Gupta, A. R., Murdoch, J. D., Raubeson, M. J., Willsey, A. J., ... & State,
    M. W. (2012). De novo mutations revealed by whole-exome sequencing are strongly associated
    with autism. *Nature*, *485*(7397), 237-241.

Shah, K. (2001). What do medical students know about autism? *Autism*, *5*(2), 127-133.

Shattuck, P. T., Steinberg, J., Yu, J., Wei, X., Cooper, B. P., Newman, L., & Roux, A. M. (2014).
    Disability identification and self-efficacy among college students on the autism spectrum. *Autism
    Research and Treatment*, Article ID 924182.

Shtayermman, O. (2009). An exploratory study of the stigma associated with a diagnosis of Asperger's
    Syndrome: The mental health impact on the adolescents and young adults diagnosed with a

disability with a social nature. *Journal of Human Behavior in the Social Environment*, *19*(3), 298-313.

Silton, N. R., & Fogel, J. (2012). Enhancing positive behavioral intentions of typical children towards children with autism. *Journal of Evidence-Based Psychotherapies*, *12*(2), 139-158.

Smith, A. (2009). The empathy imbalance hypothesis of autism: A theoretical approach to cognitive and emotional empathy in autistic development. *The Psychological Record, 59*, 489-510.

Staniland, J. J., & Byrne, M. K. (2013). The effects of a multi-component higher-functioning autism anti-stigma program on adolescent boys. *Journal of Autism and Developmental Disorders*, *43*(12), 2816-2829.

Stone, W. L. (1987). Cross-disciplinary perspectives on autism. *Journal of Pediatric Psychology*, *12*(4), 615-630.

Swaim, K. F., & Morgan, S. B. (2001). Children's attitudes and behavioral intentions toward a peer with autistic behaviors: Does a brief educational intervention have an effect? *Journal of Autism and Developmental Disorders*, *31*(2), 195-205.

Tipton, L. A., & Blacher, J. (2014). Brief report: Autism awareness: Views from a campus community. *Journal of Autism and Developmental Disorders*, *44*(2), 477-483.

Van Bergeijk, E., Klin, A., & Volkmar, F. (2008). Supporting more able students on the autism spectrum: College and beyond. *Journal of Autism and Developmental Disorders, 38*(7), 1359-1370.

Vital, P. M., Ronald, A., Wallace, G. L., & Happé, F. (2009). Relationship between special abilities and autistic-like traits in a large population-based sample of 8-year-olds. *Journal of Child Psychology and Psychiatry*, *50*(9), 1093-1101.

Volk, H. E., Kerin, T., Lurmann, F., Hertz-Picciotto, I., McConnell, R., & Campbell, D. B. (2014). Autism spectrum disorder: Interaction of air pollution with the MET receptor tyrosine kinase gene. *Epidemiology*, *25*(1), 44-47.

Wei, X., Jennifer, W. Y., Shattuck, P., McCracken, M., & Blackorby, J. (2013). Science, technology,

    engineering, and mathematics (STEM) participation among college students with an autism

    spectrum disorder. *Journal of Autism and Developmental Disorders*, *43*(7), 1539-1546.

Wing, L. (1988). The continuum of autistic characteristics. In E. Schopler & G. B. Mesibov (Eds.),

    *Diagnosis and assessment in autism* (pp. 91-110). New York, NY: Springer.

Yirmiya, N., & Charman, T. (2010). The prodrome of autism: early behavioral and biological signs,

    regression, peri-and post-natal development and genetics. *Journal of Child Psychology and*

    *Psychiatry*, *51*(4), 432-458.

Table 1

*Overall Structure of the Autism Training*

| Concept | Description |
| --- | --- |
| Definition | Changes in diagnostic criteria for ASD with the DSM-5 |
| Identification | Early signs of autism; how and when autism can be diagnosed |
| Prevalence | Factors contributing to increasing prevalence of autism |
| Who gets diagnosed? | Contributors to ethnic disparities and gender differences in diagnosis |
| ASD as spectrum | List of common traits with emphasis on uniqueness of each individual |
| Intelligence: Orthogonal to autism | Heterogeneity of intelligence in autism |
| Etiology | Interaction genes and environment; not due to parenting or vaccines |
| Empathy | Cognitive but *not* affective empathy often impaired in autism |
| Intervention | Individualized approach recommended |
| Adults with ASD | Face challenges in terms of independence, relationships, and moods |
| Effective ways to teach | Adapt to sensory differences, use visuals/text/interests as tools |
| Neurodiversity | Autism is a valuable part of human diversity that need not be cured |
| The future | What does the future hold for people with autism? |

Table 2

*Average Scores on Specific Items of Social Distance Scale*

| Willingness to engage with someone with autism | Pre-test Mean (SE) | Post-test Mean (SE) | p value |
|---|---|---|---|
| Move Next Door | 1.59 (.04) | 1.57 (.04) | .550 |
| Spend an Evening | 1.60 (.04) | 1.52 (.04) | .005 |
| Collaborate With | 1.85 (.04) | 1.72 (.04) | < .001 |
| Befriend | 1.54 (.04) | 1.48 (.04) | .122 |
| Have Marry into Family | 1.95 (.05) | 1.85 (.05) | .006 |
| Marry/Date Oneself | 2.74 (.05) | 2.55 (.05) | < .001 |

Note: *p* values are from Wilcoxon Signed-Ranks tests.

Table 3

*Average Scores on Specific Items of the Autism Awareness Survey*

|  | Pre-test Mean (SE) | Post-test Mean (SE) | p value |
|---|---|---|---|
| More Frequent Males | .42 (.06) | .88 (.07) | < .001 |
| Don't show attachments | -.38 (.07) | -.43 (.07) | .39 |
| Deliberatively uncooperative | - .60 (.06) | -.69 (.06) | .15 |
| Can go to college/marry | 1.23 (.06) | 1.22 (.05) | .84 |
| One intervention for all | -.66 (.06) | - .47 (.07) | .002 |
| Can be diagnosed by 15 months | .70 (.06) | 1.55 (.05) | < .001 |
| Proper treatment outgrow | - .34 (.06) | - .19 (.06) | .01 |
| Show affection | .74 (.06) | .78 (.06) | .62 |
| Most low IQ | -1.00 (.06) | - 1.10 (.05) | .06 |
| Lifelong | .60 (.05) | .73 (.05) | .04 |
| Violent Tendencies | -.27 (.06) | - .47 (.06) | < .001 |
| Disinterested friends | -.36 (.06) | - .55 (.07) | .02 |
| Have empathy | .37 (.05) | 1.10 (.06) | < .001 |

Note: *p* values are from Wilcoxon Signed-Ranks tests.

Table 4

*Frequency of Different Codes for Definitions of Autism Spectrum Disorder*

|  | *Frequency pre-test* | *Frequency post-test* | *p value* |
|---|---|---|---|
| Developmental | 57 | 52 | .68 |
| Spectrum | 60 | 62 | .92 |
| Social-Communicative | 98 | 103 | .74 |
| Lack social interest | 11 | 14 | .68 |
| Timid | 4 | 1 | .37 |
| Language Difficulty | 22 | 8 | .01 |
| Restricted/Repetitive | 11 | 8 | .64 |
| Behavior | 18 | 21 | .74 |
| Self-regulation | 7 | 5 | .77 |
| Deficit | 294 | 303 | .44 |
| Dependence | 12 | 7 | .35 |
| Different not less | 2 | 11 | .03 |
| Systematic | 6 | 3 | .51 |
| Etiology | 56 | 67 | .32 |
| Brain | 54 | 58 | .76 |
| Confusion | 85 | 70 | .21 |
| Cognitive Difficulty | 51 | 45 | .58 |
| Child Specific | 10 | 9 | 1.0 |
| Blank/Don't know | 24 | 7 | .002 |
| Other | 16 | 24 | .33 |

Note: Frequency indicates how often responses were coded into a given category out of 365 responses.
*p* values represent chi-square analyses.

Table 5

*Frequency of Different Codes for Challenges Adults with ASD Face*

|  | *Frequency pre-test* | *Frequency post-test* | *p value* |
|---|---|---|---|
| Employment | 137 | 157 | .15 |
| Education | 17 | 23 | .42 |
| Discrimination | 46 | 37 | .35 |
| Social-Communicative | 197 | 250 | .0001 |
| Romantic Relationships/ Family | 46 | 65 | .06 |
| Language Difficulty | 18 | 10 | .18 |
| Lack social interest | 11 | 16 | .43 |
| Timid | 4 | 13 | .05 |
| Restricted/Repetitive | 7 | 12 | .35 |
| Self-regulation | 8 | 3 | .22 |
| Dependence | 98 | 59 | .0006 |
| Confusion | 56 | 37 | .05 |
| Cognitive Difficulty | 40 | 28 | .13 |
| Blank/Don't know | 12 | 10 | .83 |
| Other | 5 | 5 | 1.0 |

Note: Frequency indicates how often responses were coded into a given category out of 365 responses. *p* values represent chi-square analyses.

Figure 1

*Example slides from the etiology section of the training.*
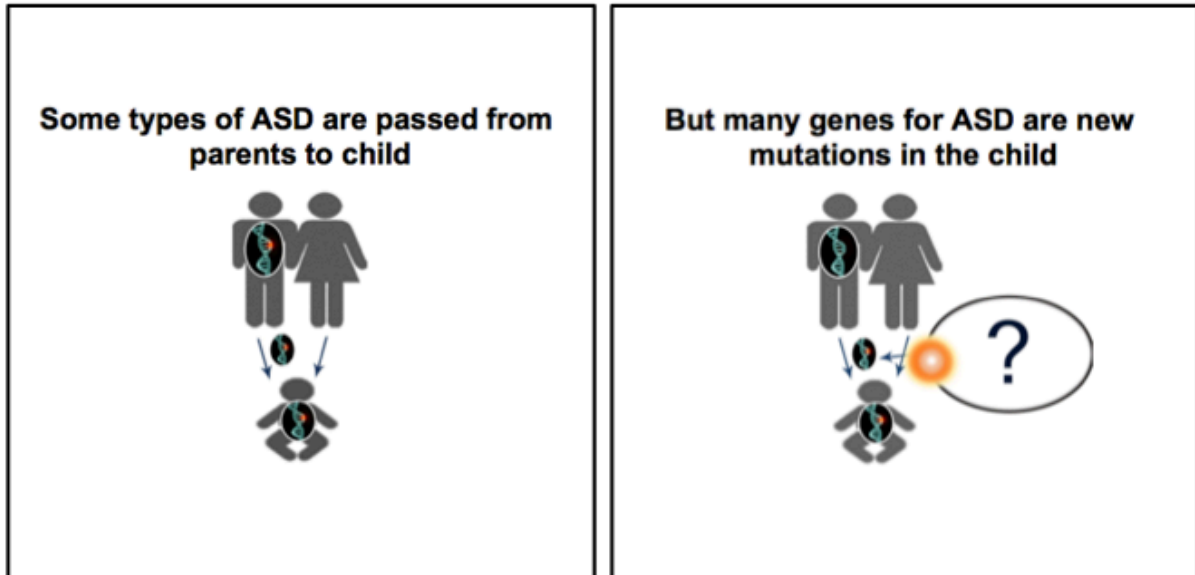
Appendix A

Social Distance Scale

Response choices included definitely unwilling (4), somewhat unwilling (3), somewhat willing (2), definitely willing (1).

1) How willing would you be to move next door to someone with autism?

2) How willing would you be to spend an evening socializing with someone with autism?

3) How willing would you be to start a collaborative project with someone with autism?

4) How willing would you be to make friends with a person with autism?

5) How willing would you be to have a person with autism marry into the family?

6) How willing would you be to marry or date a person with autism?

Appendix B

*Autism Awareness Scale*

Response choices included strongly disagree (-2), disagree (-1), neither agree nor disagree (0), agree (1), strongly agree (2).

1.  Autism is more frequently diagnosed in males than females

2.  **Children with autism do not show attachments, even to parents/caregivers**

3.  **People with autism are deliberately uncooperative**

4.  Children with autism can grow up to go to college and marry

5.  **There is one intervention that works for all people with autism**

6.  Autism can be diagnosed as early as 15 months of age

7.  **With the proper treatment, most children diagnosed with autism eventually outgrow the disorder**

8.  People with autism show affection

9.  **Most people with autism have low intelligence**

10. Children with autism grow up to be adults with autism

11. **People with autism tend to be violent**

12. **People with autism are generally disinterested in making friends**

13. People with autism have empathy

Note: We added questions 11-13 to the scale.

Bolded items are reverse scored.

Appendix C
*Targeted Questions to Assess Specific Learning Objectives*

1. How many different autism spectrum disorders are there in the DSM-5?
a) 1
b) 3
c) 5
d) 10

2. What causes autism? (Select as many choices as needed)
a) Genes passed down from parents to children
b) New changes (mutations) in the genes of affected children
c) Environmental factors, such as toxins and pollution
d) Vaccines
e) Negative parenting
f) Other (please write in your answer)

4.  Is autism diagnosed more often among wealthier and more educated families? (Select as many choices as needed)
a)  Autism is diagnosed equally frequently among poor and rich families in the US
b)  Autism is diagnosed more often among poor and uneducated families in the US
c)  Autism is diagnosed more often among wealthy and educated families in the US
d)  Autism is only diagnosed more often among wealthier and more educated families in countries where richer people have better access to healthcare

5. Members of which ethnic group in the United States are most likely to be diagnosed with autism?
 a) Native Americans
 b) Latinos/Hispanic
 c) African Americans
 d) Whites

7. What type of people tends to have more autistic traits?
a) People with above average intelligence
b) People with average intelligence
c) People with below average intelligence
d) Only people with autism have autistic traits