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ORIGINAL PAPER

A Cross-Cultural Comparison of Knowledge and Stigma Associated with Autism Spectrum Disorder Among College Students in Lebanon and the United States

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Abstract Although misconceptions associated with ASD are apparent worldwide, they may differ across cultures. This study compares knowledge and stigma associated with ASD in a country with limited autism resources, Lebanon, and a country with substantial autism resources, the United States (US). College students in the US (N = 346) and Lebanon (N = 329) completed assessments of knowledge and stigma associated with ASD before and after an online ASD training. Although students in the US exhibited higher overall knowledge and lower stigma towards ASD, certain misconceptions were more apparent in the US than in Lebanon. Participation in the training was associated with decreased stigma and increased knowledge in both countries. Thus, online training may be useful for increasing understanding about ASD internationally.

Keywords Stigma · Knowledge · ASD · Online training · Cross-cultural · Lebanon

Introduction

Autism Spectrum Disorder (ASD) may be increasing in prevalence internationally (Elsabbagh et al. 2012; but see Baxter et al. 2014 for evidence that prevalence is *not* increasing). Although the prevalence of ASD has not been systematically assessed in many regions of the world (such as low-income countries), similar prevalence rates have been observed wherever prevalence has been assessed. In contrast, services to support those with ASD and to educate the public about ASD are far from equally distributed around the globe (Grinker et al. 2011) or across the lifespan (Johnson and Levine 2014). Cross-cultural research is needed to develop autism services that are culturally appropriate for regions where these services remain scarce (Daley 2002). The current study examines attitudes about ASD in Lebanon, a country with limited supports for people with ASD (Daou 2014), and the US, a country with substantial, but unequally distributed, supports for people with ASD (Mandell et al. 2009). We examine predictors of knowledge about ASD and stigma towards people with ASD in each country, and compare baseline knowledge and stigma associated with ASD across countries.

Misconceptions About ASD: A Global Phenomenon

Prior research has demonstrated that misconceptions and stigma associated with ASD are apparent worldwide. Although the current study may be the first to compare knowledge and stigma associated with ASD across countries, incomplete and/or inaccurate knowledge about ASD has been documented among many types of people internationally, including college students in Great Britain (Shah 2001), Nigeria (Igwe et al. 2010), and the US (Tipton and Blacher 2014). Commonly reported misconceptions

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include underestimating the prevalence of ASD (Dillenburger et al. 2013), lack of knowledge about core diagnostic characteristics (Bakare et al. 2009; Gillespie-Lynch et al. 2015; Heidgerken et al. 2005; Helps et al. 1999; Kharti et al. 2011), misconceptions about etiology (Alqahtani 2012), and insufficient knowledge about how to support those on the spectrum (Chown 2010; Imran et al. 2011). Researchers have often found that women and those who have had more contact with people with ASD are more knowledgeable about autism (Dillenburger et al. 2013; Koyama et al. 2008; Wang et al. 2012).

Cross-cultural variations in knowledge about ASD may influence how it is interpreted (including whether or not it is identified), expressed, and supported (Daley 2002; Matson et al. 2011; Ravindran and Myers 2012). For example, the misconception that genetic contributions to ASD are necessarily heritable from either parent, rather than sometimes arising from de novo mutations in the child, may contribute to heightened stigma towards ASD and reduced identification of ASD in predominantly collectivistic cultures where familial reputation is highly valued (e.g., Grinker and Cho 2013).

Stigma Towards People with ASD

Stigma is a multifaceted construct defined by Goffman (1963) as deeply discrediting attributes that do not fit the normative expectations of society and thus result in a spoiled social identity for individuals or groups who possess the attributes. Stereotypes towards those who possess these attributes often result in negative outcomes including, but not limited to, poor self-esteem and difficulties with employment (Corrigan et al. 2003; Link et al. 2001). Individuals with ASD may frequently encounter higher levels of social exclusion (Campbell and Barger 2014) and bullying (Fleischer 2012; Gelbar et al. 2014). Perceived or experienced stigma towards ASD has been reported by people on the spectrum in the US (Shtayermman 2009) and Britain (Humphrey and Lewis 2008), as well as by parents of people on the spectrum internationally (e.g., Dehnavi et al. 2011; Gray 2002).

The absence of visible markers of ASD may contribute to stigma, as unknowledgeable others may perceive a person with ASD, who looks "normal," to be acting *voluntarily* in ways that violate social norms (Gray 2002). Prior studies have found that greater knowledge about ASD is associated with lower stigma (Ling et al. 2010; Mahoney 2008; but see Butler and Gillis 2011 for evidence that ASD knowledge is *not* always associated with stigma). Increased knowledge may be related to lower endorsements of discriminatory attitudes toward a range of diagnostic categories (e.g., Corrigan and Penn 1999; Holmes et al. 1999). Consequently, by increasing knowledge of ASD, it may be possible to decrease stigma associated with it. However, much of the information people receive about ASD is from the media, which may offer stereotypical images of ASD (Draaisma 2009; Huws and Jones 2011). Therefore, it is critical to address misunderstandings and stigma surrounding ASD, particularly in countries where ASD services are scarce. A further aim of the current study is to evaluate the potential of online training to improve understanding about ASD in countries with less (i.e. Lebanon) and more (i.e. the US) ASD services.

Conceptions of ASD in Lebanon and Other Arab Countries

ASD in Arab countries such as Lebanon has received relatively little attention from the research community. A recent review of autism research in Arab countries revealed a total of 75 articles published between 1992 and 2012 (Hussein and Taha 2013). In contrast, the US produced the majority of all autism research articles published internationally between 1980 and 2010, including 1040 autism publications in 2010 alone (OARC 2012).

The few prevalence studies that have been conducted in Arab countries have yielded lower ASD prevalence rates (e.g. 29 per 10,000; Eapen et al. 2007 and 1.4 per 10,000; Al-Farsi et al. 2011) relative to the global average of 62 per 10,000 reported by Elsabbagh et al. (2012). Many cases of ASD may go unidentified in Arab countries due to insufficient understanding of ASD among the public and a lack of trained professionals (Al-Farsi et al. 2011; Imran et al. 2011; Taha and Hussein 2014). Indeed, in a general population sample from the United Arab Emirates, Eapen et al. (2007) found that none of the preschoolers that they identified as having autism had been identified as autistic prior to their study.

Government-based, ASD-specific educational services are infrequently available in Arab countries and when available, they are often of low quality (Daou 2014; Hussein and Taha 2013). In addition, services for adults with ASD are particularly scarce and are often prohibitively expensive. Consequently, people on the spectrum may receive insufficient support services and face heightened experiences of ostracism in general education settings (Taha and Hussein 2014). This lack of formal support likely contributes to reliance on informal supports among families of people with ASD in Arab countries. When asked to describe their support resources, mothers of children with ASD in Turkey (one of the non-Arab countries in the Middle East, with strong historical ties to the Arab countries in the region) identified informal social supports, but not formal supports (Bilgin and Kucuk 2010). Mothers also reported stress due to financial burdens, perceived stigmatization associated with ASD, and their own lack of knowledge about the etiology and treatment of ASD. A qualitative analysis of the beliefs held by Saudi Arabian parents of children with ASD revealed significant misconceptions about ASD. For example, parents tended to rely on cultural interventions involving religious healers (Alqahtani 2012), or attributed ASD to vaccines or the "evil eye", which ascribes one's misfortunes to "envy in the eye of the beholder" (Spooner 1970, p. 312). This paucity of ASD knowledge and supports suggests a need for studies that examine knowledge and stigma associated with ASD in Arab countries.

Knowledge of ASD in Lebanon

Lebanon is a small (10,452 square km) multilingual and multicultural country in the Middle East. In comparison to the more individualistic value orientation common in the US (wherein independence and personal goals are valued over interdependence and obligations to others), Lebanon is a predominantly collectivistic country wherein interdependence and group norms are valued (Matsumoto et al. 2008). Although the dimension of individualism versus collectivism is often used to examine cross-cultural differences in value orientations, it is one of a number of shifting dimensions that may differ across cultures. Variation in individualism and collectivism is apparent within, as well as between, countries and may be associated with evolving socioeconomic factors (Greenfield 2009). Indeed, a blend of individualistic and collectivistic attitudes has been observed in Lebanon (Ayyash-Abdo 2001; Matsumoto et al. 2008) and the US (Greenfield 2009). Overall, Lebanon appears to be less collectivistic than *primarily collectivistic* countries, such as South Korea or China, and more collectivistic than *primarily individualistic* countries, such as the US and Australia (Matsumoto et al. 2008). It may be most similar to countries, such as Japan and India that are slightly more collectivistic than individualistic. Consistent with evidence that individualistic values are more evident in regions with more economic resources (Basabe and Ros 2005), the GDP of Lebanon in 2013 was $9928 while the GDP in the US was $53,143 (retrieved from http://data.worldbank.org/indicator/NY.GDP.PCAP.CD). Given that government-supported services for individuals with ASD and other developmental disabilities are rarely available in middle to low-income regions (Divan et al. 2012; Grinker et al. 2011; Mirza et al. 2009), it is not surprising that ASD-related services are scarce in Lebanon (reviewed in Daou 2014). Indeed, staff in ASD-specific schools in Lebanon often lack the training needed to provide evidence-based interventions.

Insufficient support services for individuals with ASD in Lebanon may contribute to a lack of understanding and stigma associated with ASD. Obeid and Daou (2015) found that mothers of children with ASD reported decreased well-being relative to mothers of typically developing children. The authors suggested that simply having a large social support network is insufficient to improve the well-being of mothers in the absence of ASD-specific formal supports. Azar and Badr (2006) attributed the high levels of stress and depression observed among mothers of children with intellectual disabilities in Lebanon to stigma associated with disability and to financial burdens associated with caring for their children. Indeed, surveys examining attitudes towards people with disabilities among community members in Jordan and college students in Lebanon revealed negative attitudes towards people with disabilities (Nagata 2008). Participants from Jordan who had a disabled family member or who had watched a disability awareness program on TV endorsed more positive attitudes than their counterparts. Similar benefits of prior exposure to those with disabilities were observed among students from Lebanon, but were not statistically significant. However, comparisons across countries were not possible in this research given the use of different sampling methods and surveys in each country. The current study differs from most prior research examining conceptions of ASD internationally in that the same recruitment methods and surveys were used in both Lebanon and the US [see Probst (1998) for an international comparison using similar methods across countries].

Conceptions of ASD in the US

In stark contrast to the scarcity of autism services and research in Lebanon, the US leads the world in production of autism research (OARC 2012). A number of well-funded and powerful autism organizations, such as *Autism Speaks*, spearhead ASD awareness campaigns in the US. In addition, the government is required to provide appropriate services to all school children with disabilities under the Individuals with Disabilities Education Act (IDEA). Nevertheless, striking disparities in access to support and identification of ASD are apparent in the US with fewer resources available to individuals of lower socioeconomic status and a paucity of supports for adults with ASD, who are no longer eligible for services under the IDEA (Durkin et al. 2010; Johnson and Levine 2014). In addition to the relative absence of services for adults with ASD, awareness campaigns often focus on young children with ASD and thus may contribute to the misconception that ASD is a childhood disorder (Sarrett 2011).

Despite relatively plentiful ASD resources in the US compared to developing countries such as Lebanon, misconceptions and stigma continue to exist in the US. Campbell and colleagues conducted a series of studies examining ASD knowledge and stigma among schoolchildren in the US

(Campbell and Barger 2014). The children exhibited more negative attitudes and behavioral intentions (or reduced desire to interact) toward children with ASD relative to neurotypical children. Girls reported less stigmatizing attitudes toward peers with ASD than boys, although gender differences in stigma were not consistently observed. Qualitative coding of middle school students' open-ended definitions of autism revealed that the majority (71.3 %) provided "accurate definitions" (Campbell et al. 2011). However, few "accurate" responses identified core difficulties associated with autism. In addition, some responses that the authors classified as "accurate" may instead be evidence of confusing autism with other disorders, such as "when a person or child cannot comprehend or think correctly…" (p. 384).

Misconceptions about autism have also been observed among adults in the US. A large-scale survey of residents of Utah revealed misconceptions about autism etiology, diagnosis and treatment (Holt and Christensen 2013). Similarly, health care providers erroneously indicated that autistic people do not show attachments and that autism *occurs* more frequently among people of higher socioeconomic status (Heidgerken et al. 2005). Although ASD is *diagnosed* more frequently among people of higher socioeconomic status in the US, this is likely largely attributable to greater access to health care among the wealthy in the US (Durkin et al. 2010).

A series of recent studies have assessed knowledge and stigma associated with ASD among college students in the US. This emerging line of research reflects recognition that increasing numbers of individuals on the spectrum may be entering college (Gelbar et al. 2014; Van Bergeijk, Klin and Volkmar 2008). White et al. (2011) suggested that between .7 and 1.9 % of college students in the US might have ASD. However, very few ASD-specific services are available on college campuses (Barnhill 2014), which may contribute to lack of understanding towards college students on the spectrum (Gelbar et al. 2014). Fleischer (2012) noted that college students on the spectrum often become targets of stigma and bullying. Among college students, heightened acceptance of individuals with ASD is associated with greater knowledge of ASD and more encounters with individuals with ASD (Mahoney 2008).

In the first peer-reviewed study to assess conceptions of autism among college students in the US, 685 students read a vignette describing a college student with characteristics (but not the label) of mild autism and then completed a self-report measure of openness towards the individual in the vignette (Nevill and White 2011). Students with a first-degree relative on the spectrum reported more openness than their counterparts, with no overall gender differences in openness. This finding is surprising given that females often (e.g. Campbell and Barger 2014; Chambres et al. 2008), but not always (e.g. Swaim and Morgan 2001), exhibit more accepting attitudes toward their peers with autism than males. No overall differences in openness were observed between students with high or low autistic symptoms, as assessed by the Autism Spectrum Quotient (AQ; Baron-Cohen et al. 2001).

Tipton and Blacher (2014) used an anonymous online version of the Autism Awareness Survey to examine knowledge associated with ASD among 1057 members of a college community. They found that college communities are knowledgeable about some aspects of autism; the average score on the survey was indicative of more correct than incorrect responses. However, misconceptions (such as that autism is caused by vaccines) remained common. Women and participants with autism in the immediate family had slightly higher knowledge than others.

Gardiner and Iarocci (2014) used a survey and associated vignette to examine associations between autism knowledge and openness towards people with ASD among 202 college students. While statistical analyses concerning autism knowledge were not reported, the authors stated that participants were generally quite knowledgeable about ASD. The quantity of previous contact with people with ASD (but not gender, autism traits, or autism knowledge) was associated with openness to ASD. Women, participants with social science and arts majors, and those who were more open to ASD were more willing to volunteer with people with ASD. Findings suggested that college students may be accepting of people on the spectrum in terms of distant relationships, such as living in the same building, but that 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 using social distance scales wherein participants are asked how willing they are to engage with a type of person at varying levels of intimacy (Bogardus 1933), these findings suggest that college students may hold stigmatizing attitudes toward peers with ASD. Indeed, when college students were given a social distance scale after reading a vignette about an adult (albeit not a college student), their responses suggested that they held stigmatizing attitudes toward characteristics associated with ASD (Butler and Gillis 2011). Students endorsed greater social distance towards the character in the vignette when he exhibited autism symptoms.

These findings suggest that trainings to increase knowledge and decrease stigma associated with ASD among college students are needed. To address this need, Gillespie-Lynch et al. (2015) used a pre-test post-test design to evaluate an online ASD training. Mirroring Tipton and Blacher's (2014) findings, 365 US college students indicated more correct than incorrect answers on the Autism Awareness Survey at pre-test. However, their open-ended definitions of ASD often included misconceptions. Women endorsed lower stigma relative to men. Participation in the training was associated with decreased stigma and increased knowledge of ASD. The current study builds on this study by examining knowledge and stigma associated with ASD in two cultural groups and by testing the effectiveness of the ASD training in a non-Western context.

Aims and Hypotheses of the Current Study

The aims of the current study were: (1) to examine predictors of ASD knowledge and stigma among college students in the US and Lebanon, (2) to compare knowledge and stigma associated with ASD among students in the US and Lebanon, and (3) to evaluate the cross-cultural effectiveness of an online training about ASD, which has the potential to be an accessible and low-cost method of increasing knowledge and reducing stigma associated with ASD.

Hypotheses for aim 1 We expected women and nuclear family members of people with ASD to exhibit more knowledge about, and lesser stigma towards, ASD in both countries (e.g., Campbell and Barger 2014; Chambres et al. 2008; Dillenburger et al. 2013; Gillespie-Lynch et al. 2015; Koyama et al. 2008; Tipton and Blacher 2014; Wang et al. 2012). Due to mixed findings in the literature (e.g., Gardiner and Iarocci (2014); Matthews et al. 2014; Nevill and White 2011), we had no hypotheses about potential associations between autistic traits and conceptions of ASD.

Hypotheses for aim 2 Given the scarcity of ASD services in Lebanon (Daou 2014; Hussein and Taha 2013) and higher stigma associated with the use of mental health services among individuals in the Middle East (Abdullah and Brown 2011), we expected knowledge about ASD to be lower and stigma associated with ASD to be higher prior to training among Lebanese students relative to US students. We expected Lebanese students to more often endorse outdated views about ASD, including attributing ASD to vaccines or negative parenting. Because members of individualistic societies may be more tolerant of idiosyncratic behavior than members of collectivist societies (Hwang and Charnley. 2010; Jegatheesan et al. 2010), we expected Lebanese students to more strongly endorse the view that it is important to help people with ASD appear normal. We expected Lebanese students to focus more on the social aspects of ASD in their open-ended definitions of ASD than US students as social aspects of autism may be more salient in more collectivistic countries where adaptation to prescribed social roles is favored (Grinker and Cho 2013).

Hypotheses for aim 3 We expected to replicate our prior research documenting increases in knowledge and decreases in stigma following participation in the online ASD training in a different sample of college students in the US (Gillespie-Lynch et al. 2015) among the current sample of college students in the US and in Lebanon.

Method

Participants

Students in the US were recruited from a large urban public university. An advertisement was posted on a Psychology Department subject pool website inviting students to enroll in the study to satisfy research participation requirements for Introduction to Psychology courses or to earn extra credit in other psychology courses. Lebanese undergraduates were recruited from a private university where English is the language of instruction; participation was offered as one of several extra credit options for students registered in Introduction to Psychology courses. Introduction to Psychology courses fulfill a general education requirement at both universities and attract students from a diverse range of majors. Fewer than 15 % of all participants were declared psychology majors. At both universities, the IRBs required participants to be 18 years of age or older. All data collected were anonymous. At recruitment, participants were given a link to access the survey on SurveyMonkey, where they first provided informed consent.

A total of 948 undergraduates participated in the online training (US: $N = 561$, 61.1 % female, $M = 20.3$ years, $SD = 4.1$; Lebanon: $N = 387$, 63.5 % female, $M = 18.8$ years, $SD = 2.3$). However, there were significant differences in age between these samples, $p < .001$. It was not possible to correct for this age difference analytically due to the high level of skew observed in the age variable. Therefore, the countries were matched on age ($p = .41$) by truncating both samples to include only participants who were 18 or 19 years of age. The final age-matched sample that is described in the rest of this report consisted of 675 undergraduates (US: $N = 346$, 60.1 % female, $M = 18.4$ years, $SD = .50$; Lebanon: $N = 329$, 65.4 % female, $M = 18.4$ years, $SD = .49$; see Table 1 for participant characteristics). It is important to note that the pattern of significance was largely unchanged by truncating the samples to match them on age. Any changes in the significance of the results that were obtained with the age-matched sample when compared to the original sample are indicated with footnotes.

Measures and Design

The study employed a quasi-experimental research design. Participants completed a demographics questionnaire followed by a set of questions examining knowledge and

Table 1 Participant characteristics of age-matched samples from the US and Lebanon

	US ($N = 346$)	Lebanon ($N = 329$)	p value
Age	18.4 (.50)	18.4 (.49)	.41
Average BAPQ scores	2.76 (.03)	2.72 (.04)	.48
% Male	39.9 %	34.6 %	.18
Age of exposure to English			
0–2 Years	73.3 %	26.2 %	<.001
3–7 Years	26.2 %	54.3 %	
8 and above	4.6 %	19.5 %	
ASD relationships			
Self	2.0 %	1.2 %	.56
Nuclear family	4.4 %	2.7 %	.55
Extended family	27.9 %	15.5 %	<.001
Friend	27.3 %	19.8 %	.02
Acquaintance	36.3 %	30.4 %	.12
Fellow student	22.1 %	9.7 %	<.001
Co-worker	4.7 %	0.3 %	<.001
My student	4.4 %	4.3 %	1.00

Continuous variables such as age and BABQ scores are reported as means (standard errors) while all other variables are reported as percentages

BAPQ broad autism phenotype questionnaire

attitudes about ASD, an adapted version of the Social Distance Scale (Bogardus 1933), and an adapted version of the Autism Awareness Survey (Stone 1987). Participants then completed an online PowerPoint training about ASD (Gillespie-Lynch et al. 2015), followed by a set of questions and surveys identical to the pre-test. At the end of the study, participants completed the Broad Autism Phenotype Questionnaire (Hurley et al. 2007). Participation in the study lasted approximately 1 h.

Demographics Questionnaire

The demographics questionnaire asked participants to report their age, gender, education level, major, and personal experiences with ASD, which 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.”

Conceptions of ASD

Participants were asked a series of researcher-developed open-ended and closed-ended questions examining their knowledge and attitudes toward ASD (see Appendix A). Open-ended responses to the question “What are autism spectrum disorders in your own words?” were coded into non-mutually exclusive categories by noting whether participants accurately identified symptoms associated with the DSM-5 criteria for ASD (American Psychiatric Association APA 2013); additional response categories were adapted from previously developed coding schemes (e.g. Campbell et al. 2011; Gillespie-Lynch et al. 2015). Appendix B provides the coding scheme with examples. The first and third authors independently coded 20 % of the pre-test and post-test data in the US and Lebanese samples. Agreement on all coding categories was 91 % or higher (range 91–100 %).

Autism Awareness Survey

To examine knowledge associated with ASD, we adapted the Autism Awareness Survey (Heidgerken et al. 2005; Stone 1987) with 10 items from the original scale and three new items (Gillespie-Lynch et al. 2015, see Appendix C). Items were scored on a 5-point Likert-type scale, ranging from -2 to $+2$, with higher scores indicating more knowledge. Scores were summed to create a total knowledge score that could range from -26 to 26. This version of the Autism Awareness Survey showed moderate internal consistency $\alpha = .62$ (US: $\alpha = .59$; Lebanon: $\alpha = .61$).

Social Distance Scale

To examine stigma towards ASD, we used an adapted version of the Social Distance Scale (Bogardus 1933; Gillespie-Lynch et al. 2015) consisting of a series of questions about participants’ willingness to engage with people with autism at varying levels of intimacy ranging from spending an evening with to marrying a person. Responses were scored on a 4-point Likert-type scale with 1 being “definitely willing” and 4 being “definitely unwilling.” Scores were summed to create a total stigma score that ranged from 6 to 24, with higher scores pertaining to higher stigma levels. The internal consistency of the Social Distance Scale used in the current study was $\alpha = .86$ for the total sample (US: $\alpha = .87$; Lebanon: $\alpha = .81$).

Broad Autism Phenotype Questionnaire

The Broad Autism Phenotype Questionnaire (BAPQ) is a 36-item self-report measure of characteristics associated with the broader autism phenotype, or subclinical characteristics of autism (Hurley et al. 2007). The BAPQ measures autistic traits in three domains, aloofness (e.g., “I prefer to be alone”), rigidity (e.g., “I am flexible about how things should be done”), and pragmatic language (e.g., “I have been told that I talk too much about certain topics”). Scores were averaged across items to create a total score, with higher scores indicating that participants self-reported heightened autistic traits. The internal consistency of the BAPQ for the total sample was $\alpha = .88$ (US: $\alpha = .87$; Lebanon: $\alpha = .90$).

Autism Training

The ASD training consisted of a 75-slide PowerPoint slideshow presented between the pre-test and post-test (Gillespie-Lynch et al. 2015). Participants were able to move through the slides at their own pace; periodically they were required to answer a comprehension question to progress to the next slide. Topics covered (in order) were: (1) introduction to diagnostic manuals (the DSM and the ICD), (2) explanation that there is only one ASD with varying degrees of severity according to the DSM-5, (3) outline of changes in the diagnostic criteria for ASD between the DSM-IV and the DSM-5, (4) early signs of ASD, (5) information about diagnostic assessments, including that ASD can not currently be diagnosed with blood tests or brain scans, (6) factors contributing to increasing prevalence rates such as changes in diagnostic criteria and awareness, (7) disparities in ASD diagnosis as a function of gender, ethnicity and socio-economic status, (8) cultural factors influencing rates of diagnosis, (9) difficulties and strengths that are often observed in individuals with ASD, (10) presence of autistic traits in the general population, (11) heightened autistic traits among scientists and other systematic thinkers, (12) the orthogonality of intelligence and ASD, (13) possible causes of ASD, such as interactions between multiple genetic (including de novo mutations) and environmental factors, (14) common myths about ASD, such as that negative parenting or vaccines cause autism and that people with autism lack empathy, (15) challenges faced by adults with ASD, (16) effective ways to teach people with ASD, (17) introduction to neurodiversity, or the view that autism is a valuable aspect of human diversity that should be respected rather than cured, and (18) what the future may hold for people with ASD, including that they are attending college, entering the workforce, and playing a role in research.

Analytic Plan

Descriptive analysis of the data indicated that a number of variables exhibited excessive kurtosis and/or skew. Researchers remain divided about the appropriateness of commonly used parametric tests (such as ANOVAs) for data that is not normally distributed and Likert scale data more generally. Jamieson (2004) asserted that Likert scales reflect an ordinal scale of measurement because one cannot assume that the differences between rating options are equidistant from one another. Norman (2010) replied that parametric tests are highly robust and will generate accurate conclusions even when used with highly skewed Likert scale data. Norman argued that summed items on a Likert scale (“consisting of sums across many items,” p. 629) lie on an interval scale. However, sums of small numbers of items (like our stigma measure) and/or scales with fairly low internal consistency (like our autism knowledge measure) are *not* consistent with an interval scale of measurement and remain on an ordinal scale (Wigley 2013). In addition, while commonly used parametric tests may be robust in terms of Type I errors, Type II errors may be greatly increased when researchers use parametric tests despite non-normality in their data (Fayers 2011).

Guided by the aforementioned methodological literature, we used non-parametric tests to analyze summed scores on the Autism Awareness Survey and the Social Distance Scale. Spearman’s correlations were conducted to examine associations between variables, while Mann–Whitney tests were used to compare differences across countries. Wilcoxon signed-ranks tests were used to examine changes between pre-test and post-test on the knowledge and stigma scales within each country. Parametric replications of key non-parametric analyses are available in Appendix D to demonstrate that findings remain consistent when gender is controlled for.

We used ordinal logistic regression, with country and gender as predictors, to examine scores on individual items of these scales. Binary variables were analyzed using Binary Logistic Regression with country and gender as predictors. Gender differences are only indicated when significant. Data were analyzed using SPSS version 22.

Due to the large number of statistical comparisons, a Bonferroni correction was calculated and a conservative *p* value of .001 was used.

Results

All participants completed the pre-test. Although completion rates at post-test were high, the percentage of US students (91.3 %) completing the post-test was significantly higher than the percentage of Lebanese students who completed the post-test (80.5 %), $\chi^2 = 16.36$, $p < .001$.

Demographic Characteristics

Table 1 provides comparisons of the demographic characteristics of the age-matched samples with associated *p* values. Compared to Lebanese students, US students more often reported having an extended family member, a coworker, or a fellow student with ASD.[1] Participants in Lebanon were first exposed to English later than participants in the US. No differences across countries in overall BAPQ scores were observed. Average BAPQ scores in the US ($M = 2.76$) and Lebanon ($M = 2.72$) were highly similar to those reported for participants who did not have a relative on the autism spectrum in the original BAPQ publication ($M = 2.74$; Hurley et al. 2007).

Predictors of Baseline Knowledge and Stigma

Contrary to our hypothesis, men and women did not differ in baseline knowledge on the Autism Awareness Survey in either country (US: men: $M = 7.10$, $SE = .55$, women: $M = 7.30$, $SE = .40$, $Z = -.49$ $p = .62$; Lebanon: men: $M = 4.42$, $SE = .54$, women: $M = 4.52$, $SE = .48$; $Z = -.09$ $p = .92$). However, women did endorse significantly lower stigma in the US and marginally lower stigma in Lebanon relative to men (US: men ($M = 12.49$, $SE = .35$), women ($M = 10.69$, $SE = .28$), $Z = -4.27$ $p < .001$, $r = .23$; Lebanon: men ($M = 13.57$, $SE = .32$), women ($M = 12.54$, $SE = .25$), $Z = -2.38$, $p = .02$, $r = .14$.

Also contrary to our prediction, having a nuclear family member with ASD was not associated with knowledge or stigma in either country. Nor were significant associations observed between having an extended family member on the spectrum and stigma or knowledge (*ps* ≥ .02). These null results may be due to the small number of participants in both countries who indicated that they had family members with ASD.

We did not have specific hypotheses about associations between autistic traits (BAPQ scores) and knowledge and stigma due to inconsistencies in the literature. Among US students, we observed a negative correlation between autistic traits and knowledge, r_s (312) $= -.25$, $p < .001$, and a positive correlation between autistic traits and stigma, r_s (312) $= .23$, $p < .001$. Among Lebanese students, autistic traits were unrelated to knowledge or stigma, *ps* ≥ .60. In the US sample, higher scores on the Autism Awareness Survey were associated with lower scores on the Social Distance Scale, r_s (330) $= -.23$, $p < .001$. However, no association was found between knowledge and stigma for Lebanese participants, $p = .04$.

Comparing Baseline Knowledge and Stigma in Lebanon and the US

Conceptions of ASD

Ordinal logistic regressions were used to examine item responses.[2] In all ordinal and binary logistic regressions, the reference categories for country and gender were Lebanon and male, respectively. Lebanese and US students did not differ in the perceived importance of finding a cause, $p = .70$, or a cure for ASD, $p = .39$. Lebanese students showed a trend toward being more likely to value the importance of helping people with autism appear more normal relative to students from the US (OR .62, CI .45–.85, $p = .003$).[3]

Consistent with our prediction, binary logistic regressions revealed that Lebanese students were more likely to indicate that ASD is caused by negative parenting (OR .18, CI .09–.31, $p < .001$) than US students. However, Lebanese students were *not* more likely to indicate that vaccines cause ASD, $p = .82$. Although we did not have hypotheses about beliefs about other etiologies, it is important to note that no differences were found between students in the US and Lebanon in terms of inherited or de novo genetic contributions to ASD or environmental causes *ps* ≥ .11. Counter to our hypotheses, Lebanese students were more likely to *correctly* indicate that ASD is diagnosed more often in wealthier and more educated families living in countries where richer people have better access to

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[1] In the full non-age-matched sample, US students more often reported having a friend with ASD compared to Lebanese students, $p = .001$.

[2] All statistical analyses were tested for assumptions. The following variables did not meet the proportional odds assumption of ordinal regression: importance of helping people with autism appear more normal, children with autism show attachment, and children with autism can grow up to go to college and marry. However, this assumption is violated fairly frequently (Long and Freese 2006) and similar patterns of significance were observed with non-parametric analyses.

[3] This finding was also not significant ($p = .04$) in the larger sample that was not age-matched.

Table 2 Binary logistic regressions of baseline open-ended definitions of ASD

Code	Standardized odds ratio (95 % CI)	p value
1. Social-communication difficulties	.41 (.30–.57)	<.001
2. Restricted interests/repetitive behaviors	.49 (.21–1.13)	.09
Sensory	.44 (.04–4.93)	.51
3. Disability or deficit	1.14 (.83–1.56)	.41
Not normal	.72 (.39–1.34)	.30
Dependent	1.86 (.78–4.42)	.16
4. Spectrum	1.27 (.74–2.18)	.38
5. Developmental	.56 (.32–.98)	.04
6. Child specific	2.31 (.99–5.32)	.05
7. Etiology	.84 (.55–1.29)	.42
Brain related	.71 (.45–1.13)	.15
8. Language difficulties	1.93 (.78–4.81)	.16
9. Lack of social interest/emotion	.15 (.07–.32)	<.001
Anxious/quiet	.29 (.06–1.45)	.13
10. Self-regulation difficulties	1.38 (.23–8.32)	.72
11. Systematic thinking	1.38 (.23–8.32)	.27
12. Confusion with other disorders	2.21 (1.43–3.41)	<.001
13. Cognitive difficulties	2.15 (1.20–3.83)	.01
14. Don't know	3. 49 (1.80–6.76)	<.001

Lebanon is the reference category. Gender was included in all analyses

healthcare (OR .27, CI .18–.40, $p < .001$). When asked how many ASDs there are in the DSM-5, Lebanese students were more likely than US students (OR .53, CI .36–.78, $p = .001$) to *correctly* state that there is one ASD in the DSM-5.

Binary logistic regressions examining qualitative coding of students' open-ended definitions of ASD revealed that Lebanese students were more likely than US students to *correctly* define ASD in terms of social and communication deficits (see Table 2). However, Lebanese students were also more likely to *incorrectly* define ASD in terms of a lack of social interests and emotions. US students were more likely than Lebanese students to confuse ASD with other disorders, such as a learning disability or ADHD. It is noteworthy that US students were 3.49 times more likely to indicate that they don't know what ASD is, or how to define it in their own words, compared to Lebanese students.

Autism Awareness Survey Scores

Consistent with our hypothesis, US students ($M = 7.22$, $SE = .33$) exhibited more knowledge about ASD on the Autism Awareness Survey than Lebanese students at baseline ($M = 4.47$, $SE = .36$; $Z = -5.32$, $p < .001$, $r = .21$). Table 3 reports ordinal regression analyses comparing baseline scores between the US and Lebanese students on each item of the Autism Awareness Survey. Lebanese students more often viewed people with autism as deliberately uncooperative relative to US students. They were more likely to agree that people with autism are generally disinterested in making friends, and were less likely to agree that people with autism show affection. While they were less likely to endorse the statement that children with autism can grow up to go to college and marry, they were more likely to agree that with proper treatment, most children diagnosed with autism eventually outgrow it.[4]

Social Distance Scale Scores

Consistent with our hypothesis that stigma associated with ASD would be higher in Lebanon, Lebanese students ($M = 12.94$, $SE = .20$; $Z = -5.46$, $p < .001$, $r = .22$) endorsed higher rates of stigma than US students ($M = 11.41$, $SE = .23$). Table 4 reports ordinal regression analyses comparing baseline scores on each item of the Social Distance Scale, with lower stigma evident in the US relative to Lebanon for all items except "spend an evening with someone with autism".

Women endorsed lower stigma than men on all items of the Social Distance Scale, i.e., greater willingness to move next door to someone with autism (OR .42, CI .43–.78, $p < .001$), spend an evening with someone with autism (OR .54, CI .39–.74, $p < .001$), collaborate with someone with autism (OR .63, CI .47–.85, $p = .002$), befriend

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[4] In the full-sample, Lebanese students were also less likely to agree that ASD is a lifelong disability, $p < .001$.

Table 3 Ordinal logistic regression analyses of baseline scores on Autism awareness survey items in the US and Lebanon

	Strongly disagree (%)	Somewhat disagree (%)	Neither agree nor disagree (%)	Somewhat agree (%)	Strongly agree (%)	Standardized odds ratio (95 % CI)	*p* value
More frequent males							
US	9.8	12.1	**41.9**	18.2	13.3	.85 (.64–1.13)	.27
Lebanon	9.4	7.3	**38.9**	21.3	12.2		
Can go to college/marry							
US	2.6	3.5	13.0	21.7	**54.6**	2.81 (2.08–3.79)	<.001
Lebanon	2.1	8.2	16.7	**38.3**	23.7		
Can be diagnosed by 15 months							
US	4.6	6.1	**32.7**	32.4	19.7	1.31 (.99–1.74)	.06
Lebanon	8.5	10.9	22.5	**32.2**	14.9		
Show affection							
US	3.8	11.6	18.8	**30.9**	30.3	1.74 (1.31–2.32)	<.001
Lebanon	4.6	15.2	20.7	**34.3**	14.3		
Lifelong							
US	6.6	12.7	**31.2**	27.2	17.6	1.39 (1.05–1.84)	.02
Lebanon	8.5	17.3	**27.4**	23.1	12.8		
Have empathy							
US	5.2	8.1	**47.4**	23.1	11.6	.78 (.58–1.04)	.93
Lebanon	3.3	11.2	**32.2**	30.4	11.9		
Don't show attachments							
US	26.0	22.8	**28.3**	14.5	3.8	.75 (.56–.99)	.05
Lebanon	20.1	26.1	13.4	**20.7**	8.8		
Deliberatively uncooperative							
US	**29.2**	25.1	25.1	13.3	2.6	.54 (.41–.71)	<.001
Lebanon	17.6	**23.4**	18.2	22.5	7.3		
One intervention for all							
US	29.5	15.9	**33.5**	9.8	6.6	1.18 (.88–1.56)	.27
Lebanon	24.3	23.7	**31.3**	7.3	2.4		
Proper treatment outgrow							
US	18.2	22.3	**34.1**	15.6	5.2	.47 (.35–.63)	<.001
Lebanon	7.6	18.5	**25.5**	31.3	6.1		
Most low IQ							
US	**46.5**	21.4	21.1	5.5	0.9	.82 (.61–1.10)	.18
Lebanon	**40.1**	21.6	16.4	8.2	2.7		
Violent Tendencies							
US	14.2	22.3	**34.4**	21.4	3.2	1.17 (.88–1.55)	.28
Lebanon	15.5	24.6	**24.9**	21.3	2.7		
Disinterested friends							
US	18.8	22.3	**28.6**	19.7	6.1		
Lebanon	7.6	15.5	17.0	**32.2**	16.7	.36 (.27–.48)	<.001

Percentages indicate the proportion of respondents who endorsed each response. Modal responses for each item within each sample are in bold. Lebanon is the reference category for odds ratios. Gender was included in all analyses. The names of items for which the correct response was disagreement are bolded. Odds ratios and percentages reflect responses to these items prior to reverse scoring them to obtain the overall Autism Awareness Survey score

someone with autism (OR .59, CI .44–.81, $p = .001$), have someone with autism marry into one's family (OR .58, CI .43–.77, $p < .001$), and marry someone with autism oneself (OR .61, CI .45–.81, $p = .001$).

Change in Knowledge and Stigma

A Wilcoxon Signed Ranks Test was conducted to examine whether knowledge increased following the ASD training

Table 4 Ordinal logistic regression analyses of baseline scores on social distance scale items in the US and Lebanon

Willingness to engage with someone with autism in the following ways	Definitely willing (%)	Somewhat willing (%)	Somewhat unwilling (%)	Definitely uum umnnwilling (%)	Standardized odds ratio (95 % CI)	*p* value
Move next door						
US	**47.4**	35.5	10.1	3.5	.61 (.46–.79)	.001
Lebanon	31.3	**45.0**	12.5	2.1		
Spend an evening						
US	**46.2**	36.4	9.8	4.0	.94 (.70–1.26)	.66
Lebanon	**41.9**	35.0	12.2	1.8%		
Collaborate with						
US	**38.4**	38.2	15.9	4.0	.58 (.44–.79)	<.001
Lebanon	26.4	**34.7**	25.8	4.0		
Befriend						
US	**55.2**	30.6	6.9	3.8	.57 (.42–.77)	<.001
Lebanon	**38.9**	36.5	11.9	3.6		
Have marry into family						
US	**37.3**	35.5	15.3	8.4	.28 (.20–.37)	<.001
Lebanon	11.2	29.8	**38.0**	11.9		
Marry/date oneself						
US	13.6	28.3	**33.5**	21.1	.52 (.39–.70)	<.001
Lebanon	7.0	15.8	**41.0**	27.1		

Percentages indicate the proportion of respondents who endorsed each response. Modal responses for each item within each sample are in bold. Lebanon is the reference category for odds ratios. Gender was included in all analyses

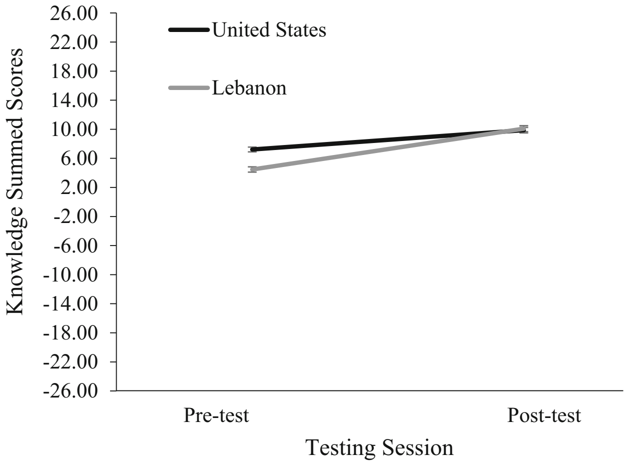

Fig. 1 Changes in knowledge with ASD training: pre-test and post-test scores on the Autism awareness survey

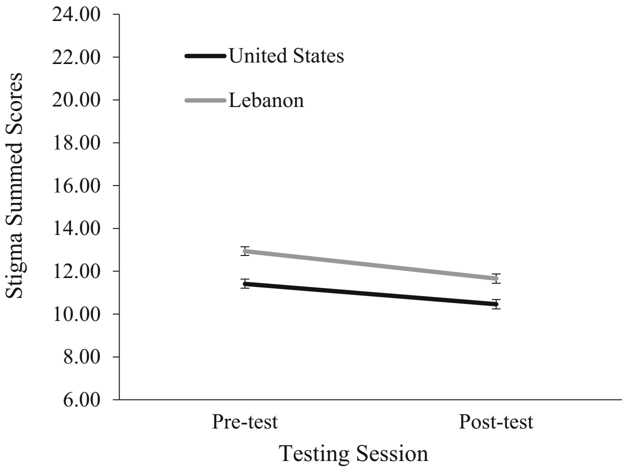

Fig. 2 Changes in stigma with ASD training: pretest and posttest scores on the Social distance scale

(see Appendix D for parametric analyses controlling for gender). As predicted, Autism Awareness Survey scores increased from pre-test to post-test for both US, $Z = -7.37$, $p < .001$, $r = .29$, and Lebanese students, $Z = -11.31$, $p < .001$, $r = .48$ (see Fig. 1). At post-test, there were no significant differences in knowledge scores between US ($M = 9.88$, $SE = .38$) and Lebanese students ($M = 10.08$, $SE = .41$; $Z = -.62$, $p = .53$).

Identical analyses were conducted to examine whether participation in the training was associated with decreased stigma across countries (see Appendix D for parametric analyses controlling for gender). Stigma was significantly lower at post-test relative to pre-test for both US, $Z = -6.74$, $p < .001$, $r = .26$, and Lebanese participants, $Z = -7.80$, $p < .001$, $r = .33$, as shown in Fig. 2. At post-test, stigma remained lower among US students ($M = 10.46$, $SE = .22$)

compared to Lebanese students ($M = 11.65$, $SE = .22$; $Z = -4.47$, $p < .001$, $r = .48$).

Discussion

While the current findings generally supported our hypotheses that knowledge about ASD would be higher and stigma associated with ASD would be lower among college students in the US relative to students in Lebanon, some aspects of ASD were better understood in Lebanon than in the US. In addition, variability in knowledge and stigma was apparent in each country. Comparisons of characteristics associated with knowledge and stigma in each country provides insights into factors that may contribute to within and between country variability in attitudes towards ASD.

Predictors of Baseline Knowledge and Stigma in the US and Lebanon

In contrast to previous research documenting greater ASD knowledge among females (e.g. Dillenburger et al. 2013; Koyama et al. 2008; Tipton and Blacher 2014; Wang et al. 2012), gender was not associated with ASD knowledge at baseline testing in either country. Recruitment of participants who were just beginning their college education may have reduced opportunities for gender differences in educational and professional trajectories to influence ASD knowledge in the current study. Our findings showed that women endorsed lower stigma towards individuals with ASD in both the US and Lebanon, although this effect was only marginally significant in Lebanon. This finding was consistent with previous research, which suggests that girls and women often (e.g. Campbell 2007; Campbell and Barger 2014; Chambres et al. 2008, Gillespie-Lynch et al. 2015) endorse less stigmatizing attitudes towards people with ASD. These findings contrast with two prior studies that did not reveal reduced stigma among female college students. Butler and Gillis (2011) did not observe gender differences in stigma towards ASD. However, their sample was 80.4 % female. Matthews et al. (2014) reported that male college students endorsed more positive affective and behavioral attitudes towards characters with autistic traits and labels in vignettes. However, men may have been more accepting of the characters in the vignettes than women because all of the characters had stereotypically male names. Future research should examine the extent to which lower stigma towards ASD among females is attributable to potential gender differences in susceptibility to social desirability or empathy (Eisenberg and Lennon 1983).

Based on research showing that those with a close family member on the spectrum may be more knowledgeable about ASD (Tipton and Blacher 2014) and have lower stigma towards ASD (Gillespie-Lynch et al. 2015), we expected nuclear family members of individuals with ASD to report higher knowledge and lower stigma towards ASD in both countries. However, no relationships between knowledge or stigma and having a nuclear family member with ASD were observed. These null effects may be due to the small number of students who reported having a nuclear family member with ASD (US: 4.4 %; Lebanon: 2.7 %). In contrast, a larger number of individuals reported having an extended family member with ASD (US: 27.9 %; Lebanon: 15.5 %). Nevertheless, no relationship between having an extended family member on the spectrum and knowledge or stigma towards ASD was observed in either country. These null effects may have arisen because some extended family members may hold stigmatizing attitudes toward their relatives on the spectrum (e.g. Gray 1993) while others may not.

Consistent with some prior research (Ling et al. 2010; Mahoney 2008, but inconsistent with Butler and Gillis 2011), heightened autism knowledge was associated with lower stigma in the US. However, no associations between knowledge and stigma were observed in Lebanon. Similarly, heightened autistic traits were associated with lower knowledge and higher stigma towards ASD in the US, while no associations between autistic traits and knowledge or stigma were apparent in Lebanon. Associations between autistic traits, knowledge and stigma in the US, but not in Lebanon, suggest that cultural factors that were not assessed in the current study may contribute to stigma towards ASD. One cultural factor that could affect stigma towards ASD in Lebanon is variability in collectivist value orientations. Variation in collectivism and individualism may be common in Lebanon (Ayyash-Abdo 2001) and greater collectivism may be associated with heightened stigma towards mental illness (Papadopoulos et al. 2013).

Comparing Baseline Knowledge and Stigma in Lebanon and the US

As a result of the scarcity of ASD-related services (Daou 2014) and the stigma associated with using disability services in Lebanon (Nagata 2008), we expected college students in Lebanon to exhibit less knowledge and more stigma towards ASD than college students in the US. In line with this hypothesis, Lebanese students were found to have lower levels of knowledge, as measured by the Autism Awareness Survey, than US students. Students in Lebanon were more likely than students in the US to endorse some common misconceptions, including that individuals with ASD lack interest in social interaction and are deliberately uncooperative. US students were more likely than Lebanese students to correctly agree that ASD is a lifelong disorder and that individuals with ASD can grow up to attend college and get married. These findings expand upon prior research documenting misconceptions about ASD in the Middle East (Saudi Arabia: Alqahtani 2012) and developing countries (Nepal: Kharti et al. 2011; Nigeria: Bakare et al. 2009; Pakistan: Imran et al. 2011) by demonstrating that knowledge is *lower* in a country with reduced access to ASD resources relative to a country with greater access.

Despite the general pattern of cross-cultural disparities in knowledge about ASD that the current study revealed, specific misconceptions about ASD were *more common* in the US relative to Lebanon. Consistent with reports that appropriate care for those on the spectrum in Arab countries may often be prohibitively expensive (Taha and Hussein 2014) and evidence suggesting that people with autism often go undiagnosed in the Middle East (e.g. Eapen et al. 2007), Lebanese students exhibited *greater awareness* of the contributions of socioeconomic disparity to access to ASD diagnoses. Lebanese students were also *more likely* to correctly indicate that there is one ASD in the DSM-5. Given lower overall knowledge among Lebanese relative to US students, it is possible that Lebanese students may not have been aware of the different types of ASD in the DSM-IV and just assumed it is, and always has been, one disorder. However, Lebanese students were also *more accurate* in reporting that individuals with ASD show social-communicative difficulties in their open-ended definitions of ASD. Lebanese students were also *less likely* than US students to confuse ASD with other disorders, such as learning disabilities.

Together, these findings support our hypothesis that the social aspects of ASD may be more salient in more collectivistic than individualistic countries, and are consistent with findings from another primarily collectivistic country, South Korea, wherein mothers of children with ASD emphasized the distinction between social symptoms of autism and intellectual disabilities (Grinker and Cho 2013). Lebanese students were also more likely than US students to mistakenly indicate that people with autism are disinterested in social interaction in their open-ended definitions of ASD. Also consistent with viewpoints about ASD documented in South Korea, Lebanese students were more likely than US students to view ASD as a transitory state and to indicate that ASD arises from negative parenting. In contrast, students in the US and Lebanon did not differ in the extent to which they endorsed the view that vaccines cause ASD.

This evidence that certain misconceptions about ASD are more common in the US while others are more common in Lebanon highlights the importance of gathering insights from people around the globe in order to truly understand autism. These findings align with research showing that people in more collectivist countries may define the self in terms of dynamic social interactions while people in more individualistic countries may more commonly define the self in terms of relatively permanent individual characteristics (e.g. Markus and Kitayama 1991). While students in Lebanon emphasized relational aspects of ASD by emphasizing its impacts on social interaction and by accurate and inaccurate endorsements of the influences of social interactions and structures on its emergence and identification, students from the US more often viewed ASD as lifelong and often included individual differences that are not specific to ASD, such as cognitive difficulties, in their definitions of ASD.

As hypothesized, Lebanese students reported higher stigma towards ASD than US students. Greater stigma was apparent in Lebanon for all items on the Social Distance Scale, except “spend an evening with someone with autism.” This item differs from other items on the scale in that it can be interpreted as involving the least amount of interaction (i.e., a single evening) with an individual with autism. Thus, Lebanese students may be more willing to engage with a person with ASD for a single evening as opposed to the more extended interaction involved in friendships and dating. The current findings extend upon prior research documenting stigma towards ASD in the Middle East (e.g., Turkey: Bilgin and Kucuk 2010) and other primarily collectivistic regions (e.g., South Korea: Grinker and Cho 2013; Hong Kong: Ling et al. 2010) by supporting Azar and Badr’s (2006) hypothesis that stigma may be *higher* in Lebanon relative to the US.

In contrast, our hypothesis concerning attitudes towards normalizing ASD was not supported, as Lebanese students were not significantly more likely to endorse the importance of helping people with autism to appear more normal. Nor did the groups differ in endorsing the importance of finding the cause or a cure for ASD. These null findings may arise from conflicting messages about ASD in the US, including information about organizations such as *Cure Autism Now* and the Neurodiversity Movement’s opposing stance that autism is a valuable aspect of human diversity that should not be cured (Kapp et al. 2013), in conjunction with a relative lack of media about ASD in Lebanon.

Change in Knowledge and Stigma

Our final aim was to determine if participation in an online ASD training was associated with improved attitudes towards ASD across cultures. Increases in knowledge and decreases in stigma in both Lebanon and the US following the online training replicate our prior work in a different sample of college students in the US (Gillespie-Lynch et al. 2015) and suggest that online training may be an effective way to improve knowledge and stigma associated with ASD internationally. Given that stigma remained higher in

Lebanon than the US even after the training, online training is likely an important *first step* toward improving attitudes towards ASD that should be followed up with in-person trainings, preferably including contact with people on the spectrum. Similarly, online assessments of conceptions of ASD should be followed up with in-person interviews with people who are directly affected by ASD to gain deeper insights about how autism is conceptualized in different countries. However, in-person trainings and interviews are more challenging to implement than online assessments; they require funding to support qualified personnel and to secure training spaces. In addition, the number of people who can participate simultaneously in in-person assessments is greatly limited relative to online assessments.

Limitations

The quasi-experimental design of the current study and the differences in attrition rates in the US and Lebanon suggest that our post-test data should be interpreted with caution. In future work, randomized assignment to the presence or absence of the online training (i.e. a true experimental design) is necessary to verify that the training is effective in altering conceptions of ASD. The lack of time between completion of the training and post-testing may have exaggerated effects of training. Future research should assess maintenance across time. Furthermore, the self-report nature of this study and the absence of assessments of social desirability make it highly likely that actual stigma levels were underestimated in the current study. Although the Social Distance Scale had high internal consistency, its lack of reverse-scored items did not allow us to identify random patterns of responding. In addition, the Autism Awareness Survey exhibited low internal consistency in this study and prior work (e.g. Campbell et al. 1996; Gillespie-Lynch et al. 2015). It is important to note that its internal consistency did not improve if the new items we developed were eliminated. Although BAPQ scores in the current study were highly similar to those reported in the original article about the BAPQ (Hurley et al. 2007), having participants complete the BAPQ after the autism training might have affected how they responded to the items on the scale.

Future cross-cultural research would benefit from assessing actual interactions with people on the spectrum before and after training and by including participants from a range of settings within each country. The convenience sample used in the current study of students at a private university in Lebanon and a public university in the US may have obscured some differences across countries. The students in Lebanon may have been more academically skilled relative to the students at the US institution, while the use of a survey administered in English may have disadvantaged Lebanese students even though they have participated in schooling in English from a young age. Reliance on college student participants in general, and on students enrolled in a specific type of course in particular, limits the generalizability of findings. Comparisons of attitudes towards ASD among people from a range of countries that vary in both cultural values and available resources for ASD will be essential for disentangling the impacts of cultural values and available resources on knowledge and stigma associated with ASD.

Conclusions

As the prevalence of ASD increases globally, more individuals who are on the spectrum may be attending college. For these students, community understanding about ASD may impact their academic success. This study represents the first comparison of cross-cultural differences in knowledge and stigma associated with ASD among college students. While students from a country with fewer ASD resources (Lebanon) reported less overall knowledge and higher stigma towards ASD at baseline than students from a country with relatively substantial ASD resources (the US), students from Lebanon were more knowledgeable about certain aspects of ASD, including disparities in access to care, than their counterparts in the US. These findings suggest that information about ASD is unequally distributed internationally and that people from different cultures can provide unique insights about ASD. Given that an online training about ASD was associated with increasing knowledge and decreasing stigma towards ASD in both countries, online training may be a cost-effective way to reduce misconceptions associated with ASD in countries with limited supports for individuals with ASD, as well as in countries where substantial supports exist but are unequally distributed.

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