A CROSS-CULTURAL STUDY OF AUTISTIC TRAITS IN THE GENERAL POPULATION

SAFIRA BINTI ABU BAKAR

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Abstract

This thesis aimed to explore cross-cultural differences in autistic traits in the Malaysian and British general populations. Freeth et al. (2013) found that Malaysian members of the general population tend to score higher on the Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, et al., 2001) compared to British members of the general population, however, it is unclear whether these findings could reflect genuine cognitive differences or whether these findings are the result of a cultural bias in the questionnaires used. For the current research, I looked at each cognitive behaviour described by the subscales of the AQ in isolation to investigate these findings in detail.

Chapter 2 focused on attention-switching on both self-reported measures (the AQ, the Social Responsiveness Scale and the Cognitive Flexibility Scale) and cognition through the use of switch tasks (the Wisconsin Card Sorting Task and the Gender-Emotion Switch Task). Chapter 3 investigated social skills and communication through Theory of Mind by looking at the AQ, an additional measure of culture, the Culture Orientation Scale, the Strange Stories Task and the Reading the Mind in the Eyes task. Chapter 4 explored imagination, as captured through creativity, through self-reported autism traits (AQ) in conjunction with tasks measuring creativity (the Alternative Uses Task and a metaphor generation task). Chapter 5 examined attention to detail by looking at autism traits (AQ) along with the use of a visual search task and a face composite task.

The overall findings of this study suggest that self-reported cultural differences in autism traits are partially reflected in cognition, particularly in the domains of attention-switching and social skills and communication. However, there are also strong indicators that the differences in self-reported autism traits between Malaysian and British members of the general population are partially the product of cultural biases embedded in the questionnaires and measures used.

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Table of Contents

List of Tables

List of Figures

Chapter 2: Attention-Switching.

Chapter 3: Social Skills and Communication.

Chapter 5: Attention to Detail.

Appendix E: Stimuli and Materials used on the Reading the Mind in the Eyes Task (RMET).

1. A Cross-Cultural Study of Autistic Traits in the General Population

1.1 Autism in Malaysia

An Autism Spectrum Condition (ASC), more commonly known as autism, is a pervasive developmental disorder characterised by difficulties with social communication and a tendency to have restricted interests and/or engage in repetitive behaviours (DSM-5; American Psychiatric Association [APA], 2013). As outlined by the diagnostic criteria, people with autism struggle to respond to social interactions, lack understanding of facial expressions, have repetitive motor movements, are inflexible with regards to routine and have hypo- or hyperactivity to sensory stimuli (DSM-5; APA, 2013). ASC is an umbrella term and those diagnosed may be mildly affected and need little support or heavily affected and needing a lot of support (APA, 2013). In this thesis, I use person-first language in line with guidelines set out by the American Psychiatric Association (i.e. people with ASCs or people with autism), however, I acknowledge that those with ASCs prefer identity-first language (i.e. autistic people).

The prevalence of ASCs has increased globally over the years, as observed in countries such as Sweden, France, Iceland, Japan, the US, Canada, Germany, Israel, and the UK (Elsabbagh et al., 2012; Matson & Kozlowski, 2011). Although there is no official registry in Malaysia, the last reported figures in 2008 reveal that one out of every 625 Malaysian children has an ASC (Azizan, 2008). Following the global trend pattern, it can be assumed that these prevalence rates have also increased in the last decade in Malaysia (Neik et al., 2014).

In Western countries, autism diagnosis can be made as early as between 3-4 years of age (Zwaigenbaum et al., 2009) and there are diagnostic tools available for children as young as 6 months old (Hiremath et al., 2021). However, in Malaysia, as there is a large disparity between the number of children who are registered with any disabilities in the Welfare Department and the number of children that remain undetected (Amar-Singh, 2008). There are many reasons as to why this disparity exists in Malaysia. Shortage of healthcare services, physician knowledge of ASCs, cost of health services, family and individual knowledge of ASCs, language barriers, and social stigma are common barriers for people with autism trying to access healthcare (Malik-Soni et al., 2021). Key barriers to achieving universal health coverage for children with autism in low- and middle-income countries include factors such as the social context and family experience, barriers to detection and diagnosis, access to appropriate evidence-based interventions and social policy and legislation (Divan et al., 2021).

Yet, it is important for individuals with autism to receive healthcare and support as they more commonly face other mental health issues, such as depression, ADHD and anxiety, and other medical conditions, such as immune deficiency conditions, gastrointestinal conditions and sleep disorders (Croen et al., 2015; Hand et al., 2020). Adults with autism have an increased risk of premature mortality, especially for those who are more severely impacted by their symptoms, compared to the general population (Hirvikoski et al., 2016). Up to 72% of people with autism experience suicidal ideation (Cassidy et al., 2018; Cassidy et al., 2014). Social misunderstandings between people with and without autism can lead to social isolation for people with autism (Mitchell et al., 2021). Those who face a lack of social support, lack of social acceptance, and feelings of loneliness are more likely to be depressed and experience suicidal ideation (Cage et al., 2018; Cassidy et al., 2018; Hedley, Uljarević, Foley, et al., 2018; Hedley, Uljarević, Wilmot, et al., 2017, 2018). Thus, it is critical that individuals with autism are not only able to access social and health support systems but that they also live in social groups that affirm, understand and include them.

In Malaysia, one of the major sources of support for children with autism are autism centres, which require diagnostic testing and charge class fees anywhere between RM356-600 (approximately GBP £61.75-104.08) per month, which would only allow middle- to high-income families access (Fikry & Hassan, 2016). This already excludes low-income families from accessing academic support for their family members with autism. The other major source of support is the “special needs” school system in Malaysia. However, factors such as narrow interpretation of ‘special needs’ and ‘inclusive education’ as well as competing priorities in the Malaysian education system have unfortunately actually led to exclusionary or even discriminatory implementation of policy instead (Jelas & Mohd Ali, 2014). In Malaysia, laymen knowledge identifies ASCs as a learning disability, unlike in the West, and lack knowledge on the other difficulties that individuals with autism face (Low et al., 2021). Malaysian university students were less willing to interact with people with autism compared to British students (de Vries et al., 2020). Non-science Malaysian university students showed a higher than average stigma towards individuals with autism and showed a larger lack of awareness about autism (Hashim et al., 2021). It is not, therefore, a stretch to argue that there is a huge lack of support and understanding for people with autism in Malaysia. These findings, above anything else, makes understanding autism and developing support for individuals with autism in Malaysia a priority, especially as prevalence rates increase in our population. An intimate understanding of ASCs in a Malaysian context is necessary for the adaptation and evolution of diagnostic tools and treatments used in Malaysia in order to meet the demand for support.

1.2 Issues with Autism Research in Malaysia

Much of the current research on autism in Malaysia focuses on interventions and the development of learning tools for children with autism (e.g. Neik et al., 2014; Roffeei et al., 2015; Shamsuddin et al., 2012). However, in a country such as Malaysia where there is a problem with diagnosis, potential differences in an undiagnosed, neurotypical (NT) population on standardised measures for ASCs must be examined to actually understand of how a diagnosed population with autism would perform on these measures as well (Freeth et al., 2013). In fact, standards of diagnosis vary between cultures for various reasons, including experience of the clinician and lack of research for individuals with autism within different cultures (Daley & Sigman, 2002; Samadi et al., 2012). This makes it difficult to ascertain much about how autism might express itself within the Malaysian population. The few individuals that do receive an official diagnosis can also participate in experimental research due to the severity of their symptoms, further making it difficult to investigate autism in Malaysia. It is further difficult to determine whether any observed differences in individuals with autism would be due to cultural differences or whether other factors (such as diagnostic criteria used and availability of diagnostic tools) can account for the difference (Zaroff & Uhm, 2012).

The use of Western diagnostic tools for autism traits have been studied in some parts of Asia. The use of the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005), for example, to measure autism traits in clinical and non-clinical populations, as well as the validity of its use as a screening tool, has been explored in Japan, China, Korea and Taiwan; psychometric properties in these Asian countries were similar to Western populations, and the SRS was suggested as a promising screening tool (Cheon et al., 2016; Gau et al., 2013; Kamio et al., 2013; Takei et al., 2014; Wang et al., 2012; Zhou et al., 2017).

However, to assume that Southeast Asian populations will function similarly to other Asian populations – or even that Chinese populations will behave similarly to Japanese populations – is an overgeneralisation and assumes homogeneity of cultural experiences within Asia. In the West, there are marked differences in autistic traits and diagnosis even within countries. Evidence suggests that there is cross-cultural variability in the applicability of the DSM-5 criteria to autistic samples between Western countries (Mandy et al., 2014). When comparing between South Korea, Israel, the UK and the US, children from the UK scored higher than all other groups on four measures of autism; nonverbal social communication/socialisation, verbal communication, social relationships, insistence on sameness/restricted interests, and the order of the groups that scored highest after that tended to differ between each measure (Matson et al., 2011). This suggests that even between Western countries there is cross-cultural variability on the expression and interpretation of ASC traits and criteria.

There is also variability *within* a single Western country. For example, white children tend to receive diagnosis before Black children in America (Mandell et al., 2002) and White children were more likely to receive diagnosis and documentation compared to children of other ethnic groups, such as Black and Hispanic children (Mandell et al., 2009). If findings differ so vastly even within a single Western country, the validity of treating findings involving specific East or South Asian populations as reflective of Asia as a whole – and specifically, Southeast Asia – must also be questioned. This is implied by the prevalence rates for autism, which are higher in East Asia compared to West Asia and South Asia (Qiu et al., 2020). The wider impact of the overgeneralisation of Asian findings on the autistic community in

Malaysia should also be considered, especially for the application of the current diagnostic tools used in Malaysia.

In fact, while autism prevalence estimates appear lower in Malaysia than in recent studies in the UK, Malaysians and Indians score higher on questionnaires measuring autism traits compared to general populations in the UK. Freeth et al. (2013) administered the Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, et al., 2001), a 50-item self-report questionnaire, to NT individuals in Malaysia, India and the UK and found that UK participants generally scored lower on the AQ compared to Malaysian and Indian participants, suggesting that Malaysian and Indian participants have more autistic traits (Freeth et al., 2013). The AQ has five subscales to represent the main categories of autistic traits; attention to detail, attention switching, social skills, communication and imagination (Baron-Cohen, Wheelwright, Skinner, et al., 2001). Focusing specifically on Malaysia in comparison to the UK, it was found that Malaysians scored higher on every subscale except for attention to detail, where there was no significant difference between the two groups (Freeth et al., 2013). This is important especially in a country like Malaysia where there is an underdiagnosed autistic population; establishing a baseline performance for the general NT population is necessary in order to understand potential differences in how individuals with autism would then perform on such measures in that context (Freeth et al. 2013).

On the one hand, self-reported measures may be culturally biased themselves. Studies in Japan estimate autism prevalence rates that were over three times higher than those in North American studies (Williams et al., 2006), although the likelihood of there really being more people with autism in Japan compared to elsewhere is quite low. Even if the differences as reported by Freeth et al. (2013) are only attributable to Malaysians tending to rate themselves higher on self-report measures, there are still important implications regarding the current diagnostic tools used in Malaysia.

On the other hand, NT Malaysians really *could* potentially exhibit higher autism traits because they *do* display a cognitive profile that resembles autism according to Western standards, rather than the findings simply being a result of cultural biases embedded in the questionnaires. If this were the case, it would be expected then that the findings of the current measures would be reflected in task performance and cognitive profiles as well as day-to-day behaviour. Indeed there is evidence of cross-cultural differences in cognition or behaviour between Asia and the West on constructs as measured with the subscales of the AQ. Populations that have to navigate multiple cultural demands, such as diasporic groups, can be expected to be better at attention-switching compared to those who do not (Harrison et al., 1990; Pope et al., 2019; Spiegler & Leyendecker, 2017). Moreover, Asians tend to process information globally compared to Westerners (McKone et al., 2010). Further differences have also been found in social communication styles and imagination between different cultures (Callaghan et al., 2005; Farver & Lee-Shin, 1997; Kasirer & Mashal, 2014; Selcuk et al., 2018; Shahaeian et al., 2011; Valanides et al., 2017; Zhang et al., 2016; Zheng et al., 2015).

The results of Freeth et al. (2013), if reflective of real cognitive differences beyond scores on self-reported measures, has several implications for current diagnostic tools in use in Malaysia. If NT Malaysians exhibit an autistic-like cognitive profile according to Western standards, one important implication is that the typical autistic profile is Western-centric and is not inclusive of cross-cultural variations in the presentation of ASCs. This, in turn, brings up important questions about whether the current tools used to diagnose ASCs in Malaysia are truly picking up on behavioural markers of autism or differences in cognition that are more attributable to culture.

This implication should also be carefully considered as these findings would impact theoretical interpretations of autism as a specific deficit or disorder by the wider academic community and clinicians. Some researchers argue that although the perspective of autism as a neurodivergence is important, especially to provide those with autism respect, inclusion and accommodation for their differences, this does not necessarily mean that autism is *not* a deficit or disorder that requires medical intervention (Hughes, 2020; Nelson, 2020). Other researchers emphasise the importance for practitioners and researchers to reframe the effectiveness of interventions to prioritise the person, develop tools to measure outcomes that are important to people with autism, and an increased emphasis in intervention programmes on coping strategies, autonomy, and well-being

(Leadbitter et al., 2021). If the findings of Freeth et al. (2013) are reflective of genuine cross-cultural differences in cognition linked to or influenced by Western-centric understanding of autism, this could have implications for the understanding of autism as neurodivergence rather than a disorder or a deficit.

Alternatively, if the results of Freeth et al. (2013) are not reflective of cognitive differences in the two populations, then questions arise regarding the applicability of the current tools used to diagnose ASCs in Malaysia, as well as the applicability of any future tools – such as the AQ – in Malaysia. If NT Malaysians indicate significantly higher autism traits than Western populations might, are the current cut-off scores in use in Malaysia (which are based off the UK scores) appropriate? Do NT Malaysians only score higher on self-reported measures of autism or on all questionnaires? Why are these differences in responses happening – and what impact does this have on the current tools in use?

The current research, therefore, proposes to study autism traits, as operationalised in the AQ, in the general Malaysian population with a series of experimental studies to unpack this issue. I want to study the autistic profile outlined by the AQ subscales by comparing experimental tasks capturing behavioural cognition to performance on self-reported measures commonly used to measure autism traits.

My aim is to investigate whether there are cultural differences in self-reported autistic traits and whether these cultural differences are then reflected in cultural differences in behaviours and cognitive profiles. I also want to explore the question of whether self-report questionnaires are more culturally biased compared to tasks, especially in a Malaysian context, to help re-evaluate the interpretations of self-reported measures in Malaysia.

1.3 Overview of the Current Research

In the next chapter (Chapter 2), I begin my investigation by exploring the AQ subscale of *attention-switching* traits, otherwise known as cognitive flexibility, as inflexibility is characteristic of the autistic profile. I examine whether self-reported cognitive flexibility reflects cognition across both population samples, and I also investigate whether self-reported findings are exclusive to the AQ or consistent between self-report measures.

Chapter 3 centres the AQ subscale of *social skills* and *communication* traits in the general populations of Malaysia and the UK, as social skills and social communication are characteristic aspects of the autistic profile. Here, I investigate whether self-reported social skills and communication abilities are reflected in behavioural measures in Malaysia and the UK.

Chapter 4 focuses exclusively on the *imagination* traits of the AQ subscale, which I operationalise as divergent thinking in creativity, where I probe whether self-reported imaginative capabilities are reflected in behavioural measures.

Chapter 5 directs my investigation to the *attention to detail* traits on the AQ subscale and whether self-reported traits are reflected in cognition.

Lastly, Chapter 6 concludes the central findings of these studies and discusses them with regards to the theoretical and practical implications of autism research within Malaysia.

2. Attention-Switching

The umbrella term executive function (EF) refers to a set of cognitive processes and competencies that include domains such as inhibition, working memory (WM), planning and attention-switching, otherwise known as cognitive flexibility (CF; Chan et al., 2008; Diamond, 2013). Children with autism may have deficits in specific domains of EF, such as CF (Willcutt et al., 2008), but such specific deficits have not been found consistently. Reviews of EF deficits in ASCs reported specific impairments in CF and planning (Craig et al., 2016; Wallace et al., 2016), though others reported difficulties in children with autism on all five major components of EF, i.e. inhibition, working memory (WM), planning, CF and verbal fluency (Corbett et al., 2009; Verte et al., 2005) which suggests an overall EF deficit (Lai et al., 2017), which is supported by a recent meta-analysis (Demetriou et al., 2018).

Although it is not a diagnostic criterion for ASCs, behaviours that are part of the diagnostic criteria in the DSM-5 (APA, 2013) appear to be related to cognitive inflexibility such as repetitive behaviours (Condy et al., 2019; South et al., 2007), inflexible adherence to routines, excessive resistance to change and rigid thinking patterns. Specifically, CF, as well as planning and inhibition in EF, have been found to relate the restrictive and repetitive symptoms of ASCs (Lopez et al., 2005).

CF difficulties can also be found in sub-clinical populations. Individuals with elevated levels of autism traits have been shown to exhibit EF difficulties that are similar but less severe than clinical populations compared to those with lower levels of autism traits (Gökçen et al., 2014), and score themselves as being less flexible (Albein-Urios et al., 2018). Older adults aged over 60 with subclinical symptoms of autism tend to show more EF difficulties, specifically on WM and CF compared to older adults who do not exhibit subclinical symptoms (Stewart et al., 2018).

However, the evidence for cognitive inflexibility difficulties in autism is derived from data collected almost exclusively from Western cultures. Therefore, extending these conclusions to non-Western cultures should be done with some caution. Moreover, culture may influence CF. Malaysians and Indians have been found to score higher on the AQ compared to UK participants (Freeth et al., 2013), including on the AQ subscale of attention-switching (i.e. CF). This suggests that UK participants are more cognitively flexible compared to Malaysian and Indian participants (Freeth et al., 2013), but there are other potential explanations that cannot be ruled out.

One possibility is that the findings of Freeth et al. (2013) of self-reported differences on the AQ are the result of Malaysians and Indians scoring themselves more severely compared to UK participants. However, as the AQ contains reverse-scored items, this does not seem likely. These findings could also be due to the AQ being developed in the West; the content of the items may be culturally biased towards Western environments and might not be reliable or applicable in non-Western countries such as Malaysia and India. However, as the AQ is a self-reported measure of autism traits, it is difficult to ascertain which of these explanations fit these findings as it is also unclear whether any differences in self-reported traits are reflected in cognitive ability.

Several studies have suggested that there might be real cultural differences in CF; people from a multicultural background tend to be more cognitively flexible. Himba adults – a tribe living in northern Namibia – were more likely to diverge from established rules compared to Western counterparts, suggesting they are more cognitively flexible (Pope et al., 2019). Children who grow up as an ethnic minority in America tend to be more flexible, arguably due to the need to navigate the demands of several different cultures (Harrison et al., 1990). Similarly, Turkish-German immigrant children who identified with both their Turkish and German cultural backgrounds were more cognitively flexible compared to Turkish-German children who identified with predominantly one cultural background, while there were no differences in other EFs such as WM or inhibition (Spiegler & Leyendecker, 2017). In adults, Asian-American college students who adhered more to European American cultural values perceived themselves as more cognitively flexible (Kim & Omizo, 2005). However, while these findings highlight the link between culture and CF, specifically addressing the idea that the needs of navigating multicultural environments result in greater CF ability, it is not clear how this could account for differences in AQ scores between British, Indian and Malaysian students which indicate *lower* CF in the Asian populations (Freeth et al., 2013).

Although the study by Freeth and colleagues suggests that Malaysians might be less flexible, other studies (Christmas & Barker, 2014; Harrison et al., 1990; Kim & Omizo, 2005) suggest that multicultural backgrounds might lead to better cognitive flexibility. Malaysia is a hugely multicultural society; around half the population is Malay and diasporic ethnic groups such as Chinese (23.7%) and Indians (7.1%) make up a large part of the population, while the rest (around 11%) are indigenous people (Noor & Leong, 2013). The navigation of cross-cultural demands is ubiquitous in Malaysian society. Malaysians could be expected to be more flexible than people from countries with a less diverse cultural make-up such as the UK. Moreover, as a result of the diasporic populations within Malaysia, they are also a highly multilingual society (Noor & Leong, 2013) which has been linked to better CF in previous studies as well (Bialystok et al., 2006; Bialystok & Viswanathan, 2009; Christoffels et al., 2015; Colzato et al., 2008; Pelham & Abrams, 2014; Poarch & van Hell, 2012).

To my knowledge, a direct comparison between Malaysian and British people with respect to CF has not yet been made. The aim of the current study, therefore, is to investigate CF in NT populations in two countries – Malaysia and the UK – by comparing objective and subjective CF as measured with cognitive tasks and questionnaires, and autism traits in a general population sample of British and Malaysian participants. I used the Wisconsin Card Sorting Task (WCST; Grant & Berg, 1948), a widely used measure of CF which has found robust differences between NT and ASC groups (Landry & Al-Taie, 2016), and the gender-emotion switch task (de Vries & Geurts, 2012). The AQ (Baron-Cohen, Wheelwright, Skinner, et al., 2001) and the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) were administered to measure autism traits. The SRS was used as an additional measure as it is one of the additional screening tools currently in-use in Malaysia (MaHTAS, 2014), and can help to ascertain whether findings with respect to differences between Malaysian and British (Freeth et al., 2013) are specific to the AQ. The Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995) was administered to measure subjective CF.

If differences on the AQ in Malaysia and the UK (Freeth et al., 2013) are reflected in cognitive functions, I would expect that Malaysians would score higher on the AQ and perform worse on the CF tasks compared to UK participants (hypothesis A). However, if the multi-cultural Malaysian society would lead to better CF, I would expect a pattern of performance where Malaysians self-report less cognitive flexibility but actually perform better on the tasks compared to UK participants, reflecting greater CF as suggested by previous literature (hypothesis B).

2.1 Methodology

2.1.2 Participants

A priori power analyses indicated that a total sample size of 118 would be sufficient to detect significant differences on an independent-samples t-test with a medium-to-large effect size (Cohen's d = 0.65), a power of 0.8 (following conventional recommendations to set power at 80%), and an alpha of .01 (to account for Bonferroni alpha corrections). We aimed to recruit 60 participants per group. 73 Malaysian participants were recruited from the University of Nottingham Malaysia. 17 participants were removed from further analyses; 11 participants were not Malaysian (e.g. Korean or Indian), 1 participant did not provide informed consent, and 5 did not complete all parts of the study. A total of 56 Malaysian participants were included in the analyses. 48 British participants were recruited from the University of Nottingham, UK and the University of Nottingham Malaysia. Data from 2 participants was incomplete and 2 participants were not British, hence were removed from the analyses, thus a total of 44 British participants were included in the analyses. Ethics approval was obtained from the University of Nottingham and the University of Nottingham, Malaysia for this study.

The Malaysian participants were aged between 18-29 years (M = 21.23, SD = 2.59), and of these participants 12 indicated they were male, and 44 indicated they were female. The Malaysian participants were mostly Malaysian Chinese (42 out of 56 participants), 8 were Malay, 4 were Malaysian Indian, 1 was Melanau and 1 Sungai. The British participants were aged between 18-27 (M = 19.95, SD = 2.35), and 7 participants indicated they were male while 37 indicated they were female. Most of the British participants were white (34 out of 44), whilst 5 indicated they were British Asian, 1 indicated they were Afro-European and 4 indicated they were Other or Mixed.

2.1.3 Stimuli and Materials

2.1.3.1 The Autism Quotient (AQ). This 50-item questionnaire measured autism traits and contained 5 subscales; attention to detail, attention switching, social skills, communication and imagination

(Baron-Cohen, Wheelwright, Skinner, et al., 2001). Test-retest reliability and interrater reliability of the AQ was shown to be good, $t(16) = 0.3$, $p = .75$ (Baron-Cohen, Wheelwright, Skinner, et al., 2001), and internal consistency was shown to be good for each of the domains (communication α = .65, social skills α = .77, imagination α = .65, attention to detail α = .63, and attention-switching α = .67; Baron-Cohen, Wheelwright, Skinner, et al., 2001). Each item was scored on a 4-point Likert scale, rather than the original dichotomous scoring scale used in Baron-Cohen et al. (2001) as the 4-point scale has been shown to be more reliable (Murray et al., 2016). Half of the items were reverse-scored. Refer to Appendix A for the questionnaire. The total score for the AQ were calculated, as well as the scores for the social skills and communication subscales.

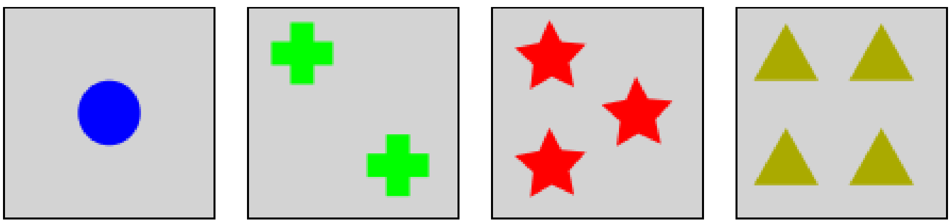
2.1.3.2 The Social Responsiveness Scale (SRS). This 65-item questionnaire aimed to measure social impairment criteria for ASC, with five subscales – social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviour (Constantino & Gruber, 2005). The SRS required responses on a 4-point Likert-scale and items are coded 0-3. The SRS has a high convergent validity with standard clinical ASD measures such as the ADI-R and the ADOS, good internal consistency (α = .96), and good specificity (.69 to 1.00) and sensitivity for ASD (.74 to .80) (Bölte et al., 2011). The total score was used as an outcome measure. (Refer to Table B1 in Appendix B for items and scoring).

2.1.3.3 The Cognitive Flexibility Scale (CFS). This 12-item questionnaire measured CF with good concurrent validity (α = .81), good construct validity (α = .72), and criterion-related validity (α = .73). The CFS was answered on a 6-point Likert-scale, from 1 to 6. The total score was used as an outcome measure. (Refer to Table B2 in Appendix B for items and scoring).

2.1.3.4 The Wisconsin Card Sorting Task (WCST). This task was presented to participants on Psychopy (v.1.1.24; Peirce, 2007, 2009). Four cards were presented to the participants on a screen along with a target card. The four cards differed in shape of item(s) on the card, number of item(s) in the card, and colour of item(s) on the card (refer to Figure 2.1 for sample stimuli). There were 64 card stimuli overall, containing dots, stars, crosses or circles, varying in item quantity (1-4) and colour (red, blue, green or yellow) in each stimulus. Each card stimulus was 100px by 100px on a grey background.

Figure 2.1.

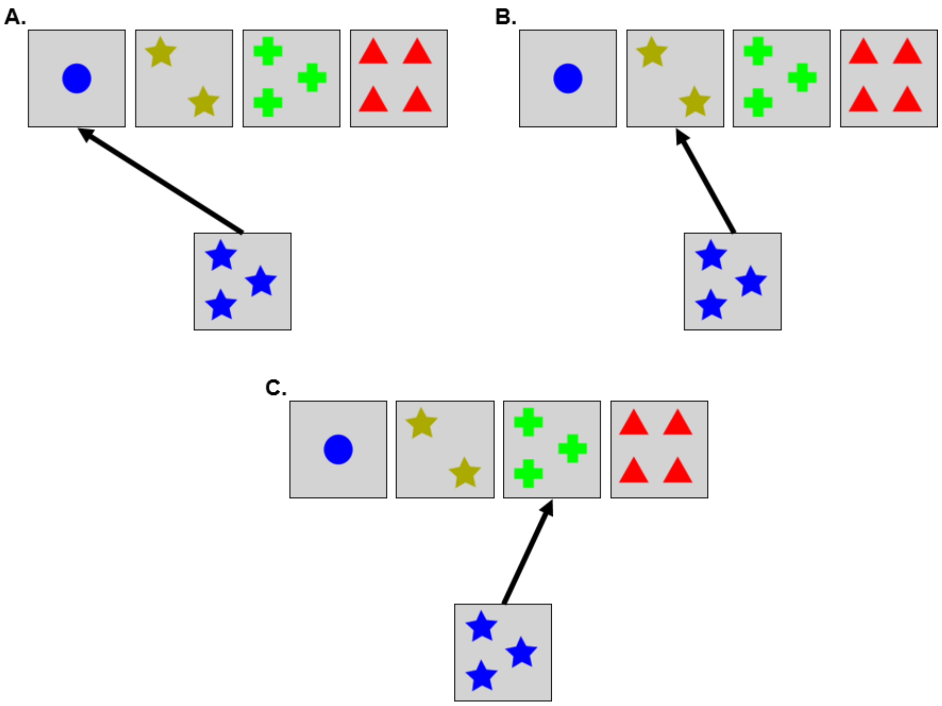
Sample of stimuli used in the WCST.



Participants were required to sort the target card based on one of the three characteristics (colour, shape or number of items), though they were not told the rules for sorting. Figure 2.2 shows some sample trials. After a response was selected using the mouse, feedback was given as to whether the answer was accurate, so participants could identify the sorting rule. Participants then moved onto the next trial and used the same rule to categorise the card for 10 trials after which the sorting rule would change without notifying the participant. Overall accuracy of responses and RT on each trial was recorded. If participants exceeded the response time interval (8000ms) given, the trial would automatically move on and record the response as incorrect. There were 120 trials in total.

Figure 2.2.

Sample trial on the WCST.



Note. Panel A: sort by colour. Panel B: sort by shape. Panel C: sort by number of items.

Although the WCST is a CF measure, other EF domains such as WM (to remember each “rule” without a cue) and inhibition (of previous movements) are needed to perform this task as well (Geurts et al., 2009), which makes it more reflective of life-like CF, where EFs are often concurrently used to perform a task.

2.1.3.5 The Gender-Emotion Switch Task (GEST). In addition to the WCST, I used a switch task (Monsell, 2003) to measure CF. When alternating between two task sets, people are slower and more prone to making errors when having to switch from one task to the other, which is identified as “switch cost” (Monsell, 2003). Specifically, I used the gender-emotion switch task (de Vries & Geurts, 2012) which has a low WM load, making it a purer measure of CF. Furthermore, this specific switch task uses face stimuli which are more complex (de Vries & Geurts, 2012). This task was presented to participants on Presentation® software (Version 18.0, Neurobehavioral Systems, Inc., Berkeley, CA, www.neurobs.com). There were 8 stimuli overall – two female faces (happy or angry) and two male faces (happy or angry). Each stimulus was 337px by 457px on a grey background. Eight face stimuli used were sourced from the Karolinska Directed Emotional Faces Set (Lundqvist et al., 1998). Refer to Figure 2.3 for samples.

Participants were required to identify the face stimuli presented to them based on gender or emotion overhead cue. To minimise the influence of WM on this task (Karbach & Kray, 2009; Stoet & López, 2011), a gender or emotion cue was present during both the fixation and target presentation. This cue was presented on the screen above the fixation point for 600ms and was also present above the target stimuli. If the overhead cue showed a gender cue, then participants had to identify whether the stimuli was male or female. If the overhead cue showed an emotion cue, participants had to identify whether the stimuli showed anger or happiness. Participants pressed either the ‘z’ key for left (indicated with a green sticker) and the ‘/’ key for right (indicated with a pink sticker).

Figure 2.3.

Samples of the face stimuli used in the GEST.

Note. Top row = gender (female) stimuli; bottom row = gender (male) stimuli; first two columns on the left = emotion (angry) stimuli; two columns on the right = emotion (happy) stimuli.

There were four versions of the task with different combinations between gender and emotion response options to avoid any implicit associations between gender and emotion; left – male/happy and right – female/angry, left – male/angry and right – female/happy, left – female/angry and right – male/happy, and left – female/happy and right – male/angry. Task instructions were presented verbally and then on the screen to participants for the task and they commenced after pressing the spacebar.

There were three practice blocks to allow participants to familiarise themselves with the task. The first two practice blocks consisted of 16 trials of the emotion and then gender cues respectively with no task switches. These blocks were repeated if the accuracy rate was lower than 75%. The third practice block consisted of 40 trials, switching between emotion and gender cues in random order.

After completing the practice blocks, the participant completed three experimental blocks. Each block consisted of 72 trials; a third of these trials were switch trials, where the current task differed from the preceding task, e.g. a gender cue after an emotion cue trial. There was a central fixation cross between each trial for 600 milliseconds (ms) to focus eyesight to the image. To avoid fatigue, the trials paused between each block wherein instructions were presented to participants until button press. Participants were encouraged to respond as quickly as possible and the cue and stimuli was presented for a maximum of 2000ms before being considered as an omission error (no response given).

2.1.4 Procedure

The questionnaires were presented in randomly generated orders to the participants online. All questionnaires used were presented to participants on Qualtrics Online Survey Suite. The tasks were administered semi-randomly as participants were randomly allocated to a pre-determined task order. Participants were instructed by the researcher using a script to standardise between the UK and Malaysia researchers to ensure all participants received the same level of instruction. The tasks took between 30 to 45 minutes to complete.

2.2 Results

The AQ total score, SRS total score, and CFS total score were each calculated by adding all the individual item scores together. The error rate (the percentage of errors across the total number of trials) on the WCST (WCST ER) was calculated for each participant. The switch-cost in error rate (SC ER) on the GEST was calculated by the difference between the ER on switch trials and the ER on repeat trials. The switch-cost in reaction time (SC RT) on the GEST was calculated from the difference between the mean RT on correct responses on the switch trials and on the repeat trials. In order to check that there was a difference between the repeat trials and the switch trials, which would indicate that the task was functioning as intended, I compared the performance of all participants together on the switch and repeat trials using a t-test. Participants had a significantly higher ER on switch trials (M = 10.93, SE = .76) compared to repeat trials (M = 7.6, SE = .71), $t(99) = -6.89$, $p < .001$, $r = .57$, and a significantly slower RT on switch trials (M = 769.15, SE = 16.12) compared to repeat trials (M = 677.05, SE = 13.89), $t(99) = -13.77$, $p < .001$, $r = 0.81$, showing that as expected on a switch task, participants were slower and less accurate on switch trials compared to repeat trials.

2.2.1 Cross-Cultural Differences in Attention-Switching

Shapiro-Wilk tests showed that not all of the data was normally distributed. Total AQ scores were normally distributed in Malaysians but not in British participants ($W(44) = .80$, $p < .001$). Total CFS scores were normally distributed across both groups. Total SRS scores were normally distributed for Malaysians but not in British participants ($W(44) = .93$, $p = .01$). WCST ER was not normally distributed in Malaysian ($W(56) = .95$, $p = .02$) and British participants ($W(44) = .77$, $p < .001$). On the GEST, SC RTs was normally distributed in Malaysians but not in British participants ($W(44) = .92$, $p = .005$). SC ERs were not normally distributed in both Malaysian ($W(56) = .95$, $p = .02$) and British participants ($W(44) = .92$, $p = .004$). I attempted to normalise these variables using a log transformation, however, assumptions of normality were still violated on the variables.

Assumptions of homogeneity were also not met on several of the variables. Levene's test showed that variances were significantly different between Malaysian ($\sigma^2 = 169.76$) and British participants ($\sigma^2 = 470.18$) on total AQ scores ($F(1, 98) = 3.95$, $p = .05$). Variance was also significantly different between Malaysian ($\sigma^2 = 33.48$) and British participants ($\sigma^2 = 32.53$) on total CFS score ($F(1, 98) = 5.60$, $p = .02$). Malaysians ($\sigma^2 = 424.12$) also had significantly less variance than

British participants ($\sigma^2 = 873.49$) on total SRS score ($F(1, 98) = 38.14$, $p < .001$). Malaysians ($\sigma^2 = 80.85$) participants had significantly more variance than British participants ($\sigma^2 = 57.46$) on WCST ER ($F(1, 98) = 4.69$, $p = .03$). However, for SC RT ($F(1, 98) = .26$, $p = .62$) and SC ER ($F(1, 98) = .76$, $p = .39$), variances were equal between the two groups, thus assumptions of homogeneity were not violated. These findings were unexpected as there was no reason to expect such high variability, and furthermore, the variability was not only specific to one group or measure used.

My initial *a priori* power analyses indicated that a total sample size of 112 would be sufficient to detect significant differences based on independent samples t-tests.[1] However, based on these findings, I instead proceeded with non-parametric tests to compare differences between the groups on these measures, with a Bonferroni alpha correction applied to control for Type I error rates when multiple tests of significance are conducted. The alpha criterion, $p = .05$, was divided by the number of tests conducted, in this case six, which gave us the corrected alpha value, $p = .01$.

Mann-Whitney U tests showed that total AQ scores in Malaysians ($Mdn = 119$) and total AQ scores in British participants ($Mdn = 103.5$) were significantly different, $U = 625$, $z = -4.22$, $p < .001$, $r = -0.42$. Malaysian participants scored significantly higher on the AQ

[1] I conducted another power analysis which indicated that a total sample size of 172 would be sufficient to detect significance differences using Mann-Whitney U tests, with a medium effect size (Cohen's $d = 0.5$), an alpha of .01 (Bonferroni corrected), and a power estimate of .8. This would mean each group needed to have 86 participants per group; the current study was underpowered.

compared to British participants. Total SRS scores were significantly different (U = 800.50, z = -3.00, p = .003, r = -0.25) between Malaysian (*Mdn* = 66) and British participants (*Mdn* = 52.5). Malaysian participants scored significantly higher on the SRS compared to British participants. Total CFS scores were not significantly different (U = 1120, z = -.78, p = .44, r = -0.08) between Malaysian (*Mdn* = 51) and British participants (*Mdn* = 51.5).

Malaysians (*Mdn* = 27.31) also performed significantly differently to British participants (*Mdn* = 21.34) on WCST ER, U = 714.50, z = -3.60, p < .001, r = -0.36. Malaysians had a significantly higher ER on the WCST compared to British participants. There were no significant differences found between Malaysian (*Mdn* = 3.19) and British (*Mdn* = 2.92) participants on switch-cost in error rate (U = 1156.50, z = -.53, p = .60, r = -0.05), and no differences between Malaysians (*Mdn* = 82.35) and British (*Mdn* = 79.15) participants on switch-cost in reaction time (U = 1153, z = -.55, p = .58, r = -0.06) on the switch task.

2.2.2 Predictive Relationships to the AQ

To investigate whether task performance could predict AQ scores, I ran a multiple linear regression. No significant regression equation was found (F(3, 96) = .28, p = .84), with an adjusted R^2 of -.02, when predicting total AQ scores from WCST ER, SC RT and SC ER. The confidence interval associated with the regression contained 0 for WCST ER, SC RT and SC ER, meaning that the null hypothesis (that there is no relationship between task performance and the AQ), is accepted. Refer to Table 2.1 for results of the regression model.

Table 2.1.

Regressions of relationship between attention-switching tasks and total AQ scores.

Variable	*B*	*SE*	β	*t*	*p*	95% CI	
						LL	UL
(Constant)	108.83	6.39		17.05	.00	96.16	121.50
WCST ER	.12	.21	.06	.58	.58	-.29	.53
SC RT	.02	.03	.07	.66	.51	-.04	.08
SC ER	-.08	.41	-.02	-.19	.88	-.90	.77

Note. CI = Confidence interval; LL = lower limit; UL = upper limit; WCST ER = WCST error rate; SC RT = GEST switch-cost in reaction time; SC ER = GEST switch-cost in error rate.

2.3 Discussion

The primary aim of this study was to investigate whether self-reported differences on the AQ between Malaysian and British individuals would be reflected in cognitive ability on measures of CF. The results showed that Malaysians scored higher than British participants on the AQ and on the SRS. This replicates the findings in Freeth et al. (2013), wherein Malaysian participants scored higher than British participants on the AQ. As the tendency for a higher scoring in Malaysian participants is not limited to the AQ alone, it cannot simply be dismissed as an artefact of the AQ. As found in Freeth et al. (2013), there are robust differences between Malaysian and British participants when answering these questionnaires.

Furthermore, I also found that Malaysians had a higher ER on the WCST compared to British participants. This finding does seem to support hypothesis A, that differences on the AQ and the SRS were reflected in a behavioural measure of CF, with Malaysian participants showing less CF on this task compared to British participants. However, I cannot conclusively state that the self-reported traits are consistently reflected in behaviour as there were no differences between the two groups on the GEST. Additionally, there were no differences between groups on the CFS. Furthermore, the participants' performance on the task measures did not predict their AQ scores in this study.

One possible explanation for the differences between Malaysian and UK participants on the WCST, but not on the GEST, is the differences between the tasks. Firstly, the GEST had practice trials and the WCST did not include practice trials; switching errors can be reduced with practice or brief feedback (Bohlmann & Fenson, 2005; Perner & Lang, 2002). Thus, perhaps British participants, who could be expected to be less flexible due to being less multicultural in comparison to Malaysians, or Malaysian participants, who could be expected to be less flexible due to scoring higher on autism traits, may have benefitted from the practice trials on the GEST, thus improving their performance. As we looked at a NT population, errors on the GEST would not have been high as if the sample was a clinical sample, and so this improved performance may have masked group differences.

Alternatively, the difference between the two groups lies in other EFs, which come into play on the WCST but not on the GEST. The

WCST involves other areas of EF such as WM and inhibition, compared to the GEST which was specifically designed as a purer measure of CF, with a lower WM load. Therefore, although no differences were shown on the GEST between the two groups, this may not be reflective of real-life behavioural CF which might be better illustrated by the WCST as it involves multiple aspects of EF.

Another explanation for the differences between tasks could lie in the specificity of the tasks used in this study. As previously mentioned, both tasks used the basic mechanism of a rule-switching task. Previous research suggests that CF can be task-specific rather than reflective of a global CF capacity in children (Deák & Wiseheart, 2015). In this study, I used classic tasks that measured CF, which leaned towards rule-switching tasks, and did not include CF tasks that were cue-inductive (selecting and integrating information that are related to a task, for example, using semantic cues to infer novel words). These findings, therefore, may merely indicate that Malaysians are worse at rule-switching tasks compared to British participants, rather than being indicative of a global CF capacity.

Indeed, despite age-related increases in ability, no differences were found between South African and American children on cue-inductive tests although American children performed better on rule-switching tasks compared to South African children as they aged (Legare et al., 2018). The researchers suggest that rule-switching CF tasks may have yielded group differences between South African children and American children due to the differential pre-school experiences between them as a result of America being a WEIRD (Western, Educated, Industrialised, Rich, Democratic) country (Legare et al., 2018). Those who are from WEIRD countries, therefore, are more likely to attend pre-schools with college-educated teachers, and pre-schools that spend more time on things like rule-based games, compared to those from communities who have more difficulty accessing education or have fewer resources allocated for education (Legare et al., 2018). Perhaps young adults in Britain, also being from a WEIRD country, simply have more practice with rule-based arbitrary symbol-mapping exercises compared to Malaysian young adults, who may not have grown up with the same resources as children.

The findings regarding behavioural measures of CF also contradict hypothesis B, based on previous studies that link multilingualism and multiculturalism to better CF. I expected that as Malaysians are more multilingual and Malaysian social structures are more multicultural, that they would perform *better* on behavioural measures of CF compared to British participants. Yet the results show that on the WCST, Malaysians performed worse than British participants, and there were no differences at all on the GEST. However, although I assumed that Malaysians would be more multilingual than British participants, I did not explicitly measure this.

Bilingualism has a facilitative effect on CF and CF is arguably the most relevant component affected by bilingualism (Bialystok et al., 2006; Colzato et al., 2008). Cross-cultural CF differences found could not be explained by social class (a factor controlled for), immigrant backgrounds or differences in cultural experience and thus the sole explanation for the findings was the presence of bilingualism (Bialystok & Viswanathan, 2009). In fact, CF facilitation found in bilingual children is also present in late bilinguals, i.e. adults who became bilingual after childhood, suggesting that bilingual ability alone is enough to facilitate CF rather than acquisition at an early age (Pelham & Abrams, 2014). Evidence suggests that bilingual education systems also increases CF performance on tasks compared to monolingual education systems (Christoffels et al., 2015). The usage of more than one language is enough for CF advantages to be seen on tasks irrespective of whether an individual is bi- or multilingual (Pelham & Abrams, 2014; Poarch & van Hell, 2012).

Whilst this does suggest that bilingual Malaysians would be expected to perform better on the switch tasks, if I keep in mind that the task instructions and questionnaires are all in English, potential misunderstandings of the task instructions or of the questionnaire items could have led to the differences in the scores both on the questionnaires and on the task. As this was not directly measured in the study, the possible confounding influence of English language proficiency cannot be estimated. However, most of the Malaysian participants were Malaysian Chinese, and Malaysian Chinese mostly speak Chinese dialects such as Mandarin, Cantonese, and Hokkien amongst others (Wang, 2016) compared to most of the British participants who were white, and white British are most often mono-lingual English-users (Office for National Statistics, 2011); the likelihood of the Malaysian participants being multilingual would be more likely than the likelihood of the British participants being multilingual. Future replications of this study should still collect demographic data about language use and proficiency; however, it is reasonable to assume that Malaysians were more multilingual than British participants and could thus be expected to have greater CF. As I did not find that, the current findings still seem to indicate that the self-reported measures of autism reflect Western norm behaviours that are less globally applicable.

There was no group difference found on the third self-report questionnaire in this study, the CFS. As there were group differences on the other self-reported measures, these findings are surprising. Therefore, I suggest that influence of language does not seem to account for the lack of group differences found on this measure. Instead, this particular finding may indicate that the CFS is measuring a different construct compared to the AQ and the SRS (Johnco et al., 2014; Martin & Anderson, 1998; Martin & Rubin, 1995). Hence, the differences between Malaysian and British participants on self-reported measures appears to be specific to autism questionnaires, and not questionnaires as a whole.

Despite differences in task performance on the WCST, participants’ task performance did not predict their AQ scores. This is surprising as the findings on the WCST (Malaysians have more errors than British participants) and the findings on the AQ (Malaysians score lower than British participants) run in the same direction. This suggests that behavioural flexibility, as seen on the tasks, does not explain the responses given on the AQ, and that there is a separation between the two. This lends credence to the idea that the reasons for the differences in task performance and the reasons for the differences on the AQ have little to do with each other, and more due to other variables, such as the type of task used or possibly a result of differing translations or interpretations of the questionnaires or its items.

3. Social Skills and Communication

One of the most distinguishing features of Autism Spectrum Conditions (ASC) symptomology is having difficulties in social communication and interaction. In the DSM-5, these social difficulties are specified to be persistent and appear in multiple contexts, although they can vary in severity (American Psychiatric Association, 2013). Individuals with ASC often have difficulties with back-and-forth conversations, with initiating social interaction, and show reduced sharing of interests or emotions. Additionally, deficits in non-verbal communication (such as lack of facial expressions and eye contact, and difficulty understanding gestures), difficulties with acting appropriately within the social context, and difficulty or disinterest in making friends are common (APA, 2013).

Because social difficulties are central to ASC, diagnostic assessment tools such as the Autism Diagnostic Interview-Revised (ADI-R; Le Couteur et al., 2003) and the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012) include assessment of an individual's social interaction. Questionnaires such as the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) and the Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Hill, et al., 2001) that can be used as screening tools for ASC (Cheon et al., 2016; Gau et al., 2013; Kamio et al., 2013; Kunihira et al., 2006; Lau et al., 2013; Takei et al., 2014; Wang et al., 2012; Zhou et al., 2017) also focus on social interaction; the SRS centres mainly on social behaviour and the AQ has *two* subscales addressing social skills and communication abilities. These subscales on the AQ measure social difficulties specific to ASCs as described in the DSM-5.

The findings of Freeth et al. (2013), discussed in Chapter 2, raise the question of whether the cultural differences found on the AQ reflect cultural differences in underlying behaviour or cognition. One possible explanation for these differences is that cultural differences on these measures are merely the artefact of cultural biases in the questionnaires themselves. There are indications that there are cultural differences in the social behaviours measured with the AQ (Freeth et al., 2013). For example, the item ‘I would rather go to a library than a party’ might be socially biased. Whilst partying would be considered a normal social behaviour in the UK among students, in Malaysia, partying would be considered an unwanted social behaviour in comparison to going to the library, as there is a larger cultural emphasis on academic pursuits and, with the country being a Muslim-majority country, the consumption of alcohol is frowned upon. The differences found in this study could therefore be attributable to the items on this measure being Western-centric.

However, the difference in AQ scores could reflect genuine cross-cultural differences in social behaviour associated with autism between Malaysia and the UK. Possibly, there are differences between Malaysia and the UK in social cognitions such as Theory of Mind and emotion recognition. Social interactions require the ability to differentiate others’ points of view and mental states (Baron-Cohen et al., 1985). Theory of Mind (ToM; Premack & Woodruff, 1978) is the ability to attribute mental states to others and understand that the mental states of others are separate and distinct to one's own. Children with ASCs have a less well-developed ToM as compared to NT children (Baron-Cohen, 2000), and tend to perform worse on measures of ToM compared to NT children (Happé, 1994; Jolliffe & Baron-Cohen, 1999; Peñuelas-Calvo et al., 2019). This is a pattern that seems to continue into adulthood (Kleinman et al., 2001; Pedreño et al., 2017). Moreover, ToM impairments are also related to ASC traits in the NT population, where individuals with elevated levels of ASC traits exhibit a similar pattern of social impairments and ToM as found in autistic populations (Gökçen et al., 2016). Therefore, if self-reported difficulties reported on the AQ are reflective of cross-cultural differences in autistic features, British and Malaysian populations could also be expected to show differences in measures of ToM, with British participants performing better than Malaysian participants, if I extrapolate from the findings of Freeth et al. (2013).

Conversely, there are conflicting findings with respect to possible cultural differences in ToM development and performance. Overall, there appears to be cross-culturally consistent development in ToM in NT populations and the idea of universal consistency in impairments in ToM in ASC populations. In typical development, the onset of mental-state reasoning (aspect of ToM) seems consistent at the age of 5 years across five different cultures – Canada, India, Peru, Samoa and Thailand (Callaghan et al., 2005). Moreover, native Japanese and white American adults show a high-level of consistency in neural responses, suggesting that the neural substrates involved in ToM are culturally consistent (Adams et al., 2010). ToM impairments found in ASC also seem to be universal as ToM impairments have also been found in Chinese (Huang et al., 2015; Zhang et al., 2016), Japanese (Naito et al., 1994), and Indian (Rudra et al., 2016) children.

However, there might be culturally-dependent elements *within* ToM, showing differences in developmental trajectories in ToM between cultures. Although both Iranian and Australian children progressed through all five scales in the used ToM Scale (diverse desires, diverse beliefs, knowledge access, false belief and hidden emotions), there is a cultural difference in the developmental route; Iranian children developed knowledge access before diverse beliefs whilst Australian children developed these two skills in reverse (Shahaeian et al., 2011). The developmental trajectories for ToM also differ between Chinese and North American children; Chinese children seem to develop ToM abilities at a seemingly faster rate (Liu et al., 2008). Similarly, Selcuk et al. (2018) found that Turkish children also exhibit a ToM acquisition pattern more similar to the patterns of children in Iran and China than children in the US, Germany and Australia. The literature further suggests that brain regions linked to behavioural ToM show evidence of being culturally-dependent, as the activation these regions were influenced by cultural contexts during ToM tasks (Frank & Temple, 2009; Kobayashi et al., 2007). From these findings, it is plausible to infer that baseline levels of ToM could also differ in adults between different cultures.

Cross-cultural differences in developmental trajectories have been attributed to differing cultural pressures to focus on specific aspects of mental state reasoning over others. For example, the sequential difference in ToM developmental trajectory may be attributable to differences in cultural demands, present in childhood, between Chinese and Western children (Wellman et al., 2006). Chinese culture focuses more on the external world in terms of morality, behaviour and outcome, and knowledge and skills compared to Western cultures, which focus more on personal mental state e.g. identifying own emotions and beliefs (Wellman et al., 2006; Zhang et al., 2016).

Cross-cultural studies comparing Asian and Western populations often assume that these populations reflect collectivistic and individualistic values respectively. Individualistic cultures tend to highlight a sense of personal identity (knowledge of true self, own goals and values), the drive to find one's true self, willingness to accept personal responsibility for happiness and sorrows, and hold moral principles that can be universalised and individuals act according to those moral principles (Hui, 1988). Individualists tend to define themselves independently and are emotionally independent of their social groups (Hofstede, 1980; Hui, 1988). Contrastingly, those in collectivistic cultures tend to see the self as an aspect of a social group, value interdependence to the extent of submerging the individual in the group and consider the group as the base unit of survival (Hui, 1988). Collectivists also tend to consider the implications of their decisions for others, be more willing to share material and non-material resources and feel more involved in the lives of others (Hui & Triandis, 1986). On the whole, Asian cultures are assumed to be more collectivistic, attributable by ties to principles of Confucianism, whereas Western cultures are assumed to be more individualistic (Triandis et al., 1988). This influence of cultural demands on ToM could be conceptualised more broadly through the concepts of individualism and collectivism.

In line with this, researchers attribute similarities in developmental trajectories between Iranian and Chinese children as being due to both cultures belonging to a highly collectivistic society (Shahaeian et al., 2011). Mediterranean adults outperformed British adults on tasks involving ToM and the Mediterranean participants also had higher levels of collectivism than British participants (Valanides et al., 2017). Moreover, ToM ability was correlated with collectivism levels, suggesting that collectivism could explain the cultural difference in ToM between Mediterranean and British adults (Valanides et al., 2017). This supports the idea that cultural orientation could lead to differing social pressures, thereby leading to differing developmental trajectories that could possibly underpin ToM in NT populations.

Cultural orientation exists on both an individual and cultural level and many factors influence how individualistic or collectivistic a person is, such as competition and emotional distance from the in-group (Triandis, 2001). Therefore, it is further worth considering whether cultural orientation on an individual level, or the level of adherence to the cultural values within any given society (i.e. being highly individualistic in a highly collectivistic culture), could affect ToM abilities as well. The UK is considered highly individualistic, with an individualism index score of 89, compared to Malaysia, which has an individualism index score of 26, which is more comparable to the individualism levels in China, which is index scored at 20 (Hofstede, 1991). However, individualism and collectivism are not mutually exclusive, and can be considered separate concepts (Brewer & Chen, 2007; Oyserman et al., 2002); Malaysians being lowly individualistic does not mean they must also be highly collectivistic as a result. In light of the evidence, not only could the differences on the AQ between Malaysian and British participants reflect differences on a socio-cognitive level, these differences may actually be attributable to individual levels of individualism and collectivism.

Therefore, the aim of the current study is to explore what the relationship is between culture and ToM ability in British and Malaysian participants. I propose to investigate these potential cultural differences in ToM in a NT population between Malaysia and the UK, taking into account different components of culture, such as cultural orientation. The Reading the Mind in the Eyes Task (RMET; Baron-Cohen, Wheelwright, Hill, et al., 2001) and the Strange Stories Task (SST; Happé, 1994) will be used to measure ToM. The Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, et al., 2001) will be used to measure autism traits, and two measures of cultural values were included; a measure of individualism and collectivism, the Culture Orientation Scale (COS; Triandis & Gelfand, 1998), in order to measure individualism and collectivism on an individual level. Moreover, the Asian Values Scale (AVS; Kim et al., 1999), a measure of adherence to social norms in an Asian context, was added because culture is broader than individualism/collectivism and this measure is a good reflection of the social norms in Malaysia,

The findings of Freeth et al. (2013) suggests that Malaysians will score higher than British participants on the AQ, indicating more autism traits compared to British participants. If the AQ scores in this study are reflective of underlying cognitive differences, then Malaysians would be expected to score higher on the AQ and perform worse on the ToM tasks compared to British participants (hypothesis A). However, if collectivism leads to greater ToM abilities, and Malaysians are more collectivistic, I would expect Malaysians to perform better than British participants on ToM tasks (hypothesis B).

3.1 Methodology

3.1.1 Participants

A priori power analysis indicated that a total sample size of 212 would be sufficient to detect significant differences on independent samples t-tests with a small-to-medium effect size (Cohen's d = .475), a power of .8 (following conventional recommendations to set power at 80%), and alpha error probability of .01 to account for alpha corrections. Therefore, the current study used data from 241 participants in total; 120 Malaysian participants and 121 UK participants. Malaysian participants were recruited primarily from the University of Nottingham, Malaysia Campus. 21 participants indicated their gender as male, and 99 indicated their gender as female, with an age range of 18-29 (*M* = 21, *SD* = 2.11). Of the Malaysian participants, 81 were Malaysian Chinese, 17 were Malay, 12 were Malaysian Indian and 10 stated they were of other ethnic groups or mixed race. UK participants were recruited via the online platform Prolific, from various locations in the UK. Of these participants, 88 were female and 33 were male, with an age range of 18-70 years (*M*=32.72, *SD*=11.25). 105 of these participants also indicated they were white, with 11 British Asian, 2 Afro-European and 3 participants indicated they were of other ethnic groups or mixed race. British participants received monetary compensation for their time, and Malaysian students received money or course credits.

Participants who indicated English as their first language were marked as L1, and if any other language was marked as their first language, they were marked as L2, as English was not their first language. Of the Malaysian participants, 59 indicated they were L1 and 61 indicated they were L2. In the UK sample, 120 participants indicated they were L1 whilst 1 participant did not state their language preference or history.

3.1.3 Stimuli and Materials

The AQ (Baron-Cohen, Wheelwright, Skinner, et al., 2001; Appendix A) was used to measure autism traits in the general population, requiring responses on a 4-point Likert scale with the items coded from 1-4. Extensive descriptions of this questionnaire can be found in Chapter 2.

3.1.3.1 The Cultural Orientation Scale (COS). This 16-item questionnaire examined individualism and collectivism subdivided in 'horizontal' and 'vertical' types. I used this measure of cultural orientation as this scale measures individualism and collectivism separately as opposed to assuming a mutually exclusive relationship between the two concepts. Therefore, for the purposes of this study, I looked at individualism and collectivism scores as a whole, without the subdivision categories of 'horizontal' and 'vertical'. These constructs have been found to map onto individualistic cultures, such as American, and collectivistic cultures, such as Korean, through factor analysis and showed good convergent (correlations as follows HC = .41, HI = .11, VC = .29, and VI = .51) and good divergent validity (Triandis & Gelfand, 1998). Each item was scored on a 9-point Likert scale from 1-9, with some items reverse-scored (refer to Appendix C). Separate values for individualism and collectivism were calculated from this questionnaire.

3.1.3.2 The Asian Values Scale (AVS). This 36-item questionnaire examined an individuals' adherence to Asian cultural values. The questionnaire has been shown to have good internal reliability ($\alpha = .82$) and good test-retest reliability ($r = .83$, $p = .00$), as well as convergent and divergent validity (Kim et al., 1999). Each item was scored on a 7-point Likert scale, from 1-7, with some items reverse-scored (refer to Appendix D). The total score for the AVS was calculated.

3.1.3.3 The Reading the Mind in the Eyes Task (RMET). Following Baron-Cohen, Wheelwright, Hill, et al. (2001), there are 36 stimuli images of eyes and an additional stimulus for a practice trial. Each image was shown to the participants, accompanied by four answering options presented underneath the image. Refer to Figure 3.1 for samples of the stimuli used. Before the start of the task, participants were provided a link to open a word list with definitions, replicating the procedure used by Baron-Cohen, Wheelwright, Hill, et al. (2001). Participants could only input one answer by selecting the option using a mouse and each trial was presented to them individually. Participants could view the image for as long as they wanted before giving their responses, as per the original procedure from Baron-Cohen, Wheelwright, Hill, et al. (2001).

East Asian stimuli from another cross-cultural study using the RMET were added to the white stimuli to mitigate potential issues due to own-race or other-race bias in face recognition (Adams et al., 2010). The East Asian stimuli had been validated within an East Asian population. Both the original RMET and the East Asian RMET from Adams et al. (2010) had the same responses and response options, only the content of the stimuli (i.e. whether it was white or Asian) differed. In the current study, two parallel versions of the RMET were created. In version 1, half of the items on the RMET used the white stimuli from Baron-Cohen, Wheelwright, Hill, et al. (2001) and the other half used Asian stimuli from Adams et al. (2010). In version 2, where version 1 had used the white stimuli, version 2 used the Asian stimuli, and vice versa. Participants in each group were allocated to these versions at random. Each image was 722x287 pixels, with 72 dpi resolution (refer to Appendix E). The accuracy for the task was calculated, but not the reaction time, as in the original task procedure.

Figure 3.1.

Sample of Stimuli Used in RMET (Adams et al., 2010; Baron-Cohen, Wheelwright, Hill, et al., 2001).

3.1.3.4 The Strange Stories Task (SST). Participants were given vignettes or ‘stories’ that hint at differing motivations for the actions or speech of different characters. For each story, 2 questions were asked to the participants: a comprehension and a mental state question. Participants were not able to see the stories again as they answered the questions, following Happé’s (1994) procedure for the SST. The responses to the comprehension question were rated as either correct or incorrect. A response could be incorrect because it involved factual errors or because of inappropriate inferences for the protagonists' actions. The responses were further scored based on whether they involved physical or mental states. Mental state answers refer to the thoughts, feelings, desires, traits, and dispositions of the protagonist, including key terms such as like, want, happy, cross, afraid, know, think, joke, pretend, lie, to fool someone, expecting. Responses were scored as a physical state answer when they referred to physical appearance, action of objects, physical events, and outcomes, including key terms such as big, looks like, is shaped like, to get rid of them, to sell them, because of the X (object), to not get X (physical outcome, e.g., put in jail, have a filling). Only one score was given per story based on their "best" response; if an appropriate and inappropriate answer was provided, the appropriate answer was scored, and if an answer appealed to both physical and mental states, the justification was scored as mental state (Happé, 1994).

In order to avoid the task being too lengthy for the participants to complete, a subsample of 8 of the 24 vignettes used in the original SST were used in the current study. These 8 studies were selected on the basis that they were previously found to be the most difficult mental state stories (Fletcher et al., 1995), to mitigate against potential ceiling effects due to using a NT population sample only. One practice trial was given, taken from the original SST vignettes listed in Happé's study (1994) (refer to Appendix F).

3.1.3 Procedure

The study was conducted on the online survey platform, Qualtrics. First, participants were presented with an information sheet and a consent form. After providing consent, they filled in their demographic details and were advised to complete the study on a laptop or desktop in order to have access to the glossary for the RMET, as according to the procedure of Baron-Cohen, Wheelwright, Hill, et al. (2001). Demographic details collected included gender, age, nationality, ethnic background, and area of study/educational background. Participants also filled in details regarding the first up to five languages they knew, and then filled in proficiency for the first two languages listed, so that I could account for any potential effects of language on the findings. They then completed the two tasks (i.e. RMET and SST) in random order. After completing the tasks, participants filled in the questionnaires in random order.

3.2 Results

146 Malaysian responses were recorded in total, however, only 120 participants were used in the final analysis. 26 Malaysian responses were removed from the final dataset due to incomplete dataset (24 responses) or duplication (2 responses). 162 UK participants were recruited, and 121 were used in the final analysis as 41 participants were removed from the final dataset due to incomplete datasets and lack of informed consent.

The total AQ score was calculated by adding up all item scores. On the COS, the individualism score was calculated by adding the scores from item 1-8. Collectivism scores were calculated by adding the scores from items 9-16. The total score for the AVS was calculated by adding up all the item scores. As almost all of the participants in the UK sample were L1 speakers (only 1 participant refrained from giving any response at all), I looked at the Malaysian data to see whether or not language had effects on the variables. There were no significant differences on the independent samples t-tests between Malaysian L1 and L2 participants on total AQ scores ($t(118) = -1.96$, $p = 0.52$), individualism scores ($t(118) = 1.23$, $p = 0.22$), collectivism scores ($t(118) = -0.56$, $p = 0.58$) or the SST scores ($t(118) = 1.58$, $p = 0.12$), which suggests that language did not affect these tasks. (Refer to Table 3.1 for more information).

However, there were significant differences between Malaysian L1 and L2 participants on RMET accuracy ($t(118) = 3.3$, $p = .001$), where L1 speakers were more accurate ($M = 26.1$, $SD = 3.43$) than L2 speakers ($M = 23.74$, $SD = 4.34$) on the RMET, and on the total AVS scores ($t(118) = -5.14$, $p < .001$), where L1 speakers scored lower ($M = 133.05$, $SD = 19.06$) compared to L2 speakers ($M = 149.46$, $SD = 15.8$). This shows that language affected these two factors in the Malaysian sample.

For the RMET, total accuracy was calculated by adding up the correct trials. Accuracy for white stimuli and Asian stimuli was also calculated. The SST was scored on a scale of 0-2, based on whether the answer was correct and whether a mental state justification was provided, as in White et al., 2009. Refer to Appendix E and Appendix F for details regarding how the RMET and the SST were scored.

Table 3.1.

Descriptive statistics and independent samples t-tests on Theory of Mind tasks and questionnaire scores between L1 and L2 Malaysian participants.

	M (*SD*)		*t*	*p*	Cohen's *d*
	L1[a]	L2[b]			
Total AQ score	111.73 (11.79)	115.97 (11.86)	-1.96	.05	.15
Individualism score	51.37 (8.44)	49.49 (8.33)	1.23	.22	.22
Collectivism score	53.56 (8.3)	54.37 (7.74)	-0.56	.58	.10
Total AVS score	133.05 (19.06)	149.46 (15.8)	-5.14	<.001	.94
RMET score	26.1 (3.43)	23.74 (11.79)	3.30	.001	.27
SST score	12.93 (2.27)	12.20 (2.8)	1.58	.12	.27

Note. [a]n = 59, [b]n = 61.

A 2x2 mixed ANOVA was conducted to compare accuracy on the RMET based on the race of the stimuli (White or Asian) and nationality of the participant (Malaysian or British). The results revealed that there was no main effect of race of stimuli on accuracy on the RMET, which meant that there was no difference in accuracy whether the stimuli were Asian or white ($F(1, 239) = .91$, $p = .34$, $\eta^2_p = .004$).

There was also no significant main effect of nationality, (F(1, 239) = 1.95, p = .16, η^2_p = .008). There was also no significant interaction between nationality of the participants and whether the stimuli were Asian or white (F(1, 239) = .01, p = .92, $\eta^2_p < .001$). This suggests that there was no other-race bias (Feingold, 1914; Meissner & Brigham, 2001) effect present on this task in this study. Therefore, subsequent analyses using the RMET did not include race of face as a factor. I also ran a 2-way independent ANOVA testing the effects of version (1 or 2) of the RMET that participants performed and nationality of the participant (Malaysian or British) on RMET accuracy. There was no significant main effect of nationality on RMET accuracy (F(1, 237) = 2.26, p = .13, η^2_p = .01) indicating that across versions there was no difference in RMET accuracy between Malaysians and British participants. There was a significant main effect of RMET version on RMET accuracy (F(1, 237) = 6.57, p = .01, η^2_p = .03); ignoring the effect of nationality, there was a significant difference in RMET accuracy between version 1 (M = 25.89, SD = 3.9) and version 2 (M = 24.61, SD = 4.04). However, there was no significant interaction effect between nationality of the participant and the task version on RMET accuracy (F(1, 237) = .81, p = .37, η^2_p = .003), which indicates that the effect of version was essentially the same for both nationalities. I did control for RMET version in subsequent analyses.

3.2.1 Cross-Cultural Differences in ToM Measures

In order to assess whether there were differences between Malaysian and British participants on the ToM measures, I conducted independent samples t-tests. There were no significant differences between British and Malaysian participants on RMET accuracy ($t(239) = -1.40$, $p = .16$) or SST score ($t(239) = .95$, $p = .35$). There were significant differences found on total AQ score ($t(239) = 2.24$, $p = .03$), collectivism score ($t(239) = 2.22$, $p = .03$), individualism score ($t(239) = 3.06$, $p = .002$) and AVS score ($t(239) = 8.93$, $p < .001$). However, following a Bonferroni alpha correction ($p = .008$), to control for Type I error rates when multiple tests of significance are conducted, the only significant differences were found between Malaysians and British participants on individualism and the AVS, with Malaysians scored higher on individualism and on the AVS compared to British participants (see Table 3.2).

Table 3.2.

Descriptive statistics and independent samples t-tests between Malaysian and British participants.

	M	B	*t*	*p*	*Cohen's d*
	M (*SD*)	*M* (*SD*)			
Total AQ score	113.88 (11.97)	110.12 (14.01)	2.24	.03	.29
Individualism score	50.42 (8.40)	47.14 (8.22)	3.06	.002	.39
Collectivism score	53.98 (8.00)	51.37 (10.05)	2.22	.03	.29
Total AVS score	141.39 (19.25)	118.43 (20.64)	9.93	<.001	1.15
RMET accuracy	24.90 (4.08)	25.62 (3.92)	-1.40	.16	.18
SST score	12.56 (2.57)	12.86 (2.37)	-.95	.35	.12

Note. M = Malaysian; B = British; M = Mean; SD = standard deviation.

As language proficiency seems to influence RMET accuracy and the AVS scores, I re-ran the independent samples t-tests on only L1 participants. As before, all results excepting for individualism score and AVS score were not significant. (Refer to Table G1 in Appendix G for full results).

3.2.2 Prediction Models

3.2.2.1 Correlations. I wanted to investigate the relationship between culture and autism traits, and whether this relationship could be underpinned by ToM. Therefore, initially I conducted multiple correlation analyses to glean an understanding of the relationships between the variables. I ran the correlations with the following variables: RMET accuracy, SST score, total AQ score, individualism score, collectivism score, and total AVS score. I also added the age of the participants as a variable in this analysis, as the age range seemed to be much larger in the British sample compared to the Malaysian sample, thus I wanted to verify whether it was a potential confounding variable (refer to Chapter 3.1.1).

As seen in Table 3.3, age was significantly correlated with RMET accuracy, AQ score, individualism and the AVS. Age was significantly positively correlated with RMET accuracy, where, as age increased, RMET accuracy also increased. Age was significantly negatively correlated with AQ score, individualism and on the AVS. Older participants scored lower on the AQ, individualism and the AVS. RMET accuracy and SST score were significantly positively correlated; as participants were more accurate on the RMET they also performed better on the SST task. The RMET was significantly negatively correlated with the AQ and the AVS; as RMET accuracy improved, participants scored lower on the AQ and the AVS. The SST was also significantly negatively correlated with individualism and the AVS; as participants performed better on the SST, they scored lower on individualism and the AVS. The AQ was significantly negatively correlated with both collectivism and the AVS; as participants scored higher on the AQ, they scored lower on collectivism and on the AVS. Both individualism and collectivism are positively correlated with the AVS, to a highly significant level (ps $\leq .002$). As age and RMET version were identified as variables that could affect the results, I ran a partial multiple correlation with RMET accuracy, SST score, total AQ score, individualism score, collectivism score and total AVS score, controlling for the age of participants and RMET version, however, this did not massively change the results (refer to Table G2 in Appendix G for full results).

I then ran three parallel mediation analyses in order to further understand the relationships between the measures of culture and the AQ scores.

3.2.2.2 Model 1: Predictive Model of Collectivism on the AQ. The first parallel mediation investigates the effect of collectivism on AQ score, as mediated by ToM abilities using PROCESS (refer to Figure 3.2). The outcome variable was total AQ score and the predictor variable was collectivism score on the COS. The mediators for this variable were RMET accuracy and total SST score. 95% bias-corrected

(BCa) confidence intervals (CI) based on 5000 bootstrapped samples were constructed around the indirect effect estimates and the estimate would be deemed significant if zero lay outside the upper and lower limits of the CI for the effect.

The total effect of collectivism on AQ scores was negatively predictive (b = -.32, 95% CI [-.5, -.14], t = -3.53, p < .001) wherein as collectivism increased, AQ scores decreased. The direct effect of collectivism on AQ scores, with all of the mediators in the model taken into account, was significantly negative, b = -.35, 95% BCa CI [-.52, -.17], t = -3.95, p < .001, where increase in collectivism predicts lower AQ scores. The indirect effect of collectivism on AQ scores, through the mediators, was not significant, b = .03, 95% CI [-.02, .09], wherein zero lies within the upper and lower limits of the 95% CI for this effect.

Collectivism did not predict RMET accuracy (b = -.04, 95% CI [-.09, .02], t = -1.25, p = .21), however, RMET accuracy did negatively predict AQ score (b = -.78, 95% CI [-1.2, -.35], t = -3.61, p < .001). A bootstrapped 95% BCa CI indicates that the indirect effect of collectivism on AQ scores through RMET accuracy (b = .03), holding all other mediators constant, was not different from zero (95% CI [-.01, .08]), therefore the relationship between collectivism and AQ score was not mediated by RMET accuracy.

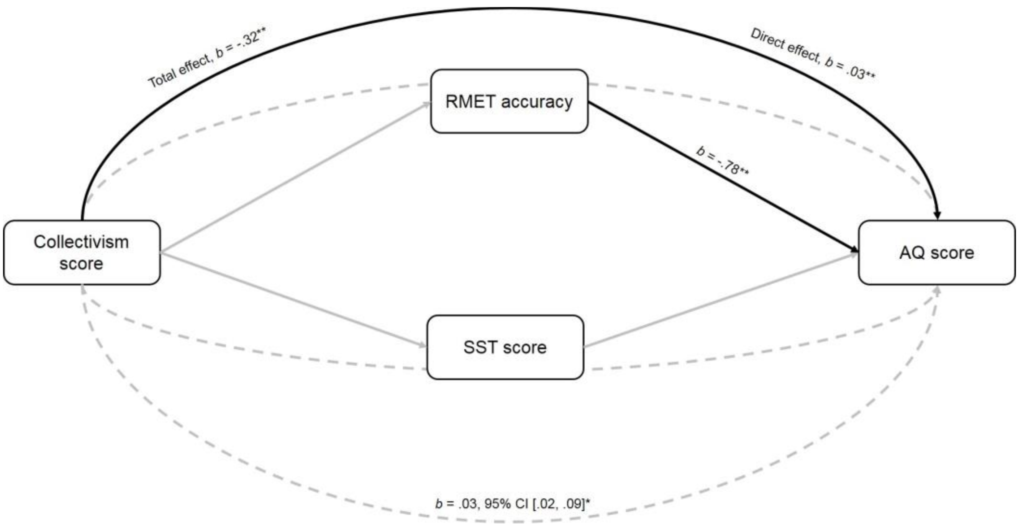
Collectivism did not predict SST score (b = -.007, 95% CI [-.04, .03], t = -.41, p = .68) and SST score did not predict AQ score (b = -.13, 95% CI [-.82, .55], t = -.38, p = .71). A bootstrapped 95% BCa CI finds that the indirect effect of collectivism through SST scores on AQ score

(b =.0009), holding all other mediators constant, was not different from zero (95% CI [-.01, .02]), therefore, the relationship between collectivism and AQ score was not mediated by SST score.

Age and RMET versions were noted to have possible effects on the dataset (refer to Chapter 3.2), therefore I ran the mediation again with age, RMET version and nationality (to purely examine cultural orientation) included as covariates to control for their effects on the variables, however these covariates did not drastically alter the pattern of results (refer to Table G3 in Appendix G).

Figure 3.2.

Prediction model for AQ scores from collectivism score with mediating variables.



Note. Model of the relationship between collectivism and AQ scores, with RMET accuracy and SST score as mediators. The CI for indirect effect is a 95% BCa bootstrapped CI based on 5000 samples. Black lines represent significant predictions; grey lines represent nonsignificant predictions; dotted lines represent indirect effects. *CI different to zero, ***p* ≤ .001

Table 3.3.

Descriptive statistics and multiple correlations analysis.

Variable	*M* (*SD*)	1	2	3	4	5	6	7
1. RMET accuracy	25.26 (4.01)	-						
2. SST score	12.71 (2.47)	.36**	-					
3. Total AQ score	112 (13.14)	-.23**	-.10	-				
4. Individualism score (COS)	48.77 (8.45)	-.03	-.13*	.08	-			
5. Collectivism score (COS)	52.67 (9.16)	-.08	-.03	-.22**	.09	-		
6. Total AVS score	129.86 (23)	-.23**	-.22**	.18**	.20[a]	.32**	-	
7. Age	26.88 (10)	.15*	.02	-.15*	-.16*	-.06	-.34**	-

Note. * $p \leq .05$, ** $p \leq .001$. [a] $p = .002$.

3.2.2.3 Model 2: Prediction Model of Asian Values Adherence on the AQ.

Adherence on the AQ. The second parallel mediation investigates the effect of the AVS on AQ score, as mediated by ToM abilities using PROCESS (refer to Figure 3.3). The outcome variable was total AQ score and the predictor variable was the AVS score. The mediators for this variable were RMET accuracy and total SST score. 95% bias-corrected (BCa) confidence intervals (CI) based on 5000 bootstrapped samples were constructed around the indirect effect estimates and the estimate would be deemed significant if zero lay outside the upper and lower limits of the CI for the effect.

The total effect of the AVS on AQ scores was positively predictive (b = .1, 95% CI [.03, .17], t = 2.82, p = .005) wherein as AVS scores increased, AQ scores also increased. The direct effect of the AVS on AQ scores, with all of the mediators in the model taken into account, was significantly positive, b = .08, 95% BCa CI [.003, .15], t = 2.04, p = .04, where increase in AVS scores predicts an increase in AQ scores. The indirect effect of the AVS on AQ scores, through the mediators, was significantly positive, b = .03, 95% CI [.005, .05], wherein zero lies outside the upper and lower limits of the 95% CI for this effect.

The AVS negatively predicted RMET accuracy (b = -.04, 95% CI [-.06, -.02], t = -3.7, p < .001); as AVS scores increase, participants can reliably be expected to perform worse on the RMET. The AVS explained 5.4% of the variance in RMET accuracy. RMET accuracy did negatively predict AQ score (*b* = -.64, 95% CI [-1.1, -.2], *t* = -2.85, *p* = .005), wherein as RMET accuracy increased, participants could reliably be expected to have lower AQ scores. A bootstrapped 95% BCa CI indicates that the indirect effect of the AVS on AQ scores through RMET accuracy (*b* = .03), holding all other mediators constant, was different from zero (95% CI [.007, .05]), therefore the relationship between the AVS and AQ score was mediated by RMET accuracy.

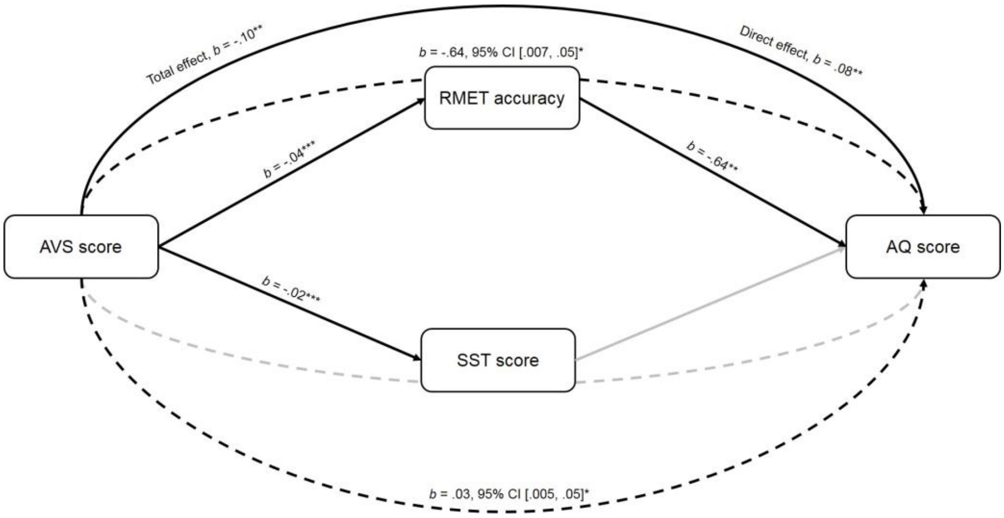
The AVS negatively predicts SST score (*b* = -.02, 95% CI [-.04, -.01], *t* = -3.41, *p* < .001); as the AVS score increases, participants can reliably be expected to perform worse on the SST. The AVS explained 4.6% of the variance in SST score. SST score did not predict AQ score (*b* = -.03, 95% CI [-.74, .68], *t* = -.08, *p* = .94). A bootstrapped 95% BCa CI finds that the indirect effect of the AVS through SST scores on AQ score (*b* =.0006), holding all other mediators constant, was not different from zero (95% CI [-.02, .02]), therefore, the relationship between collectivism and AQ score was not mediated by SST score.

As with the previous model, I ran the mediation with age, RMET version and nationality as covariates to control for their effects on the variables, however, these covariates did not drastically change the pattern of results (refer to Table G4 in Appendix G).

I also carried out a parallel mediation analysis to model whether individualism could predict AQ scores, with RMET accuracy and SST score as mediators, (refer to Table G5 in Appendix G) however, the model was not significant overall (refer to Table G6 in Appendix G) even when age, RMET version and nationality were controlled for.

Figure 3.3.

Prediction model for AQ scores from AVS scores with mediating variables.



Note. Model of the relationship between AVS scores and AQ scores, with RMET accuracy and SST score as mediators. The CI for indirect effect is a 95% BCa bootstrapped CI based on 5000 samples. Black lines represent significant predictions; grey lines represent nonsignificant predictions; dotted lines represent indirect effects. *CI different to zero, ***p* ≤ .05, ***p ≤ .001

3.3 Discussion

One of the key aims of this study was to explore the notion that AQ scores could reflect underlying cognitive differences between Malaysians and British members of the general population. Concurring with Freeth et al. (2013), I do find that Malaysians score higher than British participants on the AQ. Although the two measures of ToM (SST and RMET) correlated positively, suggesting that these tasks do measure the same underlying construct of ToM, I found no direct differences between Malaysian and British participants on either of these measures. However, the mediation analyses revealed that collectivism did significantly negatively predict autism traits and Asian values significantly positively predicted autism traits, which does partially support hypothesis B, that differences in cultural orientation affect autism traits.

Furthermore, I find that the RMET mediates the relationship between adherence to Asian values and autism traits, which does support my expectations to an extent as ToM did mediate the relationship between cultural orientation and autism traits. It could be argued that these findings were partly the result of language differences between the two population samples as language *did* affect the relationship on the RMET in Malaysians, in that L1 speakers performed more accurately than L2 speakers. A word list was provided to mitigate these effects and try to ensure that vocabulary may not be an issue, however as the study was conducted online, I could not confirm whether all participants accessed the word list. The word list was also not accessible on each page as each item was presented to the participants which means that if they did require the word list later on, they could not access it again. The current findings could also be related to differing semantic interpretations of the words, which might be different for L1 or L2 speakers. Yet, even when I controlled for language and the version of the RMET in the mediation, RMET accuracy still mediated the relationship between the AVS and the AQ. I cannot, therefore, simply dismiss these findings as the results of a language issue and should consider their wider implications.

Therefore, it is possible that some aspect or items in the COS that measure collectivism and the AVS may better capture the differences in cultural norms between Malaysian and British populations than the typical individualism/collectivism paradigm. The findings do support this idea as the AVS did predict levels of autism traits and this was partially mediated by ToM. Additionally, the AVS was also negatively correlated with both of the tasks, which supports my initial expectation that Malaysians might have poorer ToM than British participants, reflecting the self-reported levels of autism traits between the two groups.

I also do find that autism traits are partly correlated with ToM, possibly reflecting some underlying differences, partially supporting hypothesis A; as RMET accuracy decreases, AQ scores increase; in contrast however, there is no correlational relationship between SST score and AQ score. This may be specifically due to the tasks that were chosen for this study. The SST used text-related stimuli compared to the RMET which used visual stimuli, which is more complex; participants from the general population may not have as much difficulty with this task compared to someone with ASC, as there could have been ceiling effects resulting in less variability on the SST. Notably, however, the RMET has been found to be more sensitive to sociocultural factors such as ethnicity, race and education level over other cognitive tasks measuring ToM (Dodell-Feder et al., 2020). Thus, it is not truly clear whether the RMET was truly measuring ToM in the first place as I did not have additional sociodemographic information about the participants, such as education level or SES, in order to check whether RMET performance could have been confounded by these factors. However, previous studies looking at the sensitivity of the RMET cross-culturally used the original stimuli set by Baron-Cohen, Wheelwright, Skinner, et al. (2001), whereas the current study used cross-cultural stimuli validated in an Asian population (Adams et al., 2010), and thus may be somewhat less sensitive. Yet, as this was not examined directly, it remains unclear.

One way to possibly reinforce my findings would be to extend the current study by looking at whether the current findings could be replicated through the use of a task such as the Movie for the Assessment of Social Cognition (MASC; Dziobek et al., 2006), where participants are shown short video stimuli and then given a set of questions to answer regarding the mental states of the characters. The task would function similarly to the SST but involve more complex visual stimuli, and Malaysian and British video stimuli could be validated and then used in both populations to avoid potential other-race bias effects and make the stimuli context-appropriate.

Malaysians also scored higher on collectivism, individualism, and the AVS. Although previous research suggests that Malaysians can be expected to score higher on the AVS and on the items in the COS measuring collectivism, as Malaysia is an Asian country, it is unexpected that Malaysians would score *higher* than British participants on measures of individualism. Furthermore, I also found that as individualism score increases, SST score decreases. This opposes hypothesis B, the suggestion that increased levels of collectivism, and conversely lower levels of individualism, would lead to better ToM abilities. Perhaps one conclusion that could be drawn here is that individualism, rather than collectivism, has a relationship to ToM. However, individualism does not seem to predict differences on the AQ, as seen by the non-significant regression model. Hence, differences found in ToM as a result of individualism does not seem to *explain* the AQ differences between countries.

Additionally, the significant negative correlation between collectivism and AQ scores is surprising as Malaysians scored higher on both measures than British participants. Participants may sometimes present a consistent systematic tendency to respond to questionnaire items based off something other than the construct being measured (Paulhus, 1991). Researchers identify the Extreme Response Style (ERS) as one of the response styles used in such an instance, where participants tend to respond using the endpoints of the scale, i.e. the highest or lowest scoring answer, rather than the mid-points. The other response style is Acquiescence Response Style (ARS) where participants tend to agree with the items in question. Research finds that Asian respondents tend to have less ERS compared to Western respondents such as those from Australia or those of European heritage (Chen et al., 1995; Dolnicar & Grün, 2007). Other literature finds that countries with higher power distances, such as Malaysia, are also more likely to have respondents with ERS (Johnson et al., 2005). Malaysian participants may be selecting more extreme responses on the questionnaires, thereby leading to Malaysians scoring higher than British participants on the questionnaires in this study. However, findings in Chapter 2 suggest that Malaysians do not consistently score higher than British participants on *all* questionnaires, making it unlikely that the findings are simply the result of a response style. Additionally, the AQ and the AVS both contain reverse-scored items (refer to Appendix A and Appendix E), meaning that choosing more extreme values or more agreeable scores could not have led to a higher score on these questionnaires. Furthermore, the results of the current study also find a partial mediation between the AVS and AQ score, and, although the mediators did not account for the relationship between collectivism and AQ score, the direct effect of collectivism on AQ scores was significant. Response styles do not seem to sufficiently explain the current findings.

When exploring responses on English, Mandarin and Malay versions of the AQ in a Malaysian NT sample, Chee & de Vries (in press) found no differences between the English AQ and the translated *Bahasa Melayu* AQ, though this was attributed to similar levels of proficiency in these two languages. However, participants did score higher on the English AQ compared to the translated Mandarin version of the AQ (Chee & de Vries, in press). In spite of this, Malaysian Chinese participants *still* scored higher in the translated Mandarin AQ than British participants did in the English AQ (Chee & de Vries, in press), which replicated previous findings in Japan and a Japanese version of the AQ (Wakabayashi et al., 2006). Additionally, there was no significant difference in whether a participant agreed or disagreed with an item between the English AQ and translated Mandarin AQ (Chee & de Vries, in press). These findings suggest that though there may be differences in answering tendency or response style on the AQ depending on language, language proficiency does not entirely explain why Malaysians score higher on the AQ compared to British participants. Similarly, response styles may not account entirely for the findings of the current study.

To conclude, I found cultural differences between Malaysian and British participants on ToM and autism traits, supporting my hypotheses based on Freeth et al. (2013) that differences in self-reported measures of autism are reflected in cognition. Furthermore, Asian Values seem to partially explain the differences in ToM, as higher adherence to Asian values negatively predicted ToM abilities, which contrasted with expectations that greater collectivism would lead to better ToM. Moreover, although language might have partially influenced the measures of ToM and the questionnaires, language alone could not sufficiently explain the current findings. In sum, adherence to Asian cultural values predicts self-reported autism traits, and this relationship is mediated by ToM.

4. Imagination

Wing and Gould (1979) described a lack of imagination as one of the three characteristics of autism in their triad of impairments, along with impairments of social interaction and impairments of social communication. The DSM-IV also included impairments in imagination, such as imaginative play, appropriate to the developmental level, as a key diagnostic characteristic (APA, 2000). The DSM-5 highlights that impairments in imagination are especially pronounced in children with ASCs, who show a lack of pretend play and social play, as well as insistent adherence to rules during play (APA, 2013). Children with ASCs are less likely to engage in spontaneous play compared to NT children (Jarrold et al., 1993). Hence, impairment in imagination remains a consistent diagnostic criterion in ASCs.

The imagination deficit described is suggested to be specific to ASCs (Craig et al., 2001). Children with autism struggle to generate “unreal” objects tasks compared to NT children and, instead, draw real people and real objects when performing drawing tasks (Scott & Baron-Cohen, 1996). This might be due to an inability to combine two otherwise “real” representations to create a novel idea. However, other studies find that this explanation alone cannot account for an inability to generate novel ideas on drawing tasks (Craig et al., 2001). Instead, the difficulty for children with autism in imagination may be directly due to an inability to create unplanned hypothetical ideas (Turner, 1997); children with autism are more likely to give fewer novel responses on drawing tasks (Turner, 1999), and images that are produced are often thematically related to the object presented to them (Lewis & Bouchet, 1991). Another study postulates this difficulty as a specific problem in generating imaginative drawings regarding people, rather than inanimate objects. Children with autism construct less imaginative responses than NT children when the drawing task involved people rather than inanimate objects, although there were no such differences in NT children (Ten Eycke & Müller, 2015). Impairments in imagination, therefore, seem to be one of the key characteristics of ASCs in children.

In NT children, themes of imaginative play may differ depending on cultural background. Korean-American children tend to include more everyday activities and family roles compared to White American children who tend to use more fantasy themes (Farver & Lee-Shin, 1997). White American children tended to describe their own actions, were more directive and rejected their playmates' suggestions more often whereas Korean-American children described their playmates' actions, requested politely and used statements of agreement more often (Farver & Lee-Shin, 1997). Thus, not just the content of pretend play but also the manner in which social play is conducted can differ depending on culture.

Studies on children tend to focus on aspects of pretend-play as markers of imaginative ability, and this is also reflected in the diagnostic criteria for autism in the DSM-5. Attempts have been made to measure imagination in adults, such as through the use of self-reported measures that look at childhood behaviour retrospectively or those that assess the self-reported levels of imagination. The findings also suggest possible cultural differences in measures of imagination in adults. Malaysians from the general population scored higher than UK counterparts on the Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, et al., 2001), including on the imagination subscale (Freeth et al., 2013), which suggests that Malaysians score themselves as being less imaginative. One explanation for these findings is that items on the AQ are culturally biased. For example, items relating to imagination tended to refer to pretend play or about story creation (e.g., “I find making up stories easy” and “When I was young, I used to enjoy playing games involving pretending with other children”), which may be less common as child play activity in Malaysia. Malaysians may have scored as being less imaginative compared to British participants as the items measure Western concepts of imagination. However, as behaviours which are central to the identification of imaginative ability in children, such as pretend play, are not usually exhibited in adolescent or adult populations. Thus, creativity is often used as a measure of imagination in research in adults. The terms ‘imagination’ and ‘creativity’ seem to overlap with respect to operationalisation, but it can be argued that the two concepts are highly interrelated yet still separate – and that imagination is a prerequisite for creativity.

Furthermore, cultural differences have been noted in the conceptualisation of creativity, especially between the East and the West. For example, China, deeply influenced by Confucian principles, views creativity as an ability that can be acquired through learning, at any point in life (Niu, 2012). In contrast, Americans tend to view creativity as something only geniuses can achieve; innate and selective to a few (Plucker et al., 2004). Americans view creativity as something novel and radical, something rare and singular, whereas Chinese people tend to view creativity within constraints, such as reworking a traditional concept (Lan & Kaufman, 2012). Thus, although there may be some dimensions of creativity that are globally agreed upon, culture can still influence creativity (Niu & Kaufman, 2013).

Divergent thinking measures creativity, and underlying imagination, without a reliance on Western-centric concepts of creativity. Divergent thinking indicates that not one single answer, but different solutions must be generated to solve a problem, in contrast with convergent thinking – in which one unique answer is possible to solve a problem (Guilford, 1956). Divergent thinking is not synonymous to creativity but it is useful for predicting the *potential* for creativity (Runco & Acar, 2012). Tests of divergent thinking are correlated with creative behaviour exhibited in real-life (Torrance, 1981, 1988; Plucker, 1999). Children with autism provided fewer novel responses on divergent thinking tasks compared to NT children (Craig & Baron-Cohen, 1999), which suggests that divergent thinking can capture creativity and underlying imaginative capabilities in ASCs.

Verbal creativity, specifically figurative language such as metaphors (regarding something as being symbolic of something else) which, along with metonymy (substitution of an attribute for what is being referred to) have been used as a measure of divergent thinking in ASCs. Individuals with autism show poorer comprehension of figurative language compared to NT groups, specifically, metaphors were more difficult for individuals with autism to comprehend compared to irony or sarcasm (Kalandadze et al., 2018). Despite improvements with age on comprehension of figurative language, difficulties have been found in both children and adults with autism compared to NT controls (Van Herwegen & Rundblad, 2018). Although individuals with autism could comprehend lexicalised conceptual and novel metaphors, they scored lower than NT controls (Olofson et al., 2014). Similar findings are reported in children with autism; a poorer comprehension of both metaphors and metonymy compared to age-matched NT controls – whilst the performance of NT groups tended to improve with increasing age, this was not found in ASC groups (Rundblad & Annaz, 2010). Metaphor comprehension difficulties appear independent of verbal or non-verbal mental age, while vocabulary could predict metonymy comprehension in ASC groups (Rundblad & Annaz, 2010).

Verbal creativity appears to be a difficulty in ASC groups cross-culturally as well. Chinese children with autism performed worse on conventional conditions for both metaphor and metonymy comprehension than NT controls but performed similarly to NT groups on the novel conditions (Zheng et al., 2015). In contrast, Kasirer and Mashal (2014) showed that adults with autism might have little difficulty in comprehending metaphors, and even outperformed NT participants by creating more creative metaphors (Kasirer & Mashal, 2014). Initially, these findings might seem counterintuitive; along with the expected difficulty with imagination in ASCs is the expected difficulty with creativity, which would be expected to be reflected in the task performance, however, this is the opposite of what these results indicate. Yet, autistic traits are associated with higher numbers of unusual responses on divergent thinking tasks (Best et al., 2015), which is similar to the findings of Zheng et al. (2015) and of Kasirer and Mashal (2014). Therefore, although autism may result in visible differences compared to NT individuals on some aspects of imagination such as imaginative play in early childhood, this may not necessarily extend to creative imagination, in both children and in adults.

To conclude, the literature suggests that impairments in imagination are a key characteristic of ASCs. In children this is reflected in pretend play, while in adults this seems to be reflected in divergent thinking, but the findings are inconsistent. Additionally, there may be cultural differences in imagination. It is possible that these differences reflect apparent variations in even the *concept* of creativity between cultures; it may not be surprising if Asian populations perform differently on creativity tasks compared to Western populations, if the measures themselves slant towards measuring Western concepts of imagination.

Consequently, the current study aims to investigate differences in imagination between a Malaysian and British NT sample. To do so, I measured verbal creativity as a measure of divergent thinking, with the Alternative Uses Task (AUT; Guilford et al., 1978) and an adapted version of the metaphor generation task (MGT) from Kasirer and Mashal (2014), and measured self-reported creativity with the CDQ-R

(Kaufman et al., 2009). Finally, I also added the AQ in order to measure autism traits.

If Malaysians are less imaginative than British, as implied by the findings of Freeth et al. (2013), then Malaysians would score higher on the AQ, and lower on the AUT and MGT compared to British participants, and questionnaires (AQ, CDQ-R) would correlate with task performance (hypothesis A). However, if AQ scores in Malaysia and the UK are not indicative of underlying cognitive differences, then Malaysians may score lower on the AQ compared to British participants, but not the direct measures of divergent thinking, and there may be no relationship between self-reported traits of autism and creative task performance (hypothesis B).

4.1 Methodology

4.1.1 Participants

A total sample size of 192 would be sufficient to detect significant differences on independent samples t-tests with a medium effect size (Cohen’s d = .5), a power of 0.8 (following conventional recommendations to set power at 80%) and an alpha error probability of 0.01 to account for alpha corrections, according to *a priori* power analyses. Therefore, the current study aimed to collect 100 Malaysian and 100 UK participants respectively. I collected 84 Malaysian participants and 100 UK participants. Of the Malaysian participants, 54 were Malaysian Chinese, 15 were Malay, 10 were Malaysian Indian and 5 stated they were of another ethnic group or mixed ethnic groups. 73 Malaysian participants indicated that they were female, and 11 indicated they were male, with an age range of 17 to 29 years (*M* = 20.29, *SD* = 3). Of the British participants, 81 indicated that they were white, 2 indicated that they were black, 13 indicated that they were British Asian and 4 indicated that they were of another ethnic group or of mixed ethnic groups. 79 British participants stated that they were female, 20 stated that they were male and 1 stated that they were non-binary, with an age range of 18 to 35 years (*M* = 26.67, *SD* = 4.73). Malaysian participants were recruited primarily from the University of Nottingham Malaysia and UK participants were recruited online mainly via the platform Prolific. All participants were compensated accordingly for their time and ethics approval was received from the University of Nottingham Malaysia.

4.1.2 Stimuli and materials

The current study used the AQ, as in Chapter 2 and Chapter 3. Refer to Chapter 2 for extensive details on the AQ and Appendix A for the list of items and scoring.

4.1.2.1 The Alternative Uses Test (AUT). In this measure of divergent thinking participants needed to generate multiple alternative uses for 6 objects within 8 minutes. The AUT included three parts; Form A, B and C. The use of Form A has been discontinued, and Forms B and C are suggested to be used in conjunction in cases where administrators want to compare the two forms of the test or to increase the reliability of the task. In the interest of reducing the amount of time spent by participants so that participants could maintain focus, and considering the acceptable test-retest reliability for the 6-item list was found to be strong, following Cohen (1988, 1992), $r = .75$, (Guilford et al., 1978), I proceeded to use items only from Form B. Form B contained 2 blocks with 3 items each, totalling to 6 items. Answers were scored based on the uniqueness of the answers and the number of novel responses given. If the use for the item listed was acceptable, it was given a score of 1, and if it was not, it was given a score of 0. For the use listed to be classified as acceptable, it must be possible to actually use the object in the stated way, and it must be different from the common usage of the item. If different items were given the same usage (e.g. weapon), they could still be listed as acceptable uses. Any use listed that referred to any conceivable interpretation of the item was acceptable (e.g. a key not just used to unlock doors but also a key for a map). Vague or general uses were not accepted, and were not scored, except in cases where they referred to unusual or specific attributes of that item. (For a full list of the items on this task used in this study, refer to Appendix H).

4.1.2.2 The Metaphor Generation Task (MGT). In line with Kasirer and Mashal (2014), participants were told “to create and write down a new expression, which is more comprehensible within your peer group than outside it” (p.3) based on nine emotion concepts identified in Levorato and Cacciari (2002). Participants then had to produce a metaphor (e.g., “Envy is …”) and a simile (e.g. “Envy is like___”) based on these nine emotion concepts. Conventional metaphors or idioms received 2 points, literal responses receive 1 point and unrelated expressions were given 0 points. The score was converted to a percentage. (Refer to Appendix H for the full list of items.)

4.1.2.3 The Creativity Domain Questionnaire – Revised (CDQ-R). I used the revised version of the Creativity Domain Questionnaire (Kaufman et al., 2009), containing 21-items scored and four subdomains (drama, maths/science, arts and interaction), in order to examine self-reported creativity in participants. This measure was selected for its wide breadth of items, which included behaviours that might not be considered to be creative in the West, such as algebra and teaching, which could make it a more cross-culturally applicable measure of self-reported creativity. The Drama subdomain included items such as acting, singing, writing and literature. The Maths/Science subdomain contained items such as algebra, chemistry, computer science and mechanical abilities. The Interaction subdomain included items such as selling people things, teaching and problem-solving. The Arts subdomain included items such as crafts, painting and interior design. Internal consistency was good for the overall scale (α = .82) and for the domains (maths/science, arts, and interaction α = .71, and drama α = .76). Each item was scored on a 6-point Likert scale, and items were scored from 1-6. (See Kaufman et al., 2009 for full exploratory analysis, see Appendix I for list of items).

4.1.3 Procedure

The study was conducted online through Qualtrics (Provo, UT). UK participants filled the survey in via Prolific, an online participant recruitment platform, whilst Malaysian participants accessed the

Qualtrics link directly. Participants were presented with the information sheet before filling in the consent form. Participants were required to provide demographic details. All participants completed the tasks first and then the questionnaires, in order to maximise focus on the tasks.

The two tasks were presented to the participants in random order. For the AUT, participants were presented with all items from Form B, followed by all items from Form C. For the MGT, all emotional concepts were presented on the same page.

The self-report measures were also presented in random order. Items on both of the self-report measures were presented in order of the original questionnaires.

4.2 Results

The total AQ score was calculated by adding up all the item scores. On the CDQ-R, a total score was generated as well as scores for each of the identified subdomains on the CDQ-R (refer to Appendix I for items). A total score for the AUT was calculated adding up the scores on each item of the AUT for each participant. For the MGT, there were 18 responses in total with a maximum score of 3 possible on each item, meaning that there were 54 possible points to score per participant. A percentage was calculated using the total that the participants scored, as per Kasirer and Mashal (2014).

In order to check for the reliability of the scoring process, I recruited an independent Malaysian scorer for the AUT and the MGT, who scored the tasks according to specifications provided (refer to Appendix H for scoring instructions). For interrater reliability between the two scorers, intraclass correlation (ICC) estimates and their 95% confidence intervals (CI) were calculated using SPSS based on a single rater, absolute agreement, 2-way mixed effects model. On the AUT, the ICC = .92, 95% CI [.57, .97], which is indicative of moderate to excellent. On the MGT, the ICC = .95, 95% CI [.93, .97], which is indicative of excellent reliability as per the interpretation ranges outlined in Koo and Li (2016).

4.2.1. Cross-cultural differences in imagination

Independent samples t-tests were conducted to examine whether there were differences between Malaysians and British participants on the measures used in this study (refer to Table 4.1). There was no significant difference between Malaysian and British participants on the total AQ (t(182) = .79, p = .43), however, there were significant differences between the two groups on the total CDQ-R (t(182) = 2.82, p = .005), with Malaysians scoring themselves as more creative than British participants. There were no significant differences between Malaysian and British participants on the total AUT score (t(182) = -.7, p = .48) or the MGT score (t(182) = 1.18, p = .24).

I looked further into the subscales and subdomains of the questionnaires but the independent samples t-tests found no differences between Malaysians and British participants on the AQ imagination subscale (t(182) = -1.1, p = .27), the CDQ-R Maths/Science subdomain (t(182) = 1.24, p = .22), CDQ-R Arts subdomain (t(182) = 1.11, p = .27) or the CDQ-R Interaction subdomain (t(182) = 1.14, p = .25). However, there was a significant difference on the independent samples t-test on the CDQ-R Drama subdomain ($t(182) = 3.79$, $p < .001$), in which Malaysians scored themselves as being more creative than British participants. These findings were consistent even following a Bonferroni alpha correction ($p = .006$) to control for the potential of Type I errors when multiple tests of significance are conducted.

Table 4.1.

Descriptive statistics and independent samples t-tests comparing Malaysian and British participants.

	M[a]	B[b]	*t*	*p*	Cohen's *d*
	M (*SD*)	*M* (*SD*)			
Total AQ score	117.77 (12.34)	116.16 (14.92)	.79	.43	.18
AQ-I	19.62 (3.16)	20.22 (4.06)	-1.10	.27	.16
Total CDQ-R	72.33 (12.42)	66.72 (14.24)	2.82	.005	.42
CDQ-R (MS)	18.00 (5)	16.99 (5.87)	1.24	.22	.19
CDQ-R (D)	20.04 (5.3)	16.99 (5.3)	3.79	<.001	.56
CDQ-R (A)	11.58 (3.19)	11.03 (3.51)	1.11	.27	.16
CDQ-R (I)	22.71 (5.21)	21.77 (5.9)	1.14	.25	.17
Total AUT score	10.96 (5.24)	11.56 (6.1)	-0.70	.48	.11
MGT score (%)	50.37 (14.2)	47.83 (14.82)	1.18	.24	.18

Note. M = Malaysian; B = British; [a]n = 84, [b]n = 100; AQ = Autism Spectrum Quotient; AQ-I = AQ imagination subscale; AUT = Alternative Uses Task; MGT = Metaphor Generation Task; CDQ-R = Revised Creativity Domain Questionnaire; CDQ-R (MS) = CDQ-R Maths/Science subdomain; CDQ-R (D) = CDQ-R Drama subdomain; CDQ-R (A) = CDQ-R Arts subdomain; CDQ-R (I) = CDQ-R Interaction subdomain.

4.2.2 Prediction model

4.2.2.1 Correlations. I conducted multiple correlation analyses to examine the relationships between the following variables: total AQ score, AQ imagination subscale score, total CDQ-R score, CDQ-R Maths/Science subdomain, CDQ-R Arts subdomain, CDQ-R Drama subdomain, the CDQ-R Interaction subdomain, total AUT score, and total MGT score (%).

The total AQ was significantly negatively correlated with the total CDQ-R score, the CDQ-R Interaction subdomain, and the total AUT score. All other correlations with the total AQ score were not significant ($ps > .05$). The AQ imagination subscale was significantly negatively correlated with the total CDQ-R score, and additionally significantly negatively correlated with the CDQ-R Drama and CDQ-R Interaction subdomains, as the AQ imagination subscale score increased, scores on this questionnaire and these specific subscales decreased. The AQ imagination subscale was trending towards a significantly negative correlation with the total AUT score. All other correlations on the AQ imagination subscale was not significant ($ps > .05$). The CDQ-R and its' subdomains were not significantly correlated to the total AUT score or the MGT score ($ps > .05$). However, the total AUT score and the MGT score were significantly positively correlated, as total AUT score increased, so did the MGT score. (Refer to Table 4.2 for results of the correlation analyses).

I then ran a parallel mediation analysis to further examine the relationship between culture and AQ scores, by looking at the effect of nationality on AQ score, as mediated by performance on the two tasks (the AUT and the MGT). The outcome variable was the total AQ score and the predictor variable was nationality (Malaysian or British). The mediators for this analysis were the total AUT score and the MGT score, which was calculated as a percentage. 95% bias-corrected (BCa) confidence intervals (CI) based on 5000 bootstrapped samples were constructed around the indirect effect estimates and the estimate would be deemed significant if zero lay outside the upper and lower limits of the CI for the effect.

The total effect of nationality on AQ scores was not significant (b = -1.61, 95% CI [-5.65, 2.42], t = -.79, p = .43). The direct effect of nationality on AQ scores, with all of the mediators in the model taken into account, was not significant (b = -1.12, 95% CI [-5.13, 2.88], t = -.55, p = .58). The indirect effect of nationality on AQ scores, through the mediators, was not significant, b = -.49, 95% CI [-1.72, .35], wherein zero lies within the upper and lower limits of the 95% CI for this effect. This prediction model was not significant (refer to Appendix J for the full model).

4.3 Discussion

With the current study, I aimed to evaluate whether there were differences in creativity which might further explain differences on the AQ between British and Malaysian members of the general population. Surprisingly, there was no significant difference between Malaysian and British participants on the total AQ nor the AQ imagination subscale, unlike my expectations based on the findings of Freeth et al. (2013) and

Table 4.2.

Descriptive statistics and multiple correlation analysis.

Variable	*M* (*SD*)	1	2	3	4	5	6	7	8	9
1. Total AQ score	116.9 (13.79)	-								
2. AQ-I	19.95 (3.68)	.51**	-							
3. Total CDQ-R	69.28 (13.69)	-.15*	-.21**	-						
4. CDQ-R (MS)	17.45 (5.5)	.004	.04	.65**	-					
5. CDQ-R (D)	15.09 (5.07)	-.12	-.28**	.69**	.01	-				
6. CDQ-R (A)	11.28 (3.37)	-.03	-.1	.53**	.12	.36**	-			
7. CDQ-R (I)	22.2 (5.6)	-.24**	-.20**	.78**	.44**	.33**	.22**	-		
8. Total AUT score	11.29 (5.71)	-.18*	-.14	.03	-.06	.09	.07	-.005	-	
9. MGT score (%)	48.99 (14.56)	.04	-.06	.01	-.12	.13	.08	-.04	.27**	-

Note. AQ-I = AQ imagination subscale; CDQ-R (MS) = CDQ-R Maths/Science subdomain; CDQ-R (D) = CDQ-R Drama subdomain; CDQ-R (A) = CDQ-R Arts subdomain; CDQ-R (I) = CDQ-R Interaction subdomain. *p < .05. **p < .001.

unlike my previous findings in Chapter 2 and Chapter 3. The model for the prediction of autism traits from nationality, through creativity as a mediator, was not significant, most likely due to the lack of cultural differences found in autism traits.

The lack of a difference on the AQ could be the result of differences in the samples. The Malaysian sample consisted primarily of university students, but the British sample included a broader background as a result of the recruitment technique. Similarly, Chapter 3 also consisted of mixed student samples in the Malaysian sample and a broader British sample, but in Chapter 2, both participant samples were student samples. The median AQ score of the British student samples in Chapter 2 was relatively lower than the means of broader British samples in Chapter 3 and the current Chapter. University student participants may score lower on the AQ than non-university participants (Demerouti & Rispens, 2014; Wheeler et al., 2014), and as one group consisted almost entirely of university student whilst the other did not, this may account for the surprising lack of differences I found on the AQ in this study.

No group differences were found in behavioural creativity; Malaysians were not significantly more or less creative than British participants. I found moderate to excellent interrater reliability on the tasks, suggesting that the scores were reliable and stable. The two task measures were also significantly positively correlated with a large effect size, suggesting that the two tasks measured similar constructs. These findings credibly indicate that there were no behavioural differences in creativity between cultures.

As autism traits increased, AUT performance decreased, as I predicted (hypothesis A) based on the findings of previous literature and the diagnostic criteria for ASC, suggesting that there may be differences in imagination in individuals with differing levels of autistic traits. However, there was not a significant correlation between the AQ and the MGT. Studies find that group differences on metaphor processing in autism tend to become smaller or disappear entirely when the groups have a high verbal ability (Morsanyi et al., 2020). As my participants were from the general population and not from an autistic population, correlations between autism traits and the MGT may have disappeared. In Chapter 3, my language-based task also did not show significant differences. Possibly, difficulties on this task (and the language-based task in Chapter 3) are related to language-specific difficulties distinctive to autism and thus cannot be replicated in a non-clinical population.

Interestingly, Malaysians scored themselves as being more creative than British participants, shown by the significant difference found on the CDQ-R. The Drama subdomain included self-ratings of creativity on activities and behaviours such as acting ability, writing poetry/prose, vocal performance/singing, English literature/criticism, dancing and keeping a journal or blog. In the mostly-University student sample in Malaysia, there may have been more emphasis on the activities described by the Drama subdomain such as acting or dancing, with the club activities offered in university, compared to the more mixed British sample.

However, previous studies comparing university students in Malaysia and the United States on the CDQ found that factor loading, and the subsequent subdomains, differed between these countries (Tan & Qu, 2012). Although factor analysis was beyond the scope of the current study, one possible explanation for these findings could be that the factors in Malaysia and the UK are also different from the subdomains set out by Kaufman et al. (2009), making the comparison of individual factors unreliable. Thus, the analysis of the subscales on this questionnaire may not be reliable.

Additionally, as my Malaysian participants were also mostly university-level students (the same could not be said for the British sample, which was recruited online via Prolifics), the sample may have had little experience with things such as wood or metal working (or other mechanical abilities) or simply did not consider specific items as being reflective of creativity (Tan & Qu, 2012). This indicates that there may be cultural differences in the basic concept of creativity (Tan & Qu, 2012; Niu & Kaufman, 2013).

Even though there were no group differences in autism traits, those with higher autism traits did tend to score themselves as being less creative compared to those with lower autism traits, somewhat in line with my expectations (hypothesis A) and with previous findings (e.g. Kalandadze et al., 2018; Olofson et al., 2014; Van Herwegen & Rundblad, 2018). This suggests that self-perceptions of creativity, rather than cultural differences, may lead to differing levels of self-reported autism traits, as this self-rating was not reflected in behavioural creativity on the tasks. Furthermore, autism traits were specifically negatively correlated with the Interaction subdomains of the CDQ-R. This was also consistent for the imagination subscale of the AQ, which was additionally significantly negatively correlated with the Drama subdomain of the CDQ-R as well as the Interaction subdomain. This result is not particularly surprising as these subdomains overlapped with the AQ subscale of imagination, which contained items involving playing with children and reading stories (refer to Appendix A for the AQ subscale items and Appendix I for the CDQ-R subdomain items).

To conclude, from the findings of my current study, I find that there were no cultural differences in autism traits, and culture did not predict autism traits, contrary to the hypothesis. I do find evidence that those with higher autism traits also report themselves as being less creative, which fits previous research and the Western autistic profile. Notably, there were no cultural differences found in behavioural creativity but there were cultural differences found in self-reported levels of creativity. The MGT may not work well in finding differences in NT samples, as language related deficits may be specific to ASCs. Additionally, the findings on self-reported autistic traits could partly be the result of the sample as using similar university-level student samples for comparison finds cross-cultural differences on the AQ in previous chapters, however, these differences may not be as consistently found when using dissimilar samples, as in the current study. The AQ may be sensitive to the influence of other unidentified factors, possibly running in line with my expectations that the AQ is culturally biased.

Findings on the CDQ-R may perhaps indicate that the two populations considered the same activity described on the CDQ-R differently, such as mechanical abilities possibly due to the social factors surrounding the student sample. However, there are indications that the subdomains themselves are not reliable between cultures hence, the findings could also be the result of a conceptual difference between the definition of creativity and imagination between cultures. Thus, comparing similar samples – such as both population samples being student samples or both samples being more representative of the general population – is necessary when doing cross-cultural comparisons on this measure.

5. Attention to Detail

"Attention to detail", as specified in the AQ, refers to a preference for local details over global constructs (refer to Appendix A for AQ items). Behaviours such as paying attention to small changes, preference for numbers and dates, noticing small sounds are described in the AQ as attention to detail, or a tendency to process information locally rather than globally. In visual processing, a property can be considered as either global or local depending on its place in the hierarchy; the overall configuration of the information presented is considered a global feature whereas content that focuses on the details in the information presented is considered a local feature (Navon, 1977). Global processing strategies refer to the primacy of the holistic properties when processing and are dependent on the interrelations between components whereas local processing strategies refers to the reverse wherein the component properties are given priority during processing (Kimchi, 1992). Those with autism tend to show superior visual processing, including an advantage on local processing, compared to NT individuals (Jolliffe & Baron-Cohen, 2001; Mottron et al., 2003; O'Riordan et al., 2001; Shah & Frith, 1993). Local processing strategies and advantages in autism have further been linked to face processing in autism, where individuals with autism tend to struggle with global processing of faces as a whole (Behrmann, Avidan, et al., 2006; Lahaie et al., 2006).

The weak central coherence (WCC) account posits that people with autism show superior local processing in visual attention because they are slower (Happé & Frith, 2006), or impaired (Happé & Booth, 2008) in global processing, and tend to default to local processing as a result (Happé & Frith, 2006). There is some evidence that supports this stance. Whilst performance in NT populations tends to improve with age, those with ASC tend to struggle with tasks requiring global processing irrespective of age (Scherf et al., 2008). Individuals with autism are significantly slower than NT individuals when global identification is required on tasks and are significantly faster when local identification is required (Behrmann, Thomas & Humphreys, 2006). Even higher autism traits have been found to be associated with reduced global processing in NT samples, supporting the idea of WCC (Grinter et al., 2009; Van Boxtel & Lu, 2013). However, global and local processing are not mutually exclusive in most tasks, making it difficult to distinguish whether individuals with autism struggle with global processing, as posited by WCC, or actually have superior local processing (Booth & Happé, 2018).

The enhanced perceptual functioning (EPF) model suggests that individuals with autism show enhanced local processing, or a local processing bias, that is a separate process to global processing which can remain in-tact (Mottron & Burack, 2001; Mottron et al., 2003; Mottron et al., 2006). This account for the local processing advantage shown by individuals with autism emphasises that although global processing and local processing coexist, they are not mutually exclusive. Considerable evidence does support the idea of a specific local processing advantage in autism. Individuals with autism have consistently shown superior performance on the block design task (Kohs, 1923) from the Weschler intelligence scales (Wechsler, 2004) compared to others in their age range (Frith, & Happé, 1994). Individuals with autism performed significantly better compared to NT when recreating designs that had to be mentally segmented, irrespective of overall performance, suggesting a specific "segmentation" ability (Happé, 1999; Shah & Frith, 1993). In fact, this effect is pervasive enough that high AQ scorers in a NT sample showed the same enhanced local processing patterns on the same task as individuals with autism (Stewart et al., 2009). Even in facial recognition, individuals with autism show intact global processing and show a specific advantage for the processing of local facial features (Lahaie et al., 2006).

Furthermore, enhanced visual search in infancy (around 9 months) has been shown to be a significant predictor of autistic symptoms at a later stage of development, around 15 months and then 2 years (Gliga et al., 2015). Plaisted et al. (1998) demonstrated that individuals with autism have an advantage over NT individuals in search tasks irrespective of whether there was a single or multiple criterion for search items (O'Riordan et al., 2001). These findings were found even when individuals were matched for non-verbal IQ and age (O'Riordan, 2000; O'Riordan, et al., 2001), in adults (O'Riordan, 2004) and even in toddlers (Kaldy et al., 2011). Therefore, the evidence for an advantage in local processing in autism seems to be quite substantial.

However, it is unclear whether these findings are consistent cross-culturally in autism. Koh and Milne (2012) found evidence of a weak central coherence only present in English participants with autism and not in Singaporean participants with autism, and no differences were found in the NT populations between these countries. This is somewhat surprising as cultural differences in processing styles in the general population are well-noted. East Asian participants, who had mostly lived in East Asian countries, were found to show a strong global advantage on the Navon task compared to Australian participants, who had mostly lived in Australia (McKone et al., 2010). This global advantage was also found in Asian immigrants from China, Korea, Singapore, Indonesia and Malaysia who had been born in and mostly lived in Australia (i.e. second generation Asian-Australians) though in a weakened form (McKone et al., 2010). Based on these findings, NT Malaysians would also be expected to showcase the global preference.

Furthermore, processing style seems to be linked to cultural orientation, in terms of individualism and collectivism (refer to Chapter 2 for details on individualism and collectivism). Collectivists seem to naturally attend to global stimuli, even when directed and required to process locally. Participants who described themselves as highly collectivistic used greater cognitive resources when having to overcome global interference during conditions where local processing was required compared to the inverse conditions. Comparatively, those who were highly individualistic used more attentional resources to overcome local interference when global processing was required (Liddell et al., 2015). This suggests that individualists tend to attend to local stimuli, even when directed and required to attend globally. There is a credible link between cultural orientation and specific processing styles.

Nevertheless, evidence cautions against the oversimplification of using cultural orientation to assign local or global processing biases. Davidoff et al. (2008) looked at a remote culture in northern Namibia called the Himba who are highly collectivistic but showed a local bias that was higher than patterns usually seen in NT Western populations. However, this local bias was not replicated on face perception tasks. Additionally, comparisons between Kyoto college students and Himba individuals shows that Kyoto college students are more globally oriented on tasks compared to Himba individuals, although both are highly collectivistic cultures (Caparos et al., 2012). This suggests that population differences in local processing are not only a result of cultural orientation (Davidoff et al., 2008), however, other aspects of culture may still influence processing styles.

Yet, despite the findings regarding the link between collectivistic cultures and local processing, Freeth et al. (2013) found no significant differences between Malaysians and UK participants in the attention to detail subscale of the self-reported AQ. These findings imply that there is no difference in reliance on one processing strategy over the other between Malaysian and British populations. Moreover, the overall AQ scores, which are higher in Malaysians, could indicate that Malaysians have more autism traits as defined by western measures compared to UK participants. This indicates that Malaysians could be expected to have a *local* bias for processing information, contrary to findings related to collectivism, which suggest Malaysians would have a *global* processing bias. Whether there are differences in performance on tasks measuring the local/global processing between Malaysia and the UK, and the relationship between this performance and self-reported autism traits is still unclear.

Therefore, the current study aims to examine global and local processing in Malaysian and UK participants with the use of two tasks – the visual search task (VST) and the face composite task (FCT) – in order to gain a broad understanding of how attention to detail is expressed in Malaysia and the UK. Gauthier et al. (2009) suggest the face composite task as a measure of processing biases in facial recognition. The composite paradigm (Young et al., 1987) combines different top and bottom halves of faces to create new and unfamiliar faces. When using this paradigm, NT adults are shown to use a global processing strategy (Goffaux & Rossion, 2006; Robbins & McKone, 2007), leading to a composite effect: more accurate performance on misaligned similar top halves than on aligned similar top halves as when the top halves are aligned with a different bottom half, participants have more difficulty recognising that the top half is the same due to the interference of globally processing the stimuli as a whole. However, as adults with autism are already employing a local processing strategy, the composite effect disappears (Teunisse & De Gelder, 2003; Weigelt et al., 2012). Findings further suggest that high AQ scorers show a default for local processing, however, this does not come at the expense of an impaired global processing on the face composite task (Stevenson et al., 2018). The current study will also use both the AQ as a measure of self-reported autistic traits, as well as the Culture Orientation Scale (COS) items as mentioned by Triandis and Gelfand (1998) to measure individualism and collectivism.

I aimed to explore the relationships between nationality, cultural orientation, attention to detail and autism traits. In line with Freeth et al. (2013), I expect that Malaysians would score higher than British participants on the AQ, suggesting that they have higher levels of autism traits. If the self-reported autism traits reflect true cognitive differences, then Malaysians would be expected to show stronger local processing than British participants on the tasks (hypothesis A). However, alternatively, if findings on the AQ are an artefact of the questionnaire, then based on previous findings regarding cultural orientation, I would expect that British participants, being more individualistic, would perform better on the FCT and the VST, presenting a local processing bias, compared to Malaysian participants, who would be more collectivistic and therefore be expected to show a global processing bias (hypothesis B).

5.1 Methodology

5.1.1 Participants

A priori power analysis indicated that a total sample of 164 would be sufficient to detect significant differences on independent samples t-tests with a medium effect size (Cohen's f^2 = .5), a power of .8 (following conventional recommendations to set power at 80%), and an alpha error probability of .01 to account for alpha corrections; therefore, I aimed to recruit 82 Malaysians and 82 British participants for this study. I only included data from Malaysian Chinese and white British participants for this study to minimise the own-race bias effect present in face processing, as the FCT only used Malaysian Chinese and white face stimuli. Of the 72 Malaysian participants I recruited, 23 participants' data was excluded due to incompletion and an additional 6 participants were excluded as they did not meet the inclusion criteria for the study. Of the 137 British participants I recruited, 49 were excluded due to incompletion of the study.

I used the responses of 131 participants in the final analyses of this study, of which 43 were Malaysian Chinese and 88 were white British participants. Malaysian participants were aged between 17 to 25 years of age (*M* = 20.20, *SD* = 1.68), with 5 participants identifying as male and 38 identifying as female. British participants were aged between 18 to 40 years of age (*M* = 24.72, *SD* = 6.84), with 26 identifying as male and 40 identifying as female. Malaysian participants were recruited from the University of Nottingham, Malaysia and white British participants were recruited through the University of Nottingham, and the online platform Prolific. Participants were compensated accordingly for their time, through course credits or monetary compensation. All participants provided consent prior to conducting the study and ethics approval was obtained from the University of Nottingham and the University of Nottingham Malaysia.

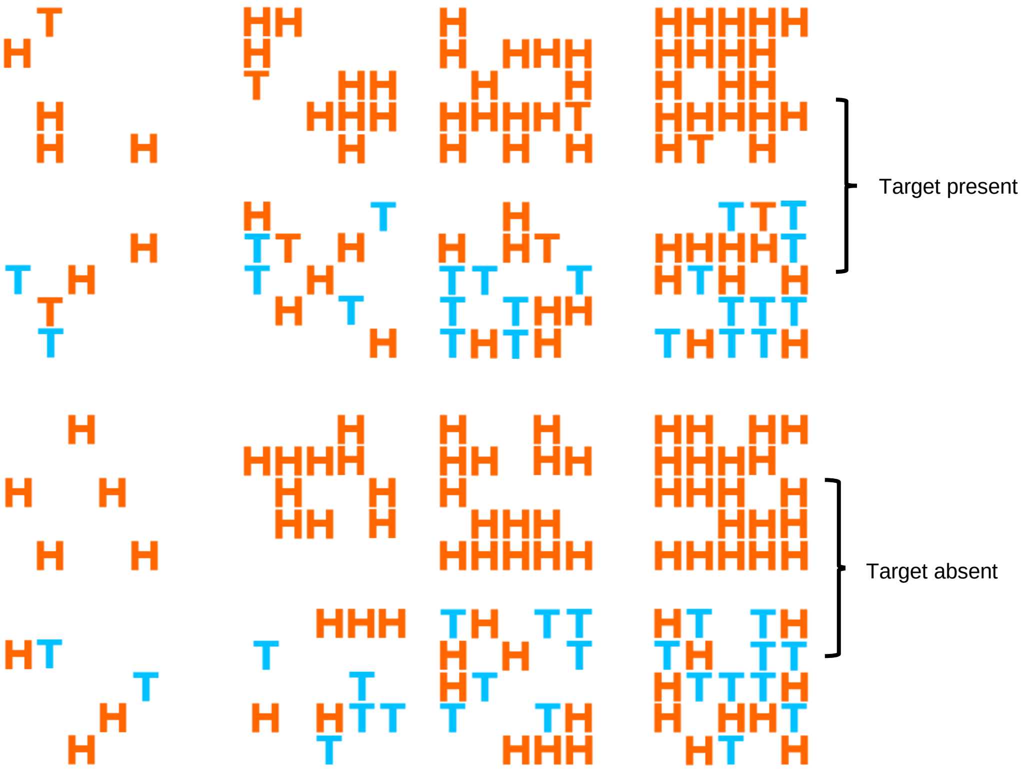
5.1.2 Stimuli and materials

The tasks were presented to participants on Psychopy (v.1.1.24; Peirce, 2007, 2009) hosted by Pavlovia (http://pavlovia.org). The current study also used the AQ, in line with the previous chapters (refer to Chapter 2.1.2 for further details), and the COS (refer to Chapter 3.1.2 for details). These questionnaires were presented to the participants online using Qualtrics Online Survey Suite.

5.1.2.1 The Visual Search Task (VST). In this task, participants were required to identify the presence of an orange-coloured “T” in an array of letters in an unlined 5x5 grid filled with varying amounts of letters. The arrays contained 5, 10, 15 or 20 letters, with gaps inside the 5x5 grid. All the arrays were presented in the centre of the screen. Distractors were also present in the array in the form of blue- and orange-coloured “Hs”, and blue-coloured “Ts”. As a single-criterion feature search task may produce ceiling effects in a NT sample, the VST also used a multiple-criterion conjunction search. Feature search arrays contained only orange-coloured H distractor items whilst conjunction search arrays contained both orange-coloured H distractor and blue-coloured T distractor items. If the “T” was present, participants pressed the spacebar and no response was required if the target was absent. There was only ever one orange-coloured “T” in the array, if it was present at all. Participants were given a maximum of 8 seconds to give a response and feedback was given after every trial in the form of the words ‘Correct!’ or ‘Incorrect!’ flashing on the screen, running in-line with the procedure used by Plaisted et al. (1998) wherein feedback was given after each trial. A fixation point appeared before each trial to orient visual attention to the same starting point before looking for the target. There were 200 trials in total.

Figure 5.1.

Sample of stimuli used in VST.



Note. Top two rows show stimuli with target present. Bottom two rows show stimuli with target absent. First row of each set shows serial search and bottom row of each set shows conjunctive search.

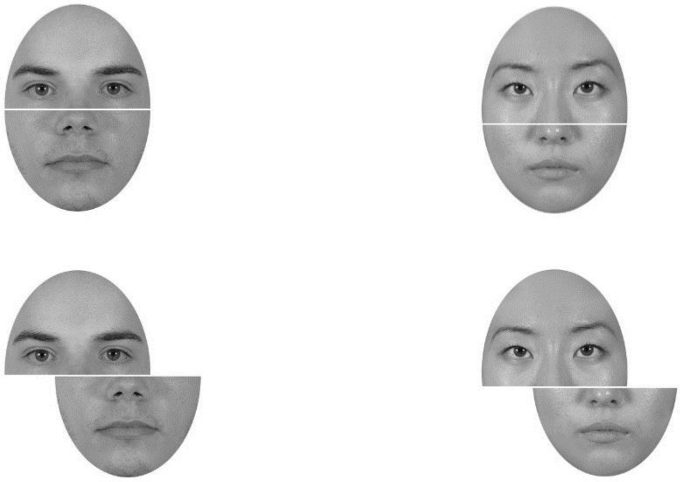
The visual search arrays were created by randomly generating the locations of 5, 10, 15 or 20 letters on a 5x5 grid (250px by 250px) The arrays included orange H's for the feature search and blue and orange H's and blue T's for the conjunctive search. There were 100 feature search stimuli and 100 target search stimuli, which were further divided into 25 for each set of 5, 10, 15 or 20 array sizes. There were 100 stimuli with the target absent and another 100 with the target. There were 200 stimuli in total created for this task. (Refer to Figure 5.1 for samples and Figures K1-K8 in Appendix K for full list of stimuli.)

5.1.2.2 The Face Composite Task (FCT). In this task, two face stimuli were presented to the participants consecutively that were either both aligned or misaligned and participants were required to identify whether the top halves of the two faces were the same. If they were the same, participants pressed the z-key and if they were not the same, they pressed the m-key. Participants were warned that the faces appear quickly – the target image was presented for 0.2s, followed by a fixation cross of 0.6s, and then the probe image which was presented for 0.5s – and were instructed to respond with their instinctive responses. They were also told to focus only on the top half of the face, irrespective of whether the face was aligned or misaligned. Six practice trials were given to participants so that they understood the procedure, and feedback was given after each of these. There were 192 experimental trials in total and no feedback was given after each experimental trial. There was no time limit set on the response on each trial and participants had to provide a response before the commencement of the net trial.

The face stimuli used in the face composite task were taken at the University of Nottingham Malaysia and edited to remove identifying features such as hair and colour using Adobe Photoshop CS5. There were 96 misaligned and 96 aligned stimuli. As the task included only Chinese-Malaysian and White stimuli, only Chinese-Malaysian participants and white participants were recruited to minimise the effect of own-race bias on face processing tasks. (Refer to Figure 5.2 for sample stimuli used in the task and Figure K9-K12 in Appendix K for full list of stimuli.)

Figure 5.2.

Sample of stimuli used in FCT.



Note. Top row shows aligned face stimuli and bottom row shows misaligned stimuli. Stimuli on the left are white stimuli and stimuli on the right are Asian stimuli.

5.1.3 Procedure

Each participant was randomly allocated to a pre-determined task order, to counterbalance between the different tasks. Irrespective of task order, participants always completed the questionnaires last so that participants were not too taxed to complete the experimental tasks. The tasks took between 30-45 minutes to complete. After completing all 3 experimental tasks, participants answered the AQ and the COS in random order as presented to them.

5.2 Results

The total AQ score was calculated by adding up all of the individual item scores. The individualism score was calculated from the COS by adding the scores from items 1-8. The collectivism score was also calculated from the COS by adding the scores from items 9-16.

I first generated variables from the accuracy for the outcome measures of the FCT. I calculated the mean accuracy on the FCT by totalling up all of the correct responses on the trials and dividing it by the total amount of trials, which was 192. I calculated the mean accuracy on the aligned trials and misaligned trials by totalling up the correct responses on the aligned and misaligned trials respectively and dividing them by the total amount of trials, which was 96. I then calculated the composite score from the difference between the accuracy on the aligned and misaligned trials as the main measure for this task.

To test for potential ceiling effects on the FCT, I ran preliminary paired samples t-tests to look for the composite effect in the mean accuracy. I found no significant differences ($t(130) = 1.02$, $p = .31$) in the mean accuracy between the aligned trials ($M = 0.76$, $SD = 0.12$) and the misaligned trials ($M = 0.76$, $SD = 0.13$), suggesting no composite effect. This was the same when I separated the trials by nationality. There was no significant difference between aligned (*M* = 0.77, *SD* = .11) and misaligned (*M* = 0.75, *SD* = .13) trials in Malaysians ($t(42) = .98$, $p = .33$) , and there was no significant difference between aligned (*M* = .76, *SD* = .12) and misaligned (*M* = 0.76, *SD* = .14) trials in British participants ($t(87) = .48$, $p = .63$). This suggests that there was a ceiling effect in accuracy.

Therefore, I calculated additional outcome measures for the FCT based on the RT; the median reaction time (MdRT) on correct responses in the aligned and misaligned trials respectively, and then calculated a composite score based on the difference between these two variables. I ran preliminary paired samples t-tests to look for a composite effect in the MdRT in order to screen for potential ceiling effects. I found a significant difference in the MdRT between aligned (*M* = .69, *SD* = .19) and misaligned trials (*M* = 0.78, *SD* = .27), $t(130) = -7.57$, $p < .001$, in the paired samples t-test, suggesting a composite effect. This was true in the Malaysian sample, where I found a significant difference between the aligned (*M* = 0.70, *SD* = .21) and misaligned trials (*M* = 0.81, *SD* = .3), $t(43) = -4.81$, $p < .001$. Significant differences ($t(87) = -5.8$, $p < .001$) were also found in the British sample between the aligned (*M* = .68, *SD* = .18) and misaligned trials (*M* = 0.76, *SD* = .25). In all instances, participants were faster to respond correctly in the aligned trials compared to the misaligned trials. As the composite effect was only found in MdRT, and not in the mean accuracy, I only used this outcome measure for the FCT in the following analyses and not the accuracy outcome measures.

Additionally, I calculated the accuracy and mean reaction time (MRT) on correct trials when the trials involved white or Malaysian Chinese stimuli and conducted two 2x2x2 mixed ANOVA in order to examine for other race bias (ORB) effects in accuracy and MRT. I found that there were no significant interactions in accuracy or MRT between the ethnicity of the stimuli and the nationality of the participant, suggesting no ORB effects in this study. Refer to Appendix L for the table of values for these analyses.

I initially calculated outcome measures based on the accuracy rate on the VST. For accuracy, I calculated the hit rate (the number of correct responses when the target was present, i.e. a response was required, divided by the total number of target present trials) and the false alarm rate (the number of incorrect responses when the target was absent, no response should be given, divided by the total number of target absent trials).

I then conducted a paired samples t-test to compare the hit rate (i.e. correct keypress when target was present) and the false alarm rate (i.e. incorrect keypress when target was absent) in order to check that participants were responding to the presence of the target rather than simply guessing. I found a significant difference ($t(130) = .287.48$, $p < .001$, 95% CI [.97, .98]) where participants correctly identified the target more compared to incorrectly identifying the absence of the target. This is a good indication that participants were responding to the target presence rather than simply guessing or pressing the response key.

I then calculated the accuracy rate on feature search trials, conjunctive search trials, and accuracy rates on each of the array sizes (5, 10, 15 and 20). In order to examine possible ceiling effects in the accuracy rate, as I was using NT participants, I analysed the task using a 2x2x4 mixed ANOVA with one between-subjects factor (nationality) and within-subject factors of search type (feature vs conjunctive) and array size (5, 10, 15 and 20). The assumption of sphericity was found to be violated for the main effects of array size, Mauchly's $W = .82$, $\chi^2(5) = 25.773$, $p < .001$, and the interaction of array size and search type, Mauchly's $W = .87$, $\chi^2(5) = 18.011$, $p = .003$. Therefore, Greenhouse-Geisser corrections of $\varepsilon = .903$ and $\varepsilon = .91$ were applied respectively.

There was a significant main effect of array size, $F(2.71, 349.51) = 6.5$, $p = < .001$, and planned comparisons revealed that participants were significantly more accurate in array size 5 ($M = 99.12$, $SE = .17$) compared to array size 10 ($p = .03$), array size 15 ($p = .004$) and array size 20 ($p = .001$). There was no significant difference in accuracy in array size 10 ($M = 98.63$, $SE = .21$) compared to array size 15 ($p = 1$) or array size 20 ($p = .31$). There was also no significant difference in accuracy ($p = 1$) between array size 15 ($M = 98.34$, $SE = .24$) or array size 20 ($M = 98.17$, $SE = .28$). These findings indicate that an increase in array size did not affect accuracy as I expected, as there were no differences between array size 10, 15 or 20, and the mean hit rate in each array size was high (mostly in the 90th percentile range) suggesting a possible ceiling effect. There was also no significant interaction between array size and nationality, $F(2.71, 349.51) = 1.43$, $p = .24$.

There was a significant main effect of search type, $F(1, 129) = 10.6$, $p = .001$, and planned comparisons showed that participants were significantly more accurate ($p < .001$) in the feature search ($M = 98.81$, $SE = .17$) compared to the conjunctive search ($M = 98.32$, $SE = .22$), showing that the addition of multiple criterion did make the task more difficult. There was no significant interaction between search type and nationality, $F(1, 129) = .188$, $p = .17$, and there was no significant interaction between array size and search type, $F(2.73, 352.13) = 2.48$, $p = .07$.

There was a significant three way interaction between array size, search type and nationality, $F(2.73, 352.13) = 3.91$, $p = .01$. Planned comparisons revealed that Malaysians ($M = 97.21$, $SE = .49$) were significantly less accurate ($p = .003$) in the conjunction search when the array size was 10 compared to British participants ($M = 99$, $SE = .34$). There were no significant differences between the groups in array size 10 in the feature search ($p = .4$). There were no significant differences between the groups in array size 5 in the feature ($p = .49$) or conjunctive search ($p = .24$). There were no significant differences in array size 15 in feature ($p = .66$) or conjunctive search ($p = .53$). There were also no significant differences in array size 20 in feature ($p = .74$) or conjunctive search ($p = .95$). Refer to Table 5.1 for values.

Table 5.1.

Estimated marginal means for interactions of array size, search type and nationality in hit rate.

Array size	Search type	Malaysian			British		
		M (SE)	*95% CI*		*M (SE)*	*95% CI*	
			LL	*UL*		*LL*	*UL*
5	Feature	98.88 (.35)	98.19	99.58	99.18 (.25)	98.7	99.7
	Conjunctive	99.44 (.34)	98.77	100.12	98.96 (.24)	98.48	99.43
10	Feature	99.35 (.38)	98.59	100.11	98.96 (.27)	98.43	99.43
	Conjunctive	97.21 (.49)	96.24	98.18	99 (.34)	98.32	99.68
15	Feature	98.51 (.49)	97.55	99.48	98.77 (.34)	98.1	99.45
	Conjunctive	97.86 (.48)	96.91	98.81	98.23 (.34)	97.56	98.89
20	Feature	98.51 (.49)	97.58	99.45	98.32 (.33)	97.66	98.97
	Conjunctive	97.95 (.58)	96.82	99.09	97.91 (.4)	97.11	98.72

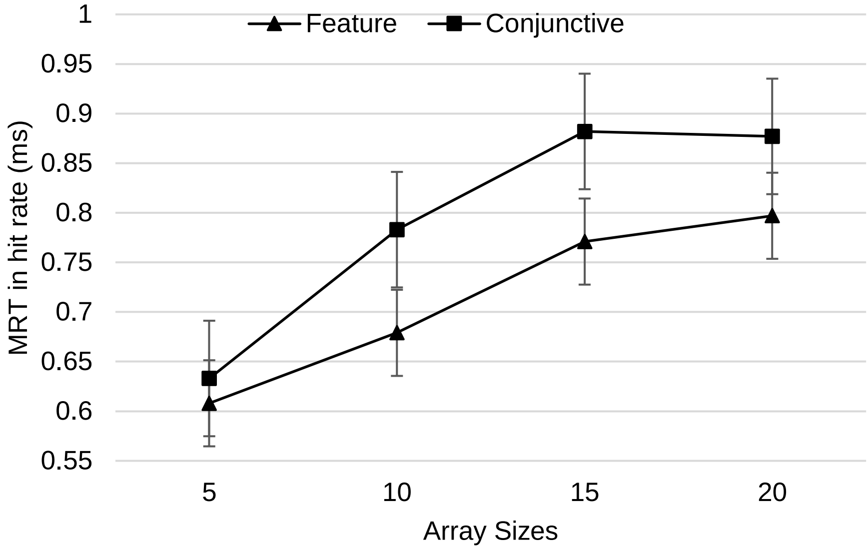
Note. M = Mean; SE = Standard error; 95% CI = 95% confidence interval; LL = lower limit; UL = upper limit.

As the accuracy rate was quite high, with most participants being in the 90th percentile range, and I did not find significant differences as the array sizes increased, in order to account for a possible ceiling effect, I also calculated an additional measure of MRT in hit rate responses to examine how quickly participants correctly identified the presence of the target, on the occasions that they did. I calculated the MRT in hit responses on feature search and conjunction search types for each array size. I then calculated another 2x2x4 mixed ANOVA on these variables. The assumption of sphericity was found to be violated for the main effects of array size, Mauchly's $W = .83$, $\chi^2(5) = 24.21$, $p < .001$, and the interaction of array size and search type, Mauchly's $W = .82$, $\chi^2(5) = 25.631$, $p < .001$. Therefore, Greenhouse-Geisser corrections of $\varepsilon = .89$ and $\varepsilon = .894$ were applied respectively.

I found a significant main effect of array $F(2.67, 344.47) = 372.89$, $p < .001$. Planned comparisons found that participants were significantly faster in correctly identifying the target presence in array size 5 ($M = 0.62$, $SE = .009$) compared to array size 10 ($p < .001$), 15 ($p < .001$), or 20 ($p < .001$). Participants were also significantly faster in array size 10 ($M = 0.73$, $SE = .01$) compared to array size 15 ($p < .001$) and 20 ($p < .001$). However, there was no significant difference ($p = 1$) between array size 15 ($M = 0.83$, $SE = .01$) and array size 20 ($M = 0.83$, $SE = .01$). This indicates that as array size increased, participants took longer to correctly identify the target presence, until array size 15 after which an increase in array size did not massively make a difference to the RT. There was no significant interaction effect between nationality and array size, *F*(2.67, 344.47) = 1.05, *p* = .36.

Figure 5.3.

Graph of array size and search type in accuracy in MRT in hit rate.



There was a significant main effect of search type, *F*(1, 129) = 180.23, *p* < .001, which planned comparisons revealed that participants were significantly faster (*p* < .001) in identifying the target in feature search (*M* = 0.71, *SE* = .01) compared to conjunction search (*M* = 0.79, *SE* = .01), indicating that the addition of multiple search criterion did make the task harder. There was also a significant interaction effect between search type and nationality, *F*(1, 129) = 5.41, *p* = .02, where Malaysians (*M* = 0.72, *SE* = .02) were significantly slower (*p* = .03) on the conjunctive search compared to British participants (*M* = 0.71, *SE* = .01). There was no significant difference in the feature search (*p* = .36).

Table 5.2.

Estimated marginal means for interactions between array size, search type and nationality in MRT in hit rate.

Array size	Search type	Malaysian			British		
		M (SE)	95% CI		M (SE)	95% CI	
			LL	UL		LL	UL
5	Feature	0.62 (.02)	0.58	0.65	0.6 (.01)	0.58	0.62
	Conjunctive	0.65 (.02)	0.62	0.68	0.62 (.01)	0.60	0.64
10	Feature	0.69 (.02)	0.66	0.73	0.67 (.01)	0.64	0.69
	Conjunctive	0.82 (.02)	0.78	0.86	0.75 (.01)	0.72	0.78
15	Feature	0.79 (.02)	0.75	0.83	0.75 (.01)	0.72	0.78
	Conjunctive	0.9 (.02)	0.85	0.94	0.87 (.02)	0.84	0.90
20	Feature	0.79 (.02)	0.75	0.83	0.8 (.01)	0.77	0.83
	Conjunctive	0.91 (.02)	0.87	0.95	0.85 (.02)	0.82	0.88

Note. M = Mean; SE = Standard error; 95% CI = 95% confidence interval; LL = lower limit; UL = upper limit.

There was a significant interaction effect between search type and nationality, $F(1, 129) = 5.41$, $p = .02$. Planned comparisons showed no significant group differences in feature search ($p = .36$) but there were significant differences in the conjunctive search ($p = .03$) where Malaysians ($M = 0.82$, $SE = .02$) were significantly slower than British ($M = 0.77$, $SE = .01$) in correctly identifying the target presence. There was also a significant interaction effect between array size and search type, $F(2.68, 345.86) = 17.92$, $p < .001$. Planned comparisons revealed that there were significant differences in both search types on all of the array sizes (all *p*s < .001), where participants were significantly faster in correctly identifying the target presence in feature search compared to conjunction search (refer to Figure 5.3).

Finally, there was a significant three-way interaction effect between array size, search type and nationality, $F(2.68, 345.86) = 3.86$, $p = .01$. Planned comparisons revealed that there were significant group differences in the conjunctive search in array size 10 ($p = .009$) and in array size 20 ($p = .02$), where Malaysians were significantly slower in correctly identifying the presence of the target compared to British participants. There were no group differences found in the other array sizes and search types (all *p*s > .05, refer to Table 5.2 for values).

Therefore, I used the following variables in the final analyses: total AQ score, individualism score, collectivism score, the MdRT composite score in the FCT (MdRT Comp), the MRT in hit rate in the array sizes 10, 15 and 20 in conjunction search on the VST.

5.2.1 Cross-cultural differences in attention to detail

Table 5.3.

Descriptive statistics and independent samples t-tests between Malaysian and British participants.

	M	B	*t*	*p*	*Cohen's d*
	M (*SD*)	*M* (*SD*)			
Total AQ score	119.53 (11.86)	112.43 (18.63)	2.64	.009	.45
Individualism score	50.63 (7.75)	46.95 (7.54)	2.6	.01	.48
Collectivism score	54.28 (7.97)	53.05 (7.76)	0.85	.40	.16
MdRT Composite	-0.12 (.15)	-0.08 (.13)	-1.17	.25	.28
MRT Conj 10	0.82 (.15)	0.75 (.12)	2.67	.009	.52
MRT Conj 15	0.90 (.16)	0.87 (.13)	0.94	.33	.21
MRT Conj 20	0.91 (.16)	0.85 (.13)	2.39	.02	.41

Note. M = Malaysian; B = British; *M* = Mean; *SD* = standard deviation; MdRT Composite = median RT composite score in the FCT; MRT Conj 10 = Mean RT in conjunctive search array size 10; MRT Conj 20 = Mean RT in conjunctive search array size 20.

To examine whether there were differences between Malaysian and British participants on my cognitive measures and the questionnaires, I conducted independent samples t-tests. On the total AQ score, the variance between Malaysian and British participants were significantly different, $F(1, 129) = 4.82$, $p = .03$, therefore, equal variances could not be assumed for this variable. All other variances were non-significant (all *p*s > .05) therefore equal variances could be assumed for those variables. I did find a significant difference on total

AQ score, $t(129) = 2.64$, $p = .009$, where Malaysians scored higher than British participants. There was also a significant difference on individualism score, $t(129) = 2.6$, $p = .01$, where Malaysians scored higher than British participants. There were no significant differences on collectivism score or the MdRT composite score in the FCT (all *p*s > .05). There were no significant differences found on the MRT in hit rate in the array size 15, $t(129) = 0.94$, $p = .33$. Significant differences were found on the MRT in hit rate in the array size 10 conjunction search, $t(129) = 2.67$, $p = .009$, and in array size 20 conjunction search, $t(129) = 2.39$, $p = .02$. However, following a Bonferroni alpha correction ($p = .008$), none of these differences were significant. Please refer to Table 5.3 for the results of these t-tests.

5.2.2 Prediction models

5.2.2.1 Correlations. To investigate the relationship between culture and autism traits, and whether this relationship could be explained by attention to detail, I first conducted multiple correlation analyses to understand the relationships between the variables. I performed the analyses with the following variables: total AQ score, individualism score, collectivism score, MdRT composite score, MRT in hit rate in array size 10 conjunction search, and MRT in hit rate in array size 20 conjunction search. Refer to Table 5.4 below for values.

Table 5.4.

Descriptive statistics and multiple correlation analysis.

Variable	*M* (*SD*)	1	2	3	4	5	6	7
1. Total AQ score	114.76 (17)	-						
2. Individualism score	48.16 (7.77)	.32**	-					
3. Collectivism score	53.45 (7.82)	-.38**	-.09	-				
4. MdRT Composite	-0.09 (.14)	.03	-.14	-.04	-			
5. MRT Conj 10	0.77 (.14)	.06	.04	.03	.03	-		
6. MRT Conj 15	0.88 (.14)	-.08	-.13	.06	.09	.66**	-	
7. MRT Conj 20	0.87 (.15)	.06	.02	.03	-.12	.59**	.58**	-

Note. ** $p \leq .001$.

Total AQ score was significantly positively correlated with individualism score and significantly negatively correlated with collectivism score. As total AQ score increased, individualism scores also increased. As total AQ score increased, however, collectivism score decreased. There were no significant correlations between total AQ score and the task measures in the FCT or the VST. Individualism and collectivism scores were not significantly correlated to each other or to the task measures in the FCT or the VST. The measures of the FCT and the measures of the VST were also not correlated with each other.

To fully understand the relationships between the variables, I conducted three parallel mediation analyses between the measures of culture and autism traits.

5.2.2.2 Model 1: Predictive Model of Nationality on the AQ. The first parallel mediation examined the effect of nationality on AQ score, as mediated by attention to detail, using PROCESS. The outcome variable was total AQ score and the predictor variable was nationality. The mediators for this analysis were median RT composites scores in the FCT, and mean RT in hit rate in array size 10, array size 15, and array size 20 in conjunctive search on the VST. 95% bias-corrected (BCa) confidence intervals (CI) based on 5000 bootstrapped samples were constructed around the indirect effect estimates and the estimate would be deemed significant if zero lay outside the upper and lower limits of the CI for the effect. Refer to Figure 5.4 for the model.

The total effect of nationality on AQ scores was significantly negatively predictive (*b* = -3.55, 95% CI [-6.63, -.47], *t* = -2.28, *p* = .02), where participants were more likely to score lower on the AQ if they were British compared to if they were Malaysian. The direct effect of nationality on AQ scores, with all of the mediators in the model taken into account, was significantly negative, *b* = -3.23, 95% BCa CI [-6.44, -.02], t = -1.99, *p* = .05, where British participants were more likely to score lower on the AQ. The indirect effect of nationality on AQ scores, through the mediators, was not significant, *b* = -.32, 95% CI [-1.78, .94], wherein zero lies within the upper and lower limits of the 95% CI for this effect.

Nationality did not predict median RT composite score in the FCT (*b* = .01, 95% CI [-.01, .04], *t* = 1.17, *p* = .24), and the composite score in the FCT did not predict AQ score (*b* = 9.38, 95% CI [-12.78, 31.53], *t* = .84, *p* = .4). A bootstrapped 95% BCa CI indicates that the indirect effect of nationality on AQ scores through median RT composite score in the FCT, holding all other mediators constant, was not different from zero (*b* = .14, 95% CI [-.25, .87]), therefore the relationship between nationality and AQ score was not mediated by the FCT.

Nationality did significantly negatively predict mean RT in the hit rate in array size 10 in conjunction search on the VST (*b* = -.03, 95% CI [-.06, -.009], *t* = -2.67, *p* = .009), where British participants were more likely to be quicker in correctly identifying the presence of the target in array size 10 during conjunction search. Nationality accounted for

5.23% of the variance in this variable. The mean RT in hit rate in array size 10 in conjunction search did not predict AQ score (*b* = 13.18, 95% CI [-17.62, 43.99], *t* = .85, *p* = .4). A bootstrapped 95% BCa CI indicates that the indirect effect of nationality on AQ scores through mean RT in hit rate in array size 10 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (*b* = -.43, 95% CI [-1.76, .37]), therefore the relationship between nationality and AQ score was not mediated by this VST measure.

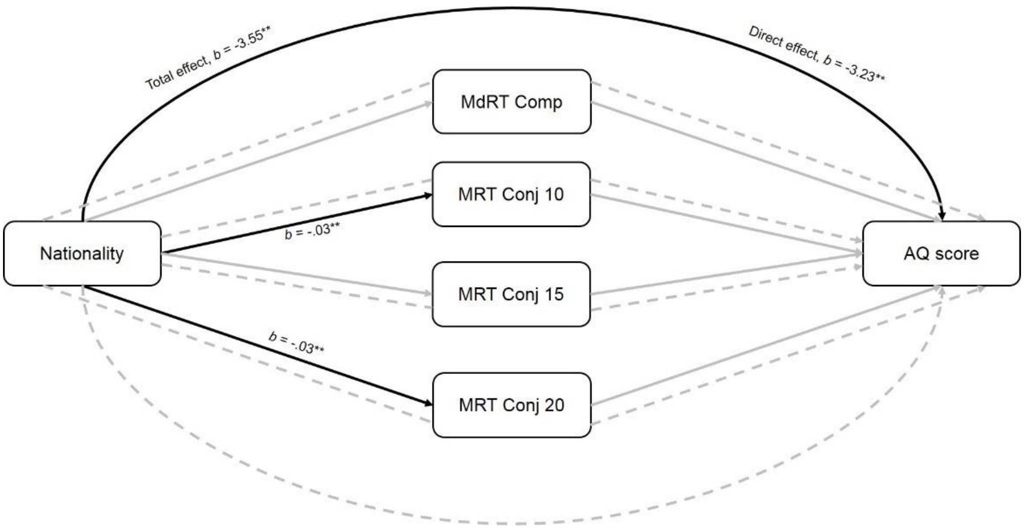
Nationality did not significantly predict mean RT in the hit rate in array size 15 in conjunction search on the VST (*b* = -.01, 95% CI [-.04, .01], *t* = -.98, *p* = .33) and the mean RT in hit rate in array size 15 in conjunction search did not predict AQ score (*b* = -27.33, 95% CI [-56.11, 1.44], *t* = -1.88, *p* = .06). A bootstrapped 95% BCa CI indicates that the indirect effect of nationality on AQ scores through mean RT in hit rate in array size 15 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (*b* = .36, 95% CI [-.43, 1.56]), therefore the relationship between nationality and AQ score was not mediated by this VST measure.

Nationality did significantly negatively predict mean RT in the hit rate in array size 20 in conjunction search on the VST (*b* = -.03, 95% CI [-.06, -.006], *t* = -2.39, *p* = .02), where British participants were more likely to be quicker in correctly identify the presence of the target in array size 20 during conjunction search. Nationality accounted for 4.24% of the variance in this variable. The mean RT in hit rate in array size 20 in conjunction search did not predict AQ score (*b* = 12.18, 95%

CI [-14.79, 39.15], $t = .89$, $p = .37$). A bootstrapped 95% BCa CI indicates that the indirect effect of nationality on AQ scores through mean RT in hit rate in array size 20 during the conjunction search on the VST, holding all other mediators constant, was not different from zero ($b = -.02$, 95% CI [-.09, .03]), therefore the relationship between nationality and AQ score was not mediated by this VST measure.

Figure 5.4.

Prediction model for AQ scores from nationality with mediating variables.



Note. Model of the relationship between nationality and AQ scores, with median RT composite score in the FCT, and mean RT in array size 10, 15 and 20 in the conjunction search on the VST as mediators. The CI for indirect effect is a 95% BCa bootstrapped CI based on 5000 samples. Black lines represent significant predictions; grey lines represent nonsignificant predictions; dotted lines represent indirect effects. *CI different to zero, ***p* ≤ .05

5.2.2.3 Model 2: Predictive Model of Individualism on the AQ. The second parallel mediation examined the effect of individualism on AQ score, as mediated by attention to detail, using PROCESS. The outcome variable was total AQ score and the predictor variable was individualism. The mediators for this analysis were median RT composites scores in the FCT, and mean RT in hit rate in array size 10, array size 15, and array size 20 in conjunctive search on the VST. 95% bias-corrected (BCa) confidence intervals (CI) based on 5000 bootstrapped samples were constructed around the indirect effect estimates and the estimate would be deemed significant if zero lay outside the upper and lower limits of the CI for the effect. Refer to Figure 5.5 for the model.

The total effect of individualism on AQ scores was significantly positively predictive (b = .69, 95% CI [.33, 1.05], t = 3.77, p = .0002); as individualism increased, participants were more likely to score higher on the AQ as well. The direct effect of individualism on AQ scores, with all of the mediators in the model taken into account, was significantly positive, b = .66, 95% BCa CI [.28, 1.03], t = 3.46, p = .0007. As individualism increased, participants were more likely to score higher on the AQ. The indirect effect of individualism on AQ scores, through the mediators, was not significant, b = .03, 95% CI [-.10, .16], wherein zero lies within the upper and lower limits of the 95% CI for this effect.

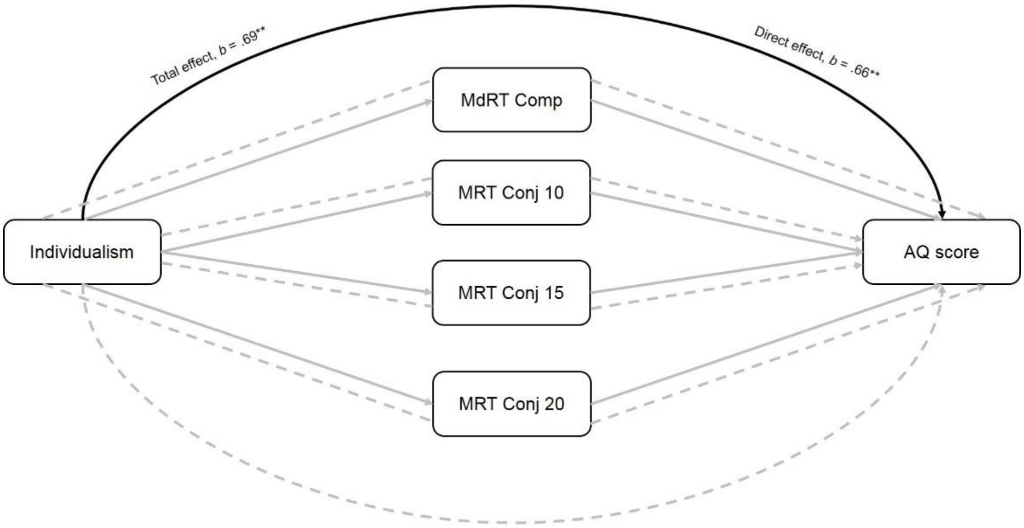
Individualism did not predict median RT composite score in the FCT (b = -.002, 95% CI [-.005, .0006], t = -1.58, p = .12), and the composite score in the FCT did not predict AQ score (b = 11.76, 95% CI [-9.80, 33.31], t = 1.08, p = .28). A bootstrapped 95% BCa CI indicates that the indirect effect of individualism on AQ scores through median RT composite score in the FCT, holding all other mediators constant, was not different from zero (*b* = -.03, 95% CI [-.15, .02]), therefore the relationship between individualism and AQ score was not mediated by the FCT.

Individualism did not predict mean RT in the hit rate in array size 10 in conjunction search on the VST (*b* = .0007, 95% CI [-.002, .004], *t* = .43, *p* = .67), and mean RT in hit rate in array size 10 in conjunction search did not predict AQ score (*b* = 11.61, 95% CI [-18.06, 41.29], *t* = .77, *p* = .44). A bootstrapped 95% BCa CI indicates that the indirect effect of individualism on AQ scores through mean RT in hit rate in array size 10 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (*b* = .008, 95% CI [-.04, .07]), therefore the relationship between individualism and AQ score was not mediated by this VST measure.

Individualism did not predict mean RT in the hit rate in array size 15 in conjunction search on the VST (*b* = -.002, 95% CI [-.006, .0008], *t* = -1.50, *p* = .14), and mean RT in hit rate in array size 15 in conjunction search did not predict AQ score (*b* = -20.59, 95% CI [-48.91, 7.73], *t* = 1.44, *p* = .15). A bootstrapped 95% BCa CI indicates that the indirect effect of individualism on AQ scores through mean RT in hit rate in array size 15 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (*b* = .05, 95% CI [-.02, .16]), therefore the relationship between individualism and AQ score was not mediated by this VST measure.

Figure 5.5.

Prediction model for AQ scores from individualism with mediating variables.



Note. Model of the relationship between individualism and AQ scores, with median RT composite score in the FCT, and mean RT in array size 10, 15 and 20 in the conjunction search on the VST as mediators. The CI for indirect effect is a 95% BCa bootstrapped CI based on 5000 samples. Black lines represent significant predictions; grey lines represent nonsignificant predictions; dotted lines represent indirect effects. *CI different to zero, ***p* ≤ .05

Individualism did not predict mean RT in the hit rate in array size 20 in conjunction search on the VST (*b* = .0004, 95% CI [-.003, .004], *t* = .24, *p* = .81), and the mean RT in hit rate in array size 20 in conjunction search did not predict AQ score (*b* = 12.99, 95% CI [-13.05, 39.04], *t* = .99, *p* = .33). A bootstrapped 95% BCa CI indicates that the indirect effect of individualism on AQ scores through mean RT in hit rate in array size 20 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (*b* = .005, 95%

CI [-.06, .08]), therefore the relationship between individualism and AQ score was not mediated by this VST measure.

5.2.2.4 Model 3: Predictive Model of Collectivism on the AQ. The third parallel mediation examined the effect of collectivism on AQ score, as mediated by attention to detail, using PROCESS. The outcome variable was total AQ score and the predictor variable was collectivism. The mediators for this analysis were median RT composites scores in the FCT, and mean RT in hit rate in array size 10, array size 15 and array size 20 in conjunctive search on the VST. 95% bias-corrected (BCa) confidence intervals (CI) based on 5000 bootstrapped samples were constructed around the indirect effect estimates and the estimate would be deemed significant if zero lay outside the upper and lower limits of the CI for the effect. Refer to Figure 5.6 for the model.

The total effect of collectivism on AQ scores was significantly negatively predictive (b = -.83, 95% CI [-1.18, -.48], t = -4.7, p < .001); as collectivism increased, participants were more likely to score lower on the AQ as well. The direct effect of collectivism on AQ scores, with all of the mediators in the model taken into account, was significantly negative, b = -.82, 95% BCa CI [-1.17, -.47], t = -4.63, p < .001. As collectivism increased, participants were more likely to score lower on the AQ. The indirect effect of individualism on AQ scores, through the mediators, was not significant, b = -.01, 95% CI [-.12, .08], wherein zero lies within the upper and lower limits of the 95% CI for this effect.

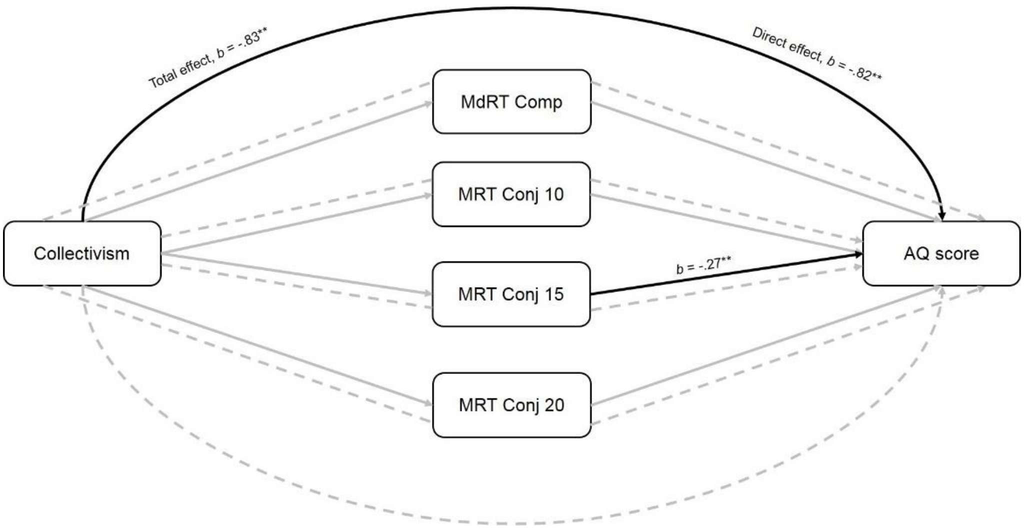
Collectivism did not predict median RT composite score in the FCT (*b* = -.0006, 95% CI [-.004, .002], *t* = -.42, *p* = .68), and the composite score in the FCT did not predict AQ score (*b* = 5.48, 95% CI [-15.26, 26.23], *t* = .52, *p* = .6). A bootstrapped 95% BCa CI indicates that the indirect effect of collectivism on AQ scores through median RT composite score in the FCT, holding all other mediators constant, was not different from zero (*b* = -.004, 95% CI [-.07, .03]), therefore the relationship between individualism and AQ score was not mediated by the FCT.

Collectivism did not predict mean RT in the hit rate in array size 10 in conjunction search on the VST (*b* = .006, 95% CI [-.003, .004], *t* = .36, *p* = .72), and mean RT in hit rate in array size 10 in conjunction search did not predict AQ score (*b* = 18.41, 95% CI [-10.03, 46.84], *t* = 1.28, *p* = .2). A bootstrapped 95% BCa CI indicates that the indirect effect of collectivism on AQ scores through mean RT in hit rate in array size 10 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (*b* = .01, 95% CI -.06, .12]), therefore the relationship between collectivism and AQ score was not mediated by this VST measure.

Collectivism did not predict mean RT in the hit rate in array size 15 in conjunction search on the VST (*b* = .001, 95% CI [-.002, .004], *t* = .65, *p* = .51), Mean RT in hit rate in array size 15 in conjunction search did negatively predict AQ score (*b* = -27.19, 95% CI [-54.07, -.31], *t* = -2, *p* = .05), wherein as mean RT in hit rate increased (i.e. participants were faster to correctly identify the presence of the target), AQ scores decreased. A bootstrapped 95% BCa CI indicates that the indirect effect of collectivism on AQ scores through mean RT in hit rate in array size 15 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (b = -.03, 95% CI -.13, .04]), therefore the relationship between collectivism and AQ score was not mediated by this VST measure.

Figure 5.6.

Prediction model for AQ scores from collectivism with mediating variables.



Note. Model of the relationship between collectivism and AQ scores, with median RT composite score in the FCT, and mean RT in array size 10, array size 15 and array size 20 in the conjunction search on the VST as mediators. The CI for indirect effect is a 95% BCa bootstrapped CI based on 5000 samples. Black lines represent significant predictions; grey lines represent nonsignificant predictions; dotted lines represent indirect effects.

*CI different to zero, **$p \leq .05$

Collectivism did not predict mean RT in the hit rate in array size 20 in conjunction search on the VST (b = .0006, 95% CI [-.003, .004], t = .35, p = .73), and the mean RT in hit rate in array size 20 in conjunction search did not predict AQ score (b = 14.44, 95% CI [-10.73, 39.61], t = 1.14, p = .26). A bootstrapped 95% BCa CI indicates that the indirect effect of collectivism on AQ scores through mean RT in hit rate in array size 20 during the conjunction search on the VST, holding all other mediators constant, was not different from zero (b = .008, 95% CI [-.07, .07]), therefore the relationship between collectivism and AQ score was not mediated by this VST measure.

5.3 Discussion

In this study, I aimed to examine potential cultural differences in autism traits and whether these differences would be reflected in attention to detail. Similar to the findings of Freeth et al. (2013), I found significant AQ differences, with Malaysians scoring higher than British participants, although the significance disappeared following alpha corrections. One possible explanation for these findings could be due to the uneven sample size, as the number of Malaysian participants was almost half of that of the British participants. This is supported by my findings as I find that assumptions of equal variances in the samples was violated specifically on the AQ measure.

I did also find group differences in individualism, with Malaysians scoring higher on both compared to British participants, although this difference also disappeared with the alpha corrections. There was no difference in collectivism. This is somewhat similar to my findings in

Chapter 3 where I found that Malaysians scored higher in both individualism and collectivism only differences in individualism remained significant following alpha corrections. That participants can score highly on both or only on one of the measures and not the other suggests that individualism and collectivism, although they are conceptually interlinked, exist independently. Additionally, as in Chapter 3, these findings could also be related to the COS itself and how it conceptualises individualism and collectivism; perhaps other measures of culture, such as the AVS, could have better captured cultural differences in values between the two samples.

The mediation analyses revealed that participants could reliably be expected to have fewer autism traits if they were British compared to if they were Malaysian. Higher levels of individualism predicted lower levels of autism traits and higher levels of collectivism predicted higher levels of autism traits. These findings are particularly surprising as Malaysians were more individualistic with an alpha level of .05 but there were no group differences found in collectivism.

I also did not find differences between cultures on the attention to detail tasks, following alpha corrections. On outcome measures of accuracy, this may be due to ceiling effects as I used a NT population. Indeed, both samples had high accuracy rates on the VST and the FCT. I did find that Malaysians were slower to correctly identify the target presence compared to British participants on the VST although this significance disappeared following alpha corrections. I also found that when participants when quicker to correctly identify the presence of the target, they tended to score higher on the AQ, however, this relationship did not mediate the relationship between collectivism and the AQ. This finding supports previous studies which found that in larger sample sizes, there was no relationship between autism traits and superior performance on the VST in the general population (e.g. Gregory & Plaisted-Grant, 2016; López-Pérez et al., 2019). Interestingly, the composite effect was present in the FCT, showing that participants were responding differently to aligned and misaligned trials. However, Malaysian and British participants did not show any group differences in the composite effect. Again, these differences may have been dampened due to the uneven sample sizes. However, other studies also find no differences between own-race or other-race face processing in NT Malaysian Chinese or White European samples despite a strong composite effect (Wong et al., 2021). Moreover, nationality did predict performance in visual search but not in the FCT. Malaysian participants were likely to be slower to identify the target presence correctly, specifically when a conjunction search was occurring in the VST, which seems to partially support my expectation that Malaysians would show a global processing bias rather than a local processing one.

Surprisingly, Malaysian participants do seem to be showing cognitive patterns previously linked to collectivism, yet this is not reflected in the self-reported measures. Although I expected a local processing advantage in a highly individualistic group, I found that Malaysians scored themselves as more individualistic, but still struggled with local processing compared to British participants. These predictive relationships also could not be explained by cognition, through the task measures. This could be the result of the Malaysian sample being an almost exclusively university-level student sample. Yet, other studies have also found no cultural differences related to individualism-collectivism in global and local processing (Lacko et al., 2020). Perhaps, cultural differences noted in local and global processing, and cultural differences found in this study, might not be the result of cultural orientation but involve some other aspect of culture, such as adherence to cultural values, as seen in Chapter 3.

Alternatively, cultural differences in local and global visual processing have also been linked to the physical environments that an individual finds themselves in as opposed to socialisation differences or cultural orientation (Miyamoto et al., 2006). Such studies posit that certain physical environments may be more visually complex or ambiguous, leaving objects to look more embedded than in other environments, leading to greater emphasis on global attention of scenes; cultural differences in environments are responsible for cultural differences in local and global processing (Miyamoto et al., 2006; Nisbett & Miyamoto, 2005). Indeed, some research finds that when attending to images, East Asians tend to fixate less on the focal object compared to Americans, and frequently made more saccades to the background and context than Americans did (Chua et al., 2005). Additionally, East Asians – who may live in physical environments that are visually complex – were found to be more sensitive to contextual changes rather than changes in the focal object compared to American populations (Masuda & Nisbett, 2006). When comparing between Czech and Taiwanese populations, analysing RTs did not show clear differences between the samples, however, studying eye movements revealed that Czech participants tended to focus more on the focal objects compared to Taiwanese participants who tended to focus more on the background (Čeněk et al., 2020).

In the context of my current findings, one possible explanation for my findings could be that there may have been differences in visual processing between the two groups on these tasks, however, my current outcome measures (e.g. the use of RTs) or design may not have been able to capture these subtler group differences in the way that eye-tracking might have been able to. Future studies could look at the fixation duration and saccades on tasks in complex scenes and to explore the environmental affordances of the participants to investigate whether cultural differences could lie there.

There may have been no group differences found on the FCT as the local processing bias is specific to clinical autistic populations, however, as there *were* group differences on the VST, this explanation may not account for why the expected group differences on the FCT were not found. In this study the two behavioural task measures were not correlated, which suggests that they actually measured different constructs. Perhaps, enhanced visual perception on the VST in autism may not have actually been the result of local processing. Some studies find that performance on the VST in autism, specifically on the conjunction search, was not related to local processing biases (Jarrold et al., 2005).

Instead, differences between individuals with autism and NT individuals on the VST may be more attributable to atypical attention patterns found in autism; individuals with autism often have a very rigid and singular attentional focus, which is often linked to preferences for structure and difficulties with CF in autism rather than local processing biases, and may provide an advantage in a task like the VST where they are required to focus on a single target item (Kaldy et al., 2016). In terms of the current study, in Chapter 2, I found indications that Malaysians were less flexible than British participants; thus, the current findings on the VST may not reflect a local processing bias in Malaysians, but actually be an indication of CF abilities in Malaysians instead. This could explain why groups differences were found on the VST but not the FCT.

To conclude, I found group differences in autism traits, with Malaysians indicating higher levels than British participants and that nationality and cultural orientation predicted autism levels, however, this predictive relationship was not explained by cognitive aspects of local processing abilities. I did find a predictive relationship between nationality and cultural orientation on the VST, where Malaysians were slower in correctly identifying the presence of the target compared to British participants. However, I did not find such differences in the FCT. This could have been due to the cultural measures used, which may not have truly captured cultural differences between Malaysian and

British participants. Individualism and collectivism are also suggested to be interrelated but separate constructs. These findings, in conjunction with the differences on the VST, may indicate that there are other aspects of culture involved in local processing, such as the environment which may give differing visual processing styles. However, as the tasks were not correlated, they could also have been measuring different constructs. Overall, I find some indication that differences on the AQ are partially reflected in cognition, and my findings in conjunction suggest that some aspect of culture other than cultural orientation could be responsible for differences on the VST.

6. General Discussion

6.1 Research Overview, Summary of Findings and Major Aims

The increasing prevalence of Autism Spectrum Conditions (ASCs) is largely understood to reflect the growth and understanding the psychology field has about autism, the willingness of people to seek a diagnosis, the increasing development of diagnostic tools in accurately determining the condition, and diagnostic migration, where characteristics once associated with one disability are now being seen as consistent with another, (Cardinal et al., 2021; Fombonne, 2020; King & Bearman, 2009; McConkey, 2020) rather than an actual increase in autism. Although global prevalence rates have been expected to rise over the years, this is difficult to confirm in Malaysia as there is no official registry. Additionally, there is a large disparity between the number of children registered with any kind of disabilities at all in the Welfare Department and the actual number of children with disabilities or other neurodivergence in Malaysia (Amar-Singh, 2008). Thus, there is likely a large disparity between those who receive an autism diagnosis in Malaysia and the actual number of individuals with ASCs that may also require support but are unable to access it or are unaware that they can access it. Yet, research in autism in Malaysia tends to lie in early intervention measures and school-based or class-based interventions (e.g. Neik et al., 2014; Roffeei et al., 2015; Shamsuddin et al., 2012). I believe that such an approach partially addresses the evolving needs of the Malaysian population, but how can we know whether such interventions work when we know so little about autism in Malaysia?

Cultural differences have been noted in NT populations across several areas of development and functioning which are affected in people with ASCs. What is considered “neurotypical functioning” in Malaysia and how does autism diverge from these cultural patterns? Developing the support systems in place for individuals with autism must come hand-in-hand with tackling the social stigma attached to a diagnosis as well as the social stigma attached to *seeking* a diagnosis at all, the development of clinical tools in use in Malaysia, and growing our understanding of what autism looks like in Malaysia on a personal and social level in order to address the needs of those with autism. It is therefore very much necessary to glean an understanding of neurotypical functioning. Therefore, the primary aim of my research was to explore whether possible cultural differences in autism traits were reflected in cognition or behaviour, or whether these differences were simply the result of the self-report measures of autism traits being culturally biased.

In Chapter 2, I examined the role of culture on autism traits, focusing specifically on attention-switching, otherwise known as cognitive flexibility (CF), using a classic switch task, the Wisconsin Card Sorting Task (WCST), and a gender-emotion switch task (GEST). I expected that if differences in autism traits were reflective of cognition, Malaysians would have higher levels of autism traits and poorer CF compared to British participants. However, if Malaysians, being more multicultural, would have a better CF, I expected that they may self-report higher levels of autism traits but they would actually perform better on the cognitive measures compared to British participants. In this study, I found that Malaysians did have more autism traits than British participants, in line with Freeth et al. (2013). Malaysian participants may have simply scored higher on these questionnaires compared to British participants because Malaysians simply score higher on questionnaires in general. Indeed, similar findings were apparent on the SRS in this study as on the AQ, suggesting that the tendency for Malaysians to score higher on autism measures was not limited to the AQ. Yet, there were no differences found on the CFS, an additional self-report measure of CF. If the results were simply due to Malaysians scoring higher on self-reported measures, I might expect the same pattern of differences on the CFS. However, the response pattern I found where Malaysians scored higher than British participants was found only on measures of autism traits. This suggests that Malaysians may score higher than British participants as a result of differing interpretations of the questionnaires or even that the content of the questionnaires being culturally biased.

Malaysians did also perform worse on the WCST compared to British participants in this study. The findings suggest that the cognitive profile implied by the self-reported measures is reflected in cognition, partially confirming hypothesis A. However, I did not find a *predictive* relationship between CF and autism traits, and differences in CF were not consistent between the tasks. It is unclear from this study whether culture can solely account for cross-cultural differences in autism traits and whether differences in CF between Malaysians and British participants could be wholly attributed to differences in culture between the groups. However, I found consistent group differences on the self-reported measures of autism traits, supporting the idea that these measures contain a cultural bias, because the findings were not consistent across all the self-reported measures used in this study. Additionally, it is also clear that Malaysians were somewhat less cognitively flexible compared to British participants, contrary to my expectations and previous findings.

In Chapter 3, I examined the role of culture on autism traits, with a focus on social skills and communication, in the form of Theory of Mind (ToM). The Reading the Mind in the Eyes Task (RMET) and the Strange Stories Task (SST) were used as classic measures of ToM. I expected that Malaysians would have higher levels of autism traits compared to British participants. If differences in autism traits reflected cognitive differences, then Malaysians would be expected to also show poorer ToM compared to British participants. If these differences in autism traits were not reflective of underlying cognitive differences, then I expected that Malaysians would show better ToM compared to British participants, as Malaysians would be more collectivistic and collectivism had previously been linked to greater ToM abilities. As in the previous study (Chapter 2), this study also found group differences in autism traits on the AQ; Malaysians reported higher levels of autism traits compared to British participants. Moreover, they scored higher on all other self-reported measures, which measured cultural orientation (both individualism and collectivism) and cultural values. As I did not expect Malaysians to score higher on individualism, this could suggest a specific answering tendency, where Malaysians maybe tended to answer items using an Extreme Response Style. However, some of the items on the questionnaires were also reverse-scored, making it unlikely that the results were simply due to answering tendency. The findings suggest that individualism/collectivism are not mutually exclusive, and that AVS might have captured cultural differences between the countries better than the traditional concepts of cultural orientation as reflected in the COS questionnaire.

Furthermore, ToM partially mediated the predictive relationship between adherence to Asian values and autism traits. Adherence to Asian values predicted performance on both ToM measures, but only the RMET in turn predicted autism traits. The indirect effects were significant only for the RMET. There were some differences between L1 and L2 speakers on the AQ and one of the ToM tasks, but the results remained the same when I ran the analyses again to control for this variable. My findings in this study seem to suggest some cultural difference on the AQ that cannot be attributed to language. This indicates that, as I expected, there *is* some kind of cultural bias in the self-reported measures, yet these differences *are* also being partially reflected in cognition. Cultural values could be influencing cognition, and in turn influencing differences in AQ scores, or culture could be directly influencing the interpretation of the questionnaires.

In Chapter 4, I examined the role of culture on autism traits, focusing particularly on imaginative capabilities, as operationalised in adults by creativity. I looked at creativity by examining divergent thinking using a metaphor generation task (MGT) and I also used the Alternative Uses Task (AUT), a classic task to measure divergent thinking. I expected that if Malaysians' self-reported autistic traits reflected behaviour, then they would be less imaginative than British participants; they would have higher levels of autism traits and perform worse on the measures of creativity compared to British participants. However, if autism traits were not indicative of underlying cognitive differences, then Malaysians would not score lower than British participants on the creativity measures, and there would be no relationship between autism traits and creative task performance. In this study, contrary to the findings of my previous studies and the findings of Freeth et al. (2013), there were no group differences on the AQ. Perhaps as a result of this, I also found no significant predictive relationship between nationality and autism traits. I also found no direct differences between the groups on measures of behavioural creativity. This could be due to sampling differences: a student sample was used from Malaysia, but the British participants were recruited online from the wider population and was thus more diverse.

However, I did find a negative relationship between autism traits and the AUT. Although the relationship cannot be confirmed to be predictive or causal in this study, this finding does run in line with my predictions and the findings of previous literature, where autism traits are related to decreased imagination. Interestingly, the MGT, which was language based, did not show significant differences. Similarly, in Chapter 3, the SST, another language-based task, also did not show significant differences between groups. I posit that difficulties on these language-based tasks indicate language-specific difficulties in autism, and thus cannot be replicated in a non-clinical population. Additionally, Malaysians scored themselves as being more creative compared to British participants, especially on items in the subdomain of Drama, which included activities such as acting, singing and writing poetry/prose. This could have been the result of the Malaysian sample being a university-level student sample, who may have a greater interest in the arts, or more time to pursue them.

In Chapter 5, I examined the role of culture on autism traits, with an emphasis on the dimension of attention to detail. I used the visual search task (VST), a classic measure of enhanced visual perception, and the face composite task (FCT), a segmentation task involving complex face stimuli, to examine attentional abilities between cultures. I expected that Malaysians may report higher levels of autism traits compared to British participants, as per the findings of Freeth et al. (2013). If these traits reflected cognitive differences, then Malaysians would show better attention to detail than British participants. If these differences were isolated to the questionnaire, then I expected that Malaysians, being a collectivistic Asian culture, would show worse attention to detail than British participants, as they would process information in a more global manner. In this study, I found that there were significant differences between groups in autism traits, with Malaysians having more autism traits compared to British participants, though this effect disappeared following alpha level corrections. I also found that Malaysians were more individualistic, but not more collectivistic, than British participants. I attributed these findings to differences in the population samples. Yet higher levels of individualism and lower levels of collectivism predicted higher levels of autism traits. Nationality predicted higher levels of autistic traits – Malaysians could be predicted to have higher levels of autistic traits compared to British participants – and nationality also predicted task performance on the VST but not on the FCT. Additionally, the two tasks were not correlated, and I only found group differences in the VST, with Malaysians being slower to correctly identify the target compared to British participants. These predictive relationships could not be accounted for entirely by cognition, and I suggest that the two task measures may not have both measured local processing but rather different aspects of visual attention.

6.2 Strengths and Limitations

This research is one of the first and few of its kind that examines autistic traits in terms of cognition from within a Malaysian population specifically; this is the heart of the study, as many studies looking into cross-cultural differences in autistic traits and behaviours tend to focus on East Asian cultures, such as China, Japan and Korea, or South Asian cultures, such as India. However, differences in autistic traits and behaviours can even be found between Western countries and even within the same country in the West (Mandell et al., 2002; Mandell et al., 2009; Mandy et al., 2014; Matson et al., 2011); it is important to look into Asian cultures separately, rather than assuming a monolithic cultural identity or cultural values, and assuming homogeneity of behaviour and cognition all across Asia. My study not only looked at a Malaysian sample specifically, but I also conducted direct cross-cultural comparisons with British samples from the general population, rather than comparing Malaysian trends to British trends found in previous literature. These direct cross-cultural comparisons provide insight into the universality of specific autism traits, and which cognitive and cultural factors could influence be responsible for differences found on the AQ between cultures. I also approached the topic of culture from beyond the one-dimensional view of nationality, and began to look at other aspects of culture such as cultural orientation and adherence to cultural values in order to glean an understanding of the underpinnings of culture that could be responsible for the AQ scores and task scores that I found. I also explored factors such as language, age, and face processing biases in relation to the tasks and questionnaires.

In Chapter 2, I used the GEST, which was a ‘purer’ measure of CF as it strived to reduce the use of other executive functions such as working memory, in conjunction with a more classic measure of CF, the WCST, as a more life-like measure of CF that used other facets of executive functioning such as working memory. The use of both tasks together, to look at CF more realistically and in a more isolated way, was a key strength of this particular study. Similarly, in Chapter 3, Chapter 4 and Chapter 5, I also used classic tasks, such as the RMET, the SST, the AUT and the VST, to measure the various cognition and abilities which allowed us to draw conclusions about cross-cultural comparisons based on a wide breadth of established findings.

However, that does not mean that this research is not without limitations. The population samples I used make my results difficult to generalise to the general population. Firstly, the majority of the participants across all of the studies identified as female. The large number of individuals diagnosed with ASCs being male, and females being under-represented and diagnosed later, is a potential issue (Dworzynski et al., 2012; Loomes et al., 2017; Marella et al., 2021; Russell et al., 2011), as established findings in autism are not only predominantly from Western countries, but have the additional aspect of a potential sex bias towards males. Autistic girls were found to score lower than autistic boys on the ADOS-2, the most widely used diagnostic tool for autism (Mussey et al., 2017), and did not meet the diagnostic criteria on the ADI-R, another widely used diagnostic tool in autism (Ratto et al., 2018). Thus, the diagnostic tools themselves could also potentially contain a sex bias. Male-female differences in ASCs were also found to be particularly salient on aspects such as pretend play and executive functions (Hull et al., 2017). Yet, contrary to these findings, other studies have found that, over time, being female predicts decreasing traits in ASC populations, but not in the general, non-clinical population (Pender et al., 2020). Thus, perhaps, the participants largely being female may not have impacted my findings overmuch as I used a non-clinical sample and the ratio of male to female participants was similar between both groups. However, these findings may not be generalisable to the entire Malaysian or British populations, which would be more gender diverse. Future studies should aim to recruit a more balanced sample in order to reflect the gender diversity within the populations.

Secondly, I was unable to recruit equal numbers of participants in the Malaysian sample from the major ethnic groups and participants often tended to be mostly Malaysian Chinese. Thus, it is difficult to generalise my findings to the other ethnic groups – specifically, to Malays and Malaysian Indians who also make up a large percentage of the Malaysian population (Noor & Leong, 2013). Thirdly, the Malaysian samples recruited were primarily student samples, though the British samples had more variability. The Malaysian student sample may make the findings of this study difficult to generalise to the wider Malaysian population, especially as the university that the data was primarily collected from was a private university. Participants from the Malaysian student sample may have had a higher SES, higher English proficiency, lived more urbanised lives, as compared to most of the general Malaysian population. Although student samples may have similar sociodemographic features as non-student samples, differences in the strength of the relationships between variables can be lower in student samples compared to non-student samples (Demerouti & Rispens, 2014; Wheeler et al., 2014). Moreover, as face-to-face/in-person recruitment was not always feasible for the British samples, participants were often recruited via the online recruitment platform Prolific. Whilst age and ethnicity could somewhat be screened for on these platforms, there would still be more variability in the backgrounds of these participants compared to the Malaysian sample. Future replications of these studies should either focus on exclusively university level student samples or comparisons between the wider population to avoid this possible confound.

Another issue to highlight is the possible interference of language. Although I tried to control for language in Chapter 3 by looking at whether results differed depending on whether participants were L1 or L2 English speakers, I did not include language as a control across all of the studies. Some of the tasks I used required working English skills, such as the SST and the MGT, to clarify and explain participants' viewpoints and statements. I attempted to mitigate potential language effects by looking at whether participants were L1 or L2 English speakers (Chapter 3). However, language effects reach beyond simply whether participants are L1 or L2 speakers, into things such as cross-cultural differences in the semantic meaning of language, due to language proficiency and history. This would have impacted not just the language-based tasks, but the very way that participants *understood* and interpreted the items on the questionnaires. This particular issue was beyond the scope of my current research, which focused primarily on exploring potential cultural differences in cognition related to autistic traits in the general population. However, it opens up potential research avenues in the future with regards to potential cultural differences in the semantic understanding of the questionnaire measures and diagnostic tools, and whether these differences could be responsible for the response styles that I found in this study.

Another the issue is that the AQ itself, and its’ subscales, may not be entirely stable. I included this measure as a measure of autism traits in the general population because of the growing trend in Asia in using the AQ as a screening tool. However, there are competing models with regards to the consistency of the subscales of the AQ (e.g. Austin, 2005; Freeth et al., 2013; Hoekstra et al., 2008; Hoekstra et al., 2011; Kloosterman et al., 2011; Lau et al., 2013; Stewart & Austin, 2009; Russell-Smith et al., 2011). Factor analysis in Freeth et al. (2013) found different factor structures in the UK and Malaysian data; a four-factor model in the UK population (social situation enjoyment, poor social communication, attention to detail, and imagination) and a four-factor model in the Malaysian population (social situation enjoyment, good attention to detail and poor social communication, social awareness and attention to detail, and imagination); none of these factors (and their items) replicated the model proposed by Baron-Cohen et al. (2001). Although the first factor, social situation enjoyment, was comparable between Malaysian and British participants, the second factor contained items describing “attention to detail” in the original AQ subscale in the Malaysian sample (Freeth et al., 2013). This factor also had lower internal consistency in the Malaysian sample (Freeth et al., 2013). In the third factor, the Malaysian sample also had items that were related to attention to detail in what would otherwise be another “social” factor. In both samples, there was a clear “imagination” factor, which had items related to story reading and pretend play with children (Freeth et al., 2013). Not all of the items were included in the final model; the British model only included 35 out of 50 items, and the Malaysian model included 31 out of 50 items in the model (Freeth et al., 2013). Thus, as the same set of behaviours was categorised differently based on culture, there are indications of cross-cultural differences in the conceptual aspects of the subscales (Freeth et al., 2013), and this makes it unreliable to compare the factors directly.

Further research conducted using confirmatory factor analysis on 11 competing AQ models supported the use of the three-factor model described by Russell-Smith et al. (2011) over all other models, including the five-factor model originally described in Baron-Cohen et al. (2001) and the four-factor model described in Freeth et al. (2013) (English et al., 2020). Of the items analysed, the three-factor model ultimately only included about 28 out of the original 50 items. The factors identified were 1) social skills, which included items specifically related to socialising preferences and social motivation 2) details/patterns, which included items relating to numbers, categories and patterns, and 3) communication/mindreading, which included items referring to ToM and social interactions (Russell-Smith et al., 2011). Furthermore, English et al. (2020) further went on to highlight that the use of total AQ scores was not suitable as there was large variability in the AQ subscales responsible for the total AQ scores, and had low internal reliability

(Cronbach's α = .37 in the general population sample and .39 in the undergraduate sample) when using the three-factor model.

My studies focused on the skills involved in the five subscales outlined in Baron-Cohen et al. (2001) in order to make comparisons to the subscale findings of Freeth et al. (2013), but, as I had noted the instability of the subscales, I opted to use the total score on the AQ in analyses. The total score on the AQ being higher in Malaysians compared to British participants may not, therefore, be entirely reflective of either behavioural or cognitive differences between groups. Instead, it could reflect a cultural difference in the interpretation of the items but also reflect a profile that had little to do with autistic traits at all. Additionally, I also scored the AQ on a 4-point Likert scale of 1-4, whereas the original scoring of the AQ was a 2-point scale from 0-1. Although I did this in light of findings that a 1-4 Likert scale for the AQ was more reliable (Murray et al., 2016) this may have actually impacted my results, as the original scoring system did not increase or decrease level of autism traits based on the 'severity' of the response.

The problems with the AQ were partially mitigated by my initial inclusion of the SRS as an alternative measure of autism traits in Chapter 2, as I found similar answering patterns on the SRS that I found on the AQ. To extend this further, I could have included it in another study that used self-reported measures not related to autism traits in order to examine whether the effects found on the AQ depending on the population were isolated to the AQ or present on all different measures of autism traits. Additionally, future replications of these studies could also calculate the AQ scores based on the original 0-1 Likert scale as well as using the 1-4 scale used in the current study to examine whether the use of a wider scale would impact the overall pattern of results. Future studies using the AQ-50 in Malaysia could consider use the three-factor model by Russell-Smith et al. (2011) for the AQ rather than using the total AQ scores or the five subscales outlined by Baron-Cohen et al. (2001). The use of scales such as the AQ-28 or AQ-10 could also be explored in a Malaysian context to test whether these measures are more suitable for use in Malaysia compared to the AQ-50, as items that are more culturally sensitive may already be excluded from these scales.

Finally, although I tried to be comprehensive in my theoretical coverage, ultimately, the bounds of my experiments were somewhat limited. For example, Chapter 3 aimed to examine social skills and communication, however, I only examined ToM and no other aspects of social cognition. In Chapter 4, I tried to examine imagination, however, due to the difficulty of measuring imagination in an adult population, I operationalised this by measuring creativity instead which, as I acknowledged in Chapter 4, is *related* to imagination but not the entirety of imagination itself. In the specific case of Chapter 4, participants also rated their own levels of creativity – I assumed that this measure was subjective, compared to the task measures, however, is creativity not subjective in itself? Can creativity – and therefore, imagination -- truly be measured by the tasks that I used? There is also the matter of how this research breaks down autism traits into components for comparison but, in reality, these components often exist simultaneously and function concurrently and in tandem with each other, and do not function independently. For example, CF has been found to be linked to ToM difficulties in ASCs (Latinus et al., 2019; McEvoy et al., 1993; Ozonoff & Pennington, 1991; Ozonoff & McEvoy, 1994) and attention to detail and social communication difficulties in ASCs (Valla & Belmonte, 2013) . Overall, although I tried to be comprehensive, inevitably it was necessary to be selective about tasks to be included and future studies could usefully include alternative tasks for many of the measures examined.

6.3 Impact, Implications and Directions for Future Research

I found mostly consistent group differences in levels of autism traits between British and Malaysian members of the general population. These group differences were partially reflected in cognition, notably in attention-switching and ToM. From my findings, I suggest that culture *does* partially cause differences on the AQ, and these differences *can* be – though not always and perhaps not consistently – reflected in cognition. The AQ is therefore measuring autistic traits to some extent, rather than simply capturing cultural differences in response patterns. Culture, as explored in this research, encompasses more than just where an individual is from or where they are currently living, but includes a wide range of factors such as cultural orientation, cultural values and demands, language, and these should be taken into account when administering Western-centric self-report items and tasks in different populations.

Conversely, there were also cases such as in Chapter 4 and Chapter 5 where there were no differences on the AQ, or where differences on the AQ disappeared following alpha level corrections. Cross-cultural differences in cognition were also not found consistently throughout the research, and culture (and aspects of culture, such as orientation) did not consistently predict how a participant might score on the AQ. AQ scores were not consistently reflective of cognition throughout the research; cross-cultural response patterns on the AQ did not consistently reflect cognition even when the tasks were measuring the same underlying concepts and found to be interrelated. These findings in conjunction suggest that participants may be reporting autistic traits that are reflective of their cognition only to some extent, as differences found on the AQ and the SRS were not always entirely reflective of cognitive differences. Language, age, cultural orientation and demands only partially accounted for differences on the AQ, so I surmise that the cross-cultural difference on the autism measures that I found could be attributable to some aspect of the questionnaires that lead participants from a specific culture to respond one way compared to another. Thus, in line with my expectations, there is also a degree of cultural bias in self-reported measures of autism traits. Future studies could be conducted to explore this further by getting participants to clarify on why they gave a specific score to specific items and additional factor analyses to identify culturally-sensitive items on the questionnaires.

I also found that, contrary to my expectations and previous research, Malaysians consistently rated themselves as more individualistic, and occasionally more collectivistic, than British participants. One possible reason for this could be that my participant sample was a student sample, which would mostly be of an urban group, which may have led them to being more individualistic. However, I would still not expect an urban Malaysian group to be more individualistic than the UK participants. Therefore, these current findings could either be the result of Malaysians simply responding higher on questionnaires in general or these findings are truly reflective of Malaysian cultural values. Malaysians could have scored higher on the measure due to the items on the COS, which may be capturing values in Malaysian culture other than individualism or collectivism. For example, items such as “When another person does better than I do, I get tensed and aroused”, “If a co-worker gets a prize, I would feel proud” and “It is important that I do my job better than others” may, especially in a student sample, capture academic competitiveness that is characteristic of the Malaysian schooling system as compared to individualistic or collectivistic characteristics. Malaysian schools, as with many schools throughout Asia, employ systems of student rankings for most of the school years, reflecting the important of academic success in Malaysian culture and academic competition between students. Therefore, if my findings on cultural orientation are the result of the specific questionnaire that I used, then the use of alternative measures of cultural orientation, such as the Self-Construal Scale (Singelis, 1994) which has been translated and validated in Malaysia (Ramley et al., 2020), could be included in future studies to investigate whether cross-cultural differences on this measure are isolated specifically to the COS.

Conversely, whilst Malaysians could be scoring higher on cultural orientation measures as a result of the specific questionnaire used, these findings may also genuinely reflect the cultural values in Malaysia. Perhaps, South-East Asian cultural values are less exclusively collectivistic as compared to East Asian cultural values. Or perhaps, these findings specifically reflect the values and influences present in Malaysia. The ethnic composition of Malaysia is largely diasporic ethnic groups (Noor & Leong, 2013), implying a level of multiculturalism that may not be present in China or Japan. Additionally, Malaysia may have a larger Western influence compared to East Asian cultures such as China, Japan or Korea, leading to a mix of values that could be expressed by scoring higher on both aspects of cultural orientation. Future studies could look into factor analysis to identify which items in particular are indicative of cultural differences in Malaysia, as these may reflect the unique cultural values of Malaysia, which could also be responsible for differences in task performance and the answering patterns I found in this study on autism-related questionnaires.

My findings also imply practical implications regarding the use of the AQ in Malaysia as a screening tool. In my research, I found that Malaysians tended to score higher on the AQ compared to British participants. This suggests that the cut-off score for the AQ in Malaysia should be higher than cut-off scores used in the West. Additionally, the findings on the AQ was partially explained by cognitive factors, cultural values and language. The sensitivity of the AQ to sociocultural factors, such as the possible elevated scores specific to student sample population and language, should be taken into account if the AQ is being considered as a potential screening tool in Malaysia. Future research in this area should try to validate these measures in our own population and even to translate these measures to allow them to be applicable within a Malaysian context.

I also found differences in cognition, most notably in ToM and attention-switching, that reflected patterns I found in the self-report measures. Social cognition is a key characteristic of ASCs; finding group differences in measures of ToM has further implications. For example, as ToM is just one aspect of social cognition, it is still unclear whether differences would also be found in other aspects of social cognition such as social motivation or joint attention. Thus, future studies should explore the potential of cross-cultural differences in social motivation and joint attention in Malaysia, and its relation to autism traits, in order to properly glean an understanding of social cognition in Malaysia.

Additionally, autism itself is widely known for its difficulties with social interaction; finding cultural differences in ToM makes ToM abilities a key area for future cross-cultural research in autism. Do people with autism in Malaysia experience or express the same social difficulties that people with autism in the West do? This brings up important questions regarding social interaction for autistic individuals in Malaysia. The *double empathy problem* is described as the problems in the two-way interaction between autistic and NT individuals that make social interactions difficult for autistic individuals; not only do autistic individuals struggle with various aspects of social interactions, but there is a breakdown of communicative reciprocity between autistic and NT individuals that could explain socio-communicative problems described as characteristic of ASCs (Milton, 2021; Williams, 2021). If NT Malaysians exhibit a more “autistic-like” ToM compared to places like the UK, could this mean that Malaysian NT individuals would be more forgiving or understanding towards the social interaction difficulties that autistic individuals face? Could there be greater levels of reciprocity between NT Malaysians and Malaysians with high levels of autism traits and autistic Malaysians, despite their initial beliefs that they would be less willing to interact with autistic people? If so, what impact does this have on social interaction difficulties being characteristic of autism?

I also found differences in attention-switching when the task more closely mimicked real-life CF as it involved other EF domains. This difference was in line with my hypothesis that differences on the AQ would be reflected in cognition, however, it ran counter to the established findings of previous research, which maintained that individuals from multicultural and multilingual cultures would be more cognitively flexible. I based my expectation that Malaysians would be more cognitively flexible on the idea that, as Malaysian ethnic populations are largely diasporic, the navigation of cultural demands between the diasporic culture and the wider Malay culture would lead to better CF, as supported by previous findings (Harrison et al., 1990; Kim & Omizo, 2005; Spiegler & Leyendecker, 2017). However, perhaps, the current findings actually indicate that Malaysians are *not* needing to navigate the demands of multiple cultural values in such a way that increases their flexibility, thus putting into question the original expectations I had of CF in Malaysia. This could imply a wider Malaysian – and not exclusively Malay – cultural identity, rather than a dominant Malay culture and distinct ethnic cultures that diasporic groups in Malaysia must constantly switch between socially. Malaysian Chinese and Malaysian Indians, which make up a large percentage of the Malaysian population, have been present in Malaysia as early as the first century, establishing trading ports and coastal towns in the Malay Peninsula since the second and third centuries. Thus, the long history and close relationships of diasporic ethnic Chinese and Indians in the Malay Peninsula could have feasibly result in mixed cultural influences across all three cultures, leading to a melting-pot Malaysian culture rather than a dominant Malay culture.

Furthermore, although I found differences between groups in CF, better or worse CF did not predict autism traits in this study. This highlights CF as a key area for future research in terms of cross-cultural differences in autism traits in Malaysia, as it is unclear whether NT Malaysians would have better or worse CF than Malaysian individuals with autism, and what impact this would have on Malaysians with

ASCs. Future research could explore CF in Malaysia to try understand the cultural moderating factors that may influence it and how this interacts with autistic traits and CF difficulties in autism as a whole.

6.4 Overall Conclusions

I aimed to investigate cultural differences in autism traits in the general population of Malaysia and the UK, and whether these differences would be reflected in cognition and behaviour or whether they were the product of a cultural bias in the questionnaires. I found that differences on the AQ were mostly consistent with the findings of Freeth et al. (2013), where Malaysians would score higher than British individuals, implying greater levels of autism traits. These effects were not isolated to the AQ, and were also found on another measure of autism traits, the SRS, and cultural measures, such as the COS. I also found some evidence suggesting that cultural differences in self-reported autism traits *are* partially reflected in cognition, particularly in ToM and attention-switching. However, I cannot irrefutably conclude that these differences in traits were entirely reflective of cognition and not the product of biases in the questionnaires or tasks.

Moreover, findings in ToM and attention-switching highlight these areas for future cross-cultural comparative research, with implications regarding the double empathy problem in autism and the potential of distinctive switching behaviour in Malaysia that differ from patterns previously found in multicultural and multilingual groups. Other factors of culture, such as language, cultural orientation and adherence to cultural values, were suggested to play a larger role than initially thought in the answering patterns of Malaysians on self-reported measures of autism traits. Implied by the findings is that answering patterns in Malaysia could be sensitive to age and other factors associated with university-level students such as SES and urbanisation. This pushes the need for validated and translated measures to be used within Malaysia. Nevertheless, the current research provides important steps and a foundation for future research, in order to establish a baseline of neurotypical behaviour to further understand how ASCs present within a Malaysian context compared to a Western context.

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Appendices

Appendix A

Items and Item Scoring on the Autism Spectrum Quotient (AQ)

Items		Likert Scale Scoring			
		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
1	I prefer to do things with others rather than on my own.	1	2	3	4
2	I prefer to do things the same way over and over again.	4	3	2	1
3	If I try to imagine something, I find it very easy to create a picture in my mind.	1	2	3	4
4	I frequently get so strongly absorbed in one thing that I lose sight of other things.	4	3	2	1
5	I often notice small sounds when others do not.	4	3	2	1

6	I usually notice car number plates or similar strings of information.	4	3	2	1
7	Other people frequently tell me that what I've said is impolite, even though I think it is polite.	4	3	2	1
8	When I'm reading a story, I can easily imagine what the characters might look like.	1	2	3	4
9	I am fascinated by dates.	4	3	2	1
10	In a social group, I can easily keep track of several different people's conversations.	1	2	3	4
11	I find social situations easy.	1	2	3	4
12	I tend to notice details that others do not.	4	3	2	1
13	I would rather go to a library than a party.	4	3	2	1
14	I find making up stories easy.	1	2	3	4
15	I find myself drawn more strongly to people than to things.	1	2	3	4

16	I tend to have very strong interests which I get upset about if I can't pursue.	4	3	2	1
17	I enjoy social chit-chat.	1	2	3	4
18	When I talk, it isn't always easy for others to get a word in edgeways.	4	3	2	1
19	I am fascinated by numbers.	4	3	2	1
20	When I'm reading a story, I find it difficult to work out the characters' intentions.	4	3	2	1
21	I don't particularly enjoy reading fiction.	4	3	2	1
22	I find it hard to make new friends.	4	3	2	1
23	I notice patterns in things all the time.	4	3	2	1
24	I would rather go to the theatre than a museum.	1	2	3	4
25	It does not upset me if my daily routine is disturbed.	1	2	3	4
26	I frequently find that I don't know how to keep a conversation going.	4	3	2	1

27	I find it easy to “read between the lines” when someone is talking to me.	1	2	3	4
28	I usually concentrate more on the whole picture, rather than the small details.	1	2	3	4
29	I am not very good at remembering phone numbers.	1	2	3	4
30	I don’t usually notice small changes in a situation, or a person’s appearance.	1	2	3	4
31	I know how to tell if someone listening to me is getting bored.	1	2	3	4
32	I find it easy to do more than one thing at once.	1	2	3	4
33	When I talk on the phone, I’m not sure when it’s my turn to speak.	4	3	2	1
34	I enjoy doing things spontaneously.	1	2	3	4
35	I am often the last to understand the point of a joke.	4	3	2	1

36	I find it easy to work out what someone is thinking or feeling just by looking at their face.	1	2	3	4
37	If there is an interruption, I can switch back to what I was doing very quickly.	1	2	3	4
38	I am good at social chit-chat.	1	2	3	4
39	People often tell me that I keep going on and on about the same thing.	4	3	2	1
40	When I was young, I used to enjoy playing games involving pretending with other children.	1	2	3	4
41	I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	4	3	2	1
42	I find it difficult to imagine what it would be like to be someone else.	4	3	2	1
43	I like to plan any activities I participate in carefully.	4	3	2	1

44	I enjoy social occasions.	1	2	3	4
45	I find it difficult to work out people's intentions.	4	3	2	1
46	New situations make me anxious.	4	3	2	1
47	I enjoy meeting new people.	1	2	3	4
48	I am a good diplomat.	1	2	3	4
49	I am not very good at remembering people's date of birth.	1	2	3	4
50	I find it very easy to play games with children that involve pretending.	1	2	3	4

Note. Adapted from Baron-Cohen et al. (2001). *Attention-switching* subscale includes items 2, 4, 10, 16, 25, 32, 34, 37, 43, and 46. *Social skills* subscale includes items 1, 11, 13, 15, 22, 36, 44, 45, 47, and 48. *Communication* subscale includes items 7, 17, 18, 26, 27, 31, 33, 35, 38 and 39. *Imagination* subscale includes items 3, 8, 14, 20, 21, 24, 40, 41, 42, and 50. *Attention to detail* subscale includes items 5, 6, 9, 12, 19, 23, 28, 29, 30, and 49.

Appendix B

Items and Item Scoring on Additional Questionnaires in Chapter 2.

Table B1.

Items and Item Scoring on the Social Responsiveness Scale (SRS).

For each question, please indicate the answer that best describes your behaviour over the past 6 months:

	Items	Likert Scale Scoring			
		Not True	Sometimes True	Often True	Almost Always True
1	I am much more uncomfortable in social situations than when I am by myself.	0	1	2	3
2	My facial expressions send the wrong message to others about how I actually feel.	0	1	2	3
3	I feel self-confident when interacting with others.	3	2	1	0

4	When under stress, I engage in rigid or inflexible patterns of behaviour that seem odd to people.	0	1	2	3
5	I do not recognize when others are trying to take advantage of me.	0	1	2	3
6	I would rather be alone than with others.	0	1	2	3
7	I am usually aware of how others are feeling.	3	2	1	0
8	I behave in ways that seem strange or bizarre to others.	0	1	2	3
9	I am overly dependent on others for help with meeting my everyday needs.	0	1	2	3
10	I take things too literally, and because of that, I misinterpret the intended meaning of parts of a conversation.	0	1	2	3
11	I have good self-confidence.	3	2	1	0
12	I am able to communicate my feelings to others.	3	2	1	0

13	I am awkward in turn-taking interactions with others (for example, I have a hard time keeping up with the give-and-take of a conversation).	0	1	2	3
14	I am not well coordinated.	0	1	2	3
15	When people change their tone or facial expression, I usually pick up on that and understand what it means.	3	2	1	0
16	I avoid eye contact or am told that I have unusual eye contact.	0	1	2	3
17	I recognize when something is unfair.	0	1	2	3
18	I have difficulty making friends, even when trying my best.	0	1	2	3
19	I get frustrated trying to get ideas across in conversations.	0	1	2	3
20	I have sensory interests that others find unusual (for example, smelling or looking at things in a special way).	0	1	2	3
21	I am able to imitate others' actions and expressions when it is socially appropriate to do so.	3	2	1	0

22	I interact appropriately with other adults.	3	2	1	0
23	I do not join group activities or social events unless prompted or strongly urged to do so.	0	1	2	3
24	I have more difficulty than others with changes in my routine.	0	1	2	3
25	I do not mind being out of step with or “not on the same wavelength” as others.	0	1	2	3
26	I offer comfort to others when they are sad.	3	2	1	0
27	I avoid starting social interactions with other adults.	0	1	2	3
28	I think or talk about the same thing over and over.	0	1	2	3
29	I am regarded by others as odd or weird.	0	1	2	3
30	I become upset in situations with lots of things going on.	0	1	2	3
31	I can’t get my mind off something once I start thinking about it.	0	1	2	3
32	I have good personal hygiene.	3	2	1	0

33	My behaviour is socially awkward, even when I am trying to be polite.	0	1	2	3
34	I avoid people who want to be emotionally close to me.	0	1	2	3
35	I have trouble keeping up with the flow of a normal conversation.	0	1	2	3
36	I have difficulty relating to family members.	0	1	2	3
37	I have difficulty relating to adults outside of my family.	0	1	2	3
38	I respond appropriately to mood changes in others (for example, when a friend's mood changes from happy to sad).	3	2	1	0
39	People think I am interested in too few topics, or that I get too carried away with those topics.	0	1	2	3
40	I am imaginative.	3	2	1	0
41	I sometimes seem to wander aimlessly from one activity to another.	0	1	2	3
42	I am overly sensitive to certain sounds, textures, or smells.	0	1	2	3

43	I enjoy small talk (casual conversation with others).	3	2	1	0
44	I have more trouble than most people with understanding chains of causation (in other words, how events are related to one another).	0	1	2	3
45	When others around me are paying attention to something, I get interested in what they are attending to.	3	2	1	0
46	Others feel that I have overly serious facial expressions.	0	1	2	3
47	I laugh at inappropriate times.	0	1	2	3
48	I have a good sense of humour and can understand jokes.	3	2	1	0
49	I do extremely well at certain kinds of intellectual tasks, but do not do as well at most other tasks.	0	1	2	3
50	I have repetitive behaviours that others consider odd.	0	1	2	3
51	I have difficulty answering questions directly and end up talking around the subject.	0	1	2	3
52	I get overly loud without realizing it.	0	1	2	3

53	I tend to talk in a monotone voice (in other words, less inflection of voice than most people demonstrate).	0	1	2	3
54	I tend to think about people in the same way that I do objects.	0	1	2	3
55	I get too close to others or invade their personal space without realizing it.	0	1	2	3
56	I sometimes make the mistake of walking between two people who are trying to talk to one another.	0	1	2	3
57	I tend to isolate myself.	0	1	2	3
58	I concentrate too much on parts of things rather than seeing the whole picture.	0	1	2	3
59	I am more suspicious than most people.	0	1	2	3
60	Other people think I am emotionally distant and do not show my feelings.	0	1	2	3
61	I tend to be inflexible.	0	1	2	3

62	When I tell someone my reason for doing something, it strikes the person as unusual or illogical.	0	1	2	3
63	My way of greeting another person is unusual.	0	1	2	3
64	I am much more tense in social settings than when I am by myself.	0	1	2	3
65	I find myself staring or gazing off into space.	0	1	2	3

Table B2.

Items and Item Scoring on the Cognitive Flexibility Scale (CFS).

	Items	Likert Scale Scoring					
		Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree
1	I have difficulty using my knowledge on a given topic in real life situations.	1	2	3	4	5	6
2	I can find workable solutions to seemingly unsolvable problems.	6	5	4	3	2	1
3	My behavior is a result of conscious decisions that I make.	6	5	4	3	2	1
4	I feel like I never get to make decisions.	1	2	3	4	5	6

5	I seldom have choices when deciding how to behave.	6	5	4	3	2	1
6	I can communicate an idea in many different ways.	6	5	4	3	2	1
7	I am willing to listen and consider alternatives for handling a problem.	6	5	4	3	2	1
8	I avoid new and unusual situations.	1	2	3	4	5	6
9	I have the self-confidence necessary to try different ways of behaving.	6	5	4	3	2	1
10	I am willing to work at creative solutions to problems.	6	5	4	3	2	1
11	In any given situation, I am able to act appropriately.	6	5	4	3	2	1

12	I have many possible ways of behaving in any given situation.	6	5	4	3	2	1

Appendix C

Items and Item Scoring on the Cultural Orientation Scale (COS)

Items	Likert Scale Scoring								
	Definitely No	No	Moderately No	Slightly No	Neither	Slightly Yes	Moderately Yes	Yes	Definitely Yes
Horizontal Individualism									
1. I'd rather depend on myself than others.	1	2	3	4	5	6	7	8	9
2. I rely on myself most of the time; I rarely rely on others.	1	2	3	4	5	6	7	8	9
3. I often do "my own thing."	1	2	3	4	5	6	7	8	9
4. My personal identity, independent of others, is very important to me.	1	2	3	4	5	6	7	8	9
Vertical Individualism									
1. It is important that I do my job better than others.	1	2	3	4	5	6	7	8	9
2. Winning is everything.	1	2	3	4	5	6	7	8	9
3. Competition is the law of nature.	1	2	3	4	5	6	7	8	9

4. When another person does better than I do, I get tense and aroused.	1	2	3	4	5	6	7	8	9
Horizontal Collectivism									
1. If a coworker gets a prize, I would feel proud	1	2	3	4	5	6	7	8	9
2. The well-being of my coworkers is important to me.	1	2	3	4	5	6	7	8	9
3. To me, pleasure is spending time with others.	1	2	3	4	5	6	7	8	9
4. I feel good when I cooperate with others.	1	2	3	4	5	6	7	8	9
Vertical Collectivism									
1. Parents and children must stay together as much as possible.	1	2	3	4	5	6	7	8	9
2. It is my duty to take care of my family, even when I have to sacrifice what I want.	1	2	3	4	5	6	7	8	9
3. Family members should stick together, no matter what sacrifices are required.	1	2	3	4	5	6	7	8	9
4. It is important to me that I respect the decisions made by my groups.	1	2	3	4	5	6	7	8	9

Appendix D

Items and Item Scoring on the Asian Values Scale (AVS)

Items	Likert Scale Scoring						
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. One should not deviate from familial and social norms.	1	2	3	4	5	6	7
2. Following familial and social expectations is important.	1	2	3	4	5	6	7
3. One need not follow one's family's and the society's norms.	7	6	5	4	3	2	1
4. One need not conform to one's family's and the society's expectations.	7	6	5	4	3	2	1
5. The worst thing one can do is bring disgrace to one's family reputation.	1	2	3	4	5	6	7

6. When one receives a gift, one should reciprocate with a gift of equal or greater value.	1	2	3	4	5	6	7
7. One need not follow the role expectations (gender, family hierarchy) of one's family.	7	6	5	4	3	2	1
8. Family's reputation is not the primary social concern.	7	6	5	4	3	2	1
9. Occupational failure does not bring shame to the family.	7	6	5	4	3	2	1
10. Educational failure does not bring shame to the family.	7	6	5	4	3	2	1
11. One need not achieve academically to make one's parents proud.	7	6	5	4	3	2	1
12. The ability to control one's emotions is a sign of strength.	1	2	3	4	5	6	7

13. Parental love should be implicitly understood and not openly expressed.	1	2	3	4	5	6	7
14. One should have sufficient inner resources to resolve emotional problems.	1	2	3	4	5	6	7
15. One should think about one's group before oneself.	1	2	3	4	5	6	7
16. One should consider the needs of others before considering one's own needs.	1	2	3	4	5	6	7
17. One's achievements should be viewed as family's achievements.	1	2	3	4	5	6	7
18. Modesty is an important quality for a person.	1	2	3	4	5	6	7
19. One should not be boastful.	1	2	3	4	5	6	7
20. One should be humble and modest.	1	2	3	4	5	6	7

21. One's family need not be the main source of trust and dependence.	7	6	5	4	3	2	1
22. Children need not take care of their parents when the parents become unable to take care of themselves.	7	6	5	4	3	2	1
23. Children should not place their parents in retirement homes.	1	2	3	4	5	6	7
24. Elders may not have more wisdom than younger persons.	7	6	5	4	3	2	1
25. Educational and career achievements need not be one's top priority.	7	6	5	4	3	2	1
26. One need not be able to resolve psychological problems on one's own.	7	6	5	4	3	2	1

27. One need not control one's own expression of emotions.	7	6	5	4	3	2	1
28. One need not focus all energies on one's studies.	7	6	5	4	3	2	1
29. One need not minimise or depreciate one's own achievements.	7	6	5	4	3	2	1
30. One need not remain reserved and tranquil.	7	6	5	4	3	2	1
31. One should avoid bringing displease to one's ancestors.	1	2	3	4	5	6	7
32. One should be able to question a person in an authority position.	7	6	5	4	3	2	1
33. One should be discouraged from talking about one's accomplishments.	1	2	3	4	5	6	7
34. One should not make waves.	1	2	3	4	5	6	7

35. One should not inconvenience others.	1	2	3	4	5	6	7
36. Younger persons should be able to confront their elders.	7	6	5	4	3	2	1

Appendix E

Stimuli and Materials used for Reading the Mind in the Eyes Task (RMET)

Figure E1.

White Stimuli for RMET (includes practice stimulus, from Baron-Cohen, Wheelwright, Hill, et al., 2001).

Figure E2.

East Asian Stimuli for RMET (from Adams et al., 2010).

Table E1.

Scoring sheet for RMET (retrieved from Baron-Cohen, Wheelwright, Hill, et al., 2001).

P1	jealous	*panicked*	Arrogant	hateful
1	*playful*	comforting	irritated	bored
2	terrified	*upset*	arrogant	annoyed
3	joking	flustered	*desire*	convinced
4	joking	*insisting*	amused	relaxed
5	irritated	sarcastic	*worried*	friendly
6	aghast	*fantasising*	impatient	alarmed
7	apologetic	friendly	*uneasy*	dispirited

8	*despondent*	relieved	shy	excited
9	annoyed	hostile	horrified	*preoccupied*
10	*cautious*	insisting	bored	aghast
11	terrified	amused	*regretful*	flirtatious
12	indifferent	embarrassed	*sceptical*	Dispirited
13	decisive	*anticipating*	threatening	shy
14	irritated	disappointed	depressed	*accusing*
15	*contemplative*	flustered	encouraging	amused
16	irritated	*thoughtful*	encouraging	sympathetic
17	*doubtful*	affectionate	playful	aghast
18	*decisive*	amused	aghast	bored
19	arrogant	grateful	sarcastic	*tentative*
20	dominant	*friendly*	guilty	horrified
21	embarrassed	*fantasising*	confused	panicked
22	*preoccupied*	grateful	insisting	imploring
23	contented	apologetic	*defiant*	Curious
24	*pensive*	irritated	excited	hostile
25	panicked	incredulous	despondent	*interested*
26	alarmed	shy	*hostile*	anxious
27	joking	*cautious*	arrogant	reassuring
28	*interested*	joking	affectionate	Contented
29	impatient	aghast	irritated	*reflective*
30	grateful	*flirtatious*	hostile	disappointed
31	ashamed	*confident*	joking	dispirited
32	*serious*	ashamed	bewildered	alarmed
33	embarrassed	guilty	fantasising	*concerned*
34	aghast	baffled	*distrustful*	terrified

35	puzzled	*nervous*	insisting	contemplative
36	ashamed	nervous	*suspicious*	Indecisive

Note. List of target mental state terms for each item in italics, listed with distractors. P1 = practice trial item.

Appendix F

Stimuli and Materials for the Strange Stories Task (SST)

Experimental Questions for SST (Retrieved from Fletcher et al., 1995)

Sample SST.

One day, while she is playing in the house, Anna accidentally knocks over and breaks her mother's favourite crystal vase. Oh dear, when her mother finds out she will be very cross! So when Anna's mother comes home and sees the broken vase and asks Anna what happened, Anna says, "The dog knocked it over, it wasn't my fault!"

Is it true what Anna says? Why does Anna say this?

Story – Double Bluff.

Simon is a big liar. Simon’s brother Jim knows this, he knows that Simon never tells the truth! Now yesterday Simon stole Jim’s ping-pong paddle, and Jim knows Simon has hidden it somewhere, though he can’t find it. He’s very cross. So he finds Simon and he says, ‘‘Where is my pingpong paddle? You must have hidden it either in the cupboard or under your bed, because I’ve looked everywhere else. Where is it, in the cupboard or under your bed’’? Simon tells him the paddle is under his bed.

Comprehension and Mental State Questions. Is it true what Simon says? Where will Jim look for the paddle and why?

Story – Double Bluff.

During the war, the Red army captures a member of the Blue army. They want him to tell them where his army's tanks are; they know they are either by the sea or in the mountains. They know that the prisoner will not want to tell them, he will want to save his army, and so he will certainly lie to them. The prisoner is very brave and very clever, he will not let them find his tanks. The tanks are really in the mountains. Now when the other side asks him where his tanks are, he says, ''They are in the mountains.''

Comprehension and Mental State Questions. Is it true what the prisoner says? Why did the prisoner say what he said?

Story – Lie.

Brian is always hungry. Today at school it is his favourite meal—sausages and beans. He is a very greedy boy, and he would like to have more sausages than anybody else, even though his mother will have made him a lovely meal when he gets home! But everyone is allowed two sausages and no more. When it is Brian's turn to be served, he says, ''Oh, please can I have four sausages, because I won't be having any dinner when I get home!''

Comprehension and Mental State Questions. Is it true what Brian says? Why does Brian say this?

Story – Persuasion.

Jill wanted to buy a kitten, so she went to see Mrs. Smith, who had lots of kittens she didn't want. Now Mrs. Smith loved the kittens, and she wouldn't do anything to harm them, though she couldn't keep them all herself. When Jill visited she wasn't sure she wanted one of Mrs. Smith's kittens, since they were all males and she had wanted a female. But Mrs. Smith said, ''If no one buys the kittens I'll just have to drown them!''

Comprehension and Mental State Questions. Was it true, what Mrs Smith says? Why does Mrs Smith say this to Jane?

Story – White Lie.

One day Aunt Jane came to visit Peter. Now Peter loves his aunt very much, but today she is wearing a new hat; a new hat which Peter thinks is very ugly indeed. Peter thinks his aunt looks silly in it, and much nicer in her old hat. But when Aunt Jane asks Peter, ''How do you like my new hat?,'' Peter says, ''Oh, its very nice.''

Comprehension and Mental State Questions. Is it true what Peter says? Why does Peter say this?

Story – White Lie.

Helen waited all year for Christmas, because she knew at Christmas she could ask her parents for a rabbit. Helen wanted a rabbit more than anything in the world. At last Christmas Day arrived, and Helen ran to unwrap the big box her parents had given her. She felt sure it would contain a little rabbit in a cage. But when she opened it, with all the family standing round, she found her present was just a boring old set of encyclopedias, which Helen did not want at all! Still, when Helen's parents asked her how she liked her Christmas present, she said, "It's lovely, thank you. It's just what I wanted."

Comprehension and Mental State Questions. Is it true what Helen says? Why did Helen say this?

Story – Misunderstanding.

Late one night old Mrs. Peabody is walking home. She doesn’t like walking home alone in the dark because she is always afraid that someone will attack her and rob her. She really is a very nervous person! Suddenly, out of the shadows comes a man. He wants to ask Mrs. Peabody what time it is, so he walks toward her. When Mrs. Peabody sees the man coming toward her, she starts to tremble and says, ‘‘Take my purse, just don’t hurt me please!’’

Comprehension and Mental State Questions. Was the man surprised by what Mrs Peabody says? Why does Mrs Peabody say this?

Story – Misunderstanding.

A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn’t know the man is a burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, ‘‘Hey, you! Stop!,’’ the burglar turns round, sees the policeman and gives himself up. He puts his hands up and admits that he did the break-in at the local shop.

Comprehension and Mental State Questions. Was the policeman surprised? Why did the burglar do this?

Table F1.

Scoring sheet for SST (retrieved from White et al., 2009)

Story type	**Mental state question**	**Scoring criteria**
Double bluff	Why will Jim look in the cupboard for the paddle?	**2 points** – reference to Jim knowing Simon lies **1 point** – reference to facts (that's where it really is, Simon's a big liar) or Simon hiding it without reference to implications of lying **0 points** – reference to general nonspecific information (because he looked everywhere else)
Double bluff	Why did the prisoner say that?	**2 points** – reference to fact that other army will not believe and hence look in other place, reference to prisoner's realization that that's what they'll do, or reference to double bluff **1 point** – reference to outcome (to save his army's tanks) or to mislead them **0 points** – reference to motivation that misses the point of double bluff (he was scared)
Lie	Why does Brian say this?	**2 points** – reference to fact that he's trying to elicit sympathy, being deceptive **1 point** – reference to his state (greedy), outcome (to get more sausages) or factual

		0 points – reference to a motivation that misses the point of sympathy elicitation/deception, or factually incorrect
Persuasion	Why did Mrs. Smith say that?	**2 points** – reference to persuasion, manipulating feelings, trying to induce guilt/pity **1 point** – reference to outcome (to sell them or get rid of them in a way which implies not drowning) or simple motivation (to make Jill sad) **0 points** – reference to general knowledge or dilemma without realization that the statement was not true (she's a horrible woman)
White lie	Why does he say that?	**2 points** – reference to white lie or wanting to spare her feelings; some implication that this is for aunt's benefit rather than just for his, desire to avoid rudeness or insult **1 point** – reference to trait (he's a nice boy) or relationship (he likes his aunt); purely motivational (so she won't shout at him) with no reference to aunt's thoughts or feelings; incomplete explanation (he's lying, he's pretending). **0 points** – reference to irrelevant or incorrect facts/feelings (he likes the hat, he wants to trick her)
White lie	Why did she say this?	**2 points** – reference to white lie or wanting to spare their feelings; some implication that

		this is for parent's benefit rather than just for her, desire to avoid rudeness or insult **1 point** – reference to trait (she's a nice girl) or relationship (she likes her parents); purely motivational (so they won't shout at her) with no reference to parent's thoughts or feelings; incomplete explanation (she's lying, she's pretending) **0 points** – reference to irrelevant or incorrect facts/feelings (she likes the present, she wants to trick them)
Misunderstanding	Why did she say that?	**2 points** – reference to her belief that he was going to mug her or her ignorance of his real intention **1 point** – reference to her trait (she's nervous) or state (she's scared) or intention (so he wouldn't hurt her) without suggestion that fear was unnecessary **0 points** – factually incorrect/irrelevant answers; reference to the man actually intending to attack her
Misunderstanding	Why did the burglar do that?	**2 points** – reference to belief that policeman knew that he'd burgled the shop **1 point** – reference to something factually correct in story **0 points** – factually incorrect/irrelevant answers

Appendix G

Supplementary Analyses Completed in Chapter 3.

Table G1.

Descriptive statistics and independent samples t-tests on L1 participants.

	Malaysians[a]	British[b]	*t*	*p*	*Cohen's d*
	M (*SD*)	*M* (*SD*)			
RMET accuracy	26.10 (3.43)	25.58 (3.91)	0.88	.38	.14
SST score	12.93 (2.27)	12.85 (2.38)	0.22	.83	.03
Total AQ score	111.73 (11.79)	110.27 (13.98)	0.69	.49	.11
Individualism score	51.37 (8.44)	47.13 (8.25)	3.21	.002	.51
Collectivism score	53.56 (8.30)	51.32 (10.07)	1.48	.12	.24
Total AVS score	133.05 (19.06)	118.70 (20.51)	4.50	.00	.72

Note. [a]$n = 59$; [b]$n = 120$.

Table G2.

Descriptive statistics and partial correlations analysis.

Variable	*M* (*SD*)	1	2	3	4	5
1. RMET accuracy	25.26 (4.01)	-				
2. SST score	12.71 (2.47)	.38**	-			
3. Total AQ score	112 (13.14)	-.21**	-.10	-		
4. Individualism score (COS)	48.77 (8.45)	.07	-.13*	.05	-	
5. Collectivism score (COS)	52.67 (9.16)	-.07	-.03	-.24**	.07	-
6. Total AVS score	129.86 (23)	-.21**	-.22**	.14[a]	.16[b]	.32**

Note. * $p \leq .05$, ** $p \leq .001$. [a] $p = .03$, [b] $p = .02$. Age and RMET version controlled for.

Table G3.

Predictive Model of Collectivism on Total AQ Score in Theory of Mind with Covariates.

	b (*SE*)	*t*	95% CI		R^2	*F*	*df*	*p*
			LL	UL				
Total effect (*c*)[a]								
X → Y	-.35 (.09)***	-3.93	-.53	-.18	.09	5.74	4, 236	<.001
Component (*a*)[a]								
X → M_1	-.03 (.03)*	-1.08	-.09	.03	.05	3.42	4, 236	.009
X → M_2	-.01 (.02)	-.3	-.04	.03	.01	.6	4, 236	.66
Overall model[a]					.14	6.25	6, 234	<.001
Direct effect (*c'*) X → Y	-.38 (.09)***	-4.27	-.55	-.2				
Component (*b*)								

$M_1 \rightarrow Y$	-.72 (.22)***	-3.24	-1.15	-.28	<.001
$M_2 \rightarrow Y$	-.12 (.35)	-.35	-.81	.57	.72

Indirect effects	Bootstrapping effect (SE)	95% CI	
		LL	UL
Total	.02 (.02)	-.02	.08
$X \rightarrow M_1 \rightarrow Y$	.02 (02)	-.02	.07
$X \rightarrow M_2 \rightarrow Y$	.0007 (.01)	-.01	.02

Note. X = predictor variable, collectivism score; M_1 = RMET accuracy; M_2 = SST score; Y = outcome variable, AQ score; CI = 95% bias-corrected confidence interval, 5000 bootstrap samples; LL = lower limit; UL = upper limit. Unstandardised regression coefficients are reported.

*indirect effect estimates deemed significant as zero lay outside the upper and lower limits of the CI for the effect. ** $p < .05$. *** $p < .001$. [a] Age, RMET version and nationality entered as covariates.

Table G4.

Predictive Model of AVS Score on Total AQ Score in Theory of Mind with Covariates.

	b (*SE*)	*t*	95% CI		R^2	*F*	*df*	*p*
			LL	UL				
Total effect (*c*)[a]								
X → Y	.08 (.04)**	1.89	-.003	.16	.04	2.67	4, 236	.03
Component (*a*)[a]								
X → M_1	-.04 (.01)***	-3.49	-.07	-.02	.1	6.33	4, 236	.0001
X → M_2	-.03 (.01)**	-3.36	-.04	-.01	.05	3.43	4, 236	.01
Overall model[a]					.08	3.23	6, 234	.005
Direct effect (*c'*) X → Y	.05 (.04)**	1.18	-.03	-.14				
Component (*b*)								

$M_1 \rightarrow Y$	-.61 (.23)**	-2.64	-1.07	-.16	.009
$M_2 \rightarrow Y$	-.07 (.37)	-.2	-.79	.65	.84

Indirect effects	Bootstrapping effect (SE)	95% CI	
		LL	UL
Total	.03 (.01)*	.004	.06
$X \rightarrow M_1 \rightarrow Y$	.03 (.01)*	.006	.06
$X \rightarrow M_2 \rightarrow Y$	.002 (.01)	-.02	.02

Note. X = predictor variable, AVS score; M_1 = RMET accuracy; M_2 = SST score; Y = outcome variable, AQ score; CI = 95% bias-corrected confidence interval, 5000 bootstrap samples; LL = lower limit; UL = upper limit. Unstandardised regression coefficients are reported.

*indirect effect estimates deemed significant as zero lay outside the upper and lower limits of the CI for the effect. ** $p < .05$. *** $p < .001$. [a] Age, RMET version and nationality entered as covariates.

Table G5.

Predictive Model for Individualism on Total AQ Score in Theory of Mind.

	b (*SE*)	*t*	95% CI		R^2	*F*	*df*	*p*
			LL	UL				
Total effect (*c*)								
X → Y	.12 (.1)	1.23	-.07	-.32	.006	1.51	1, 239	.22
Component (*a*)								
X → M_1	.02 (.03)	.5	-.05	.08	.001	.25	1, 239	.62
X → M_2	-.04 (.02)**	-1.98	-.07	-.0002	.02	3.92	1, 239	.05
Overall model					.18	4.97	3, 237	.002
Direct effect (*c'*) X → Y	.13 (7.7)**	1.33	-.06	.33				
Component (*b*)								

$M_1 \rightarrow Y$	-.74 (.22)***	-3.33	-1.18	-.3	.001
$M_2 \rightarrow Y$	-.06 (.36)	-.17	-.78	.65	.86

Indirect effects	Bootstrapping effect (SE)	95% CI	
		LL	UL
Total	-.009 (.03)	-.06	.05
$X \rightarrow M_1 \rightarrow Y$	-.01 (.02)	-.06	.04
$X \rightarrow M_2 \rightarrow Y$	.002 (.01)	-.03	.03

Note. X = predictor variable, individualism score; M_1 = RMET accuracy; M_2 = SST score; Y = outcome variable, AQ score; CI = 95% bias-corrected confidence interval, 5000 bootstrap samples; LL = lower limit; UL = upper limit. Unstandardised regression coefficients are reported.

** $p < .05$. *** $p < .001$.

Table G6.

Predictive Model of Individualism on Total AQ Score in Theory of Mind with Covariates.

	b (*SE*)	*t*	95% CI		R^2	*F*	*df*	*p*
			LL	UL				
Total effect (*c*)[a]								
X → Y	.07 (.1)	.71	-.13	.27	.03	1.88	4, 236	.11
Component (*a*)[a]								
X → M_1	.03 (.03)**	1.06	-.03	.09	.05	3.41	4, 236	.01
X → M_2	-.04 (.02)	-1.91	-.07	-.001	.02	1.5	4, 236	.2
Overall model[a]					.07	3.12	6, 234	.006
Direct effect (*c'*) X → Y	.09 (.1)**	.9	-.12	.29				
Component (*b*)								

$M_1 \rightarrow Y$	-.68 (.23)**	-2.95	-1.13	-.23		.004
$M_2 \rightarrow Y$	-.08 (.37)	-.22	-.81	.64		.82

Indirect effects	Bootstrapping effect (SE)	95% CI	
		LL	UL
Total	-.019 (.03)	-.08	.04
$X \rightarrow M_1 \rightarrow Y$	-.22 (.24)	-.07	.02
$X \rightarrow M_2 \rightarrow Y$	.003 (.01)	-.03	.03

Note. X = predictor variable, individualism score; M_1 = RMET accuracy; M_2 = SST score; Y = outcome variable, AQ score; CI = 95% bias-corrected confidence interval, 5000 bootstrap samples; LL = lower limit; UL = upper limit. Unstandardised regression coefficients are reported.

** $p < .05$. *** $p < .001$. [a] Age, RMET version and nationality entered as covariates.

Appendix H

Stimuli and Materials used in Chapter 4

Stimuli and scoring used in AUT (retrieved from Guilford, 1978).

Form B Part I.

SHOE. (Used as footwear).

BUTTON. (Used to fasten things).

KEY. (Used to open lock).

Form B Part II.

WOODEN PENCIL. (Used for writing).

AUTOMOBILE TIRE. (Used on the wheel of an automobile).

EYEGLASSES. (Used to improve vision).

Scoring guidelines for AUT.

From experience in scoring this kind of test, a number of rules have been adopted. These rules are given below, followed by specific examples of acceptable and unacceptable responses to items.

1. The scorer should mark all responses (stated use) either acceptable (1) or unacceptable (0).
2. A use, to be acceptable, should be possible for the object. For example, stating that an automobile tire can be used as a ring for the finger is unacceptable under this rule.
3. An acceptable use must be different from the given use, i.e., it must not fall within the class of the given, common use. The scorer should tend to leniency in this regard, however, a response being ruled out only if it is clearly just a modification of the given use. Saying that a milk carton can be used to "hold orange juice" is not sufficiently different from "used to

hold milk," which is given. On the other hand, the use "to mix paints in" involves more than the idea of containing and therefore qualifies.

4. Where the same idea of use may be more than one object, e.g., "as a weapon" or "to burn," credit should be given for each response unless some use is obviously overworked, particularly with the same wording.
5. Vague or very general uses are not acceptable. Examples of such responses are listed below. Note, however, that some seemingly vague responses are listed as acceptable. This is for the reason that they pertain to some unusual, specific attribute of the object.
6. A use that pertains to any conceivable interpretation of the object is acceptable. For example, "shoe" is not only footwear; it may also be part of a brake. A "button" not only appears on clothing, it can be a symbol as for a campaign or a club. A "nail" may be a metal object for fastening or at the end of a finger or toe.

The lists of uses for the various items have accumulated in experiences with the Unusual Uses test. They are meant to serve as guides, not to be followed unquestionably. The scorer may find occasional responses that are acceptable under the rules that do not appear in the list. Under the rules, some responses, although listed, should not be given credit, for example duplicating uses.

Examples of responses that are too vague to be accepted:

To have fun with	To make something
As a game	To throw it
To break	As a weapon (except chair, safety pin)
To use the parts	

To hit with (except chair)	To throw away
To burn (except chair, milk carton)	To get

Examples, item by item:

1. SHOE (used as footwear)

Acceptable

To crush bugs	Hide money in
As a hammer	Ash tray
Tie on car after wedding	Put out fires
Drink champagne out of	Keep socks in
To hit someone with	To measure in feet
For a paper weight	To throw at a cat (dog, but not both)
For dog to chew on	
Stamp out cigars (cigarettes)	

Unacceptable

To kick people	Use as leather
Shoe a horse (footwear)	Fix them
Walk on	Polish them

2. BUTTON (used to fasten things)

Acceptable

To draw circles	Make eyes on a doll (or nose, but not both)

Use as checkers

Add to a collection

Put in necklace

Make a twirler

Use in slingshot

Play tiddley winks

A marker for golf

As a charm

Book mark

As an emblem

To suck on (to avoid thirst)

Unacceptable

Melt to use plastic

Throw at people

Use as toy (too vague)

3. KEY (used to open a lock)

Acceptable

Open cans (e.g., coffee)

Jar opener

For cleaning nails

To decorate wall

As screw driver

Electrical connection

To score a test

Explain a map

Shows membership in a club

Unacceptable

To start a car

To kill someone

To jingle in pocket

4. WOODEN PENCIL (used for writing)

Acceptable

Punch holes

Use as dowel pin

Start a fire

Hold up a window

As a dagger

Rod for baby to grasp

Use as a roller

As a pointer

Measuring stick

As trapeze for a parrot

Perch for a bird

To demonstrate double vision

As a wand

For an experiment on static

Mast on toy ship

Knitting needle substitute

Plug a hole

As a straight edge

To stir paint

Test of strength of child

As a baton

Unacceptable

Draw pictures

Erase marks

Do figuring

Label clothes

5. AUTOMOBILE TIRE (used on wheel of automobile)

Acceptable

As a hula hoop

As a raft

Walls for flower bed

As a bumper (one use only)

As a swing

Unacceptable

As a ring (for finger)

Covering on wagon wheel

6. EYE GLASSES (used to improve vision)

Acceptable

Protection from being hit

As a disguise

To hide a hearing aid

To change personality

To improve appearance | To start a fire

Unacceptable

To magnify things

To wreck your eyes

To see people coming

Stimuli used in MGT.

Scoring guidelines for MGT.

Note: Metaphors directly state a comparison—"Love is a battlefield." Similes use the words like or as to compare things—"Life is like a box of chocolates."

Fill out the following for each participant and each response:

1. Is the expression **literal** (literal language is used to mean exactly what is written) or **figurative** (figurative language is used to mean something other than what is written, something symbolic, suggested, or implied)?
2. Provide a score:
    - A novel metaphoric response (e.g., *feeling worthless is like a mirror smashed to pieces*) = 3 points
    - A conventional metaphor or idiom (e.g., *feeling embarrassed is like having a red face*) = 2 points
    - Literal responses or paraphrases (e.g., *feeling successful is like a victory*) = 1 point.
    - Unrelated expressions = 0 points.

Appendix I

Items and Item Scoring on the Revised Creativity Domain Questionnaire (CDQ-R)

Items	Likert Scale Scoring					
	Not at all creative	Not very creative	A little creative	Somewhat creative	Very creative	Extremely creative
Acting[b]	1	2	3	4	5	6
Algebra/Geometry[a]	1	2	3	4	5	6
Chemistry[a]	1	2	3	4	5	6
Computers/Computer Science[a]	1	2	3	4	5	6
Crafts[c]	1	2	3	4	5	6
Dancing[b]	1	2	3	4	5	6
English Literature/Criticism[b]	1	2	3	4	5	6

Interior Design/Decorating[c]	1	2	3	4	5	6
Keeping a journal/blog[b]	1	2	3	4	5	6
Leadership[d]	1	2	3	4	5	6
Life sciences/biology[a]	1	2	3	4	5	6
Logic/Puzzles[a]	1	2	3	4	5	6
Mechanical abilities[a]	1	2	3	4	5	6
Money management[d]	1	2	3	4	5	6
Painting/Drawing[c]	1	2	3	4	5	6
Playing with children[d]	1	2	3	4	5	6
Selling people things[d]	1	2	3	4	5	6
Solving personal problems[d]	1	2	3	4	5	6
Teaching/education[d]	1	2	3	4	5	6

Vocal performance/Singing[b]	1	2	3	4	5	6
Writing poetry/prose[b]	1	2	3	4	5	6

Note. [a] = CDQ-R Maths/Science subdomain; [b] = CDQ-R Drama subdomain; [c] = CDQ-R Arts subdomain; [d] = CDQ-R Interaction subdomain.

Appendix J

Predictive Model for Nationality on Total AQ Score in Creativity.

	b (*SE*)	*t*	95% CI		R^2	*F*	*df*	*p*
			LL	UL				
Total effect (*c*)								
X → Y	-1.61 (2.04)	-.79	-5.65	2.42	.003	.62	1, 182	.43
Component (*a*)								
X → M_1	.60 (.85)	.70	-1.08	2.27	.003	.49	1, 182	.48
X → M_2	-2.54 (2.15)	-1.18	-6.79	1.71	.008	1.39	1, 182	.24
Overall model					.04	2.56	3, 180	.06
Direct effect (*c'*) X → Y	-1.12 (2.03)	-.55	-5.13	2.88				
Component (*b*)								

$M_1 \rightarrow Y$	-.48 (.18)**	-2.62	-.84	-.12	.01
$M_2 \rightarrow Y$	.08 (.07)	1.11	-.06	.22	.27

Indirect effects	Bootstrapping effect (SE)	95% CI	
		LL	UL
Total	-.49 (.53)	-1.72	.35
$X \rightarrow M_1 \rightarrow Y$	-.23 (.46)	-1.35	.47
$X \rightarrow M_2 \rightarrow Y$	-.20 (.30)	-.99	.19

Note. X = predictor variable, nationality of participants; M_1 = AUT score; M_2 = MGT score; Y = outcome variable, AQ score; CI = 95% bias-corrected confidence interval, 5000 bootstrap samples; LL = lower limit; UL = upper limit. Unstandardised regression coefficients are reported.

** $p < .05$. *** $p < .001$.

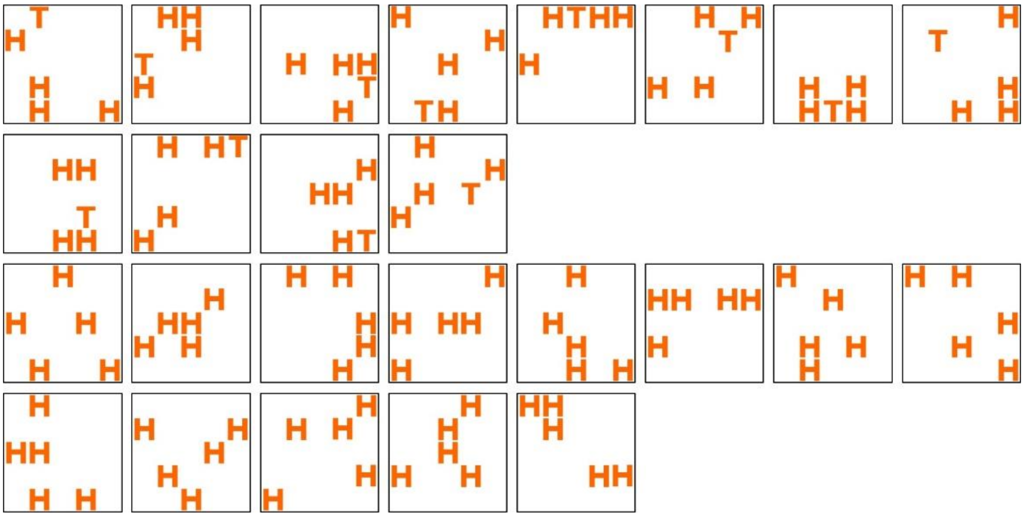
Appendix K

Stimuli used in Chapter 5

List of stimuli used in VST

Figure K1.

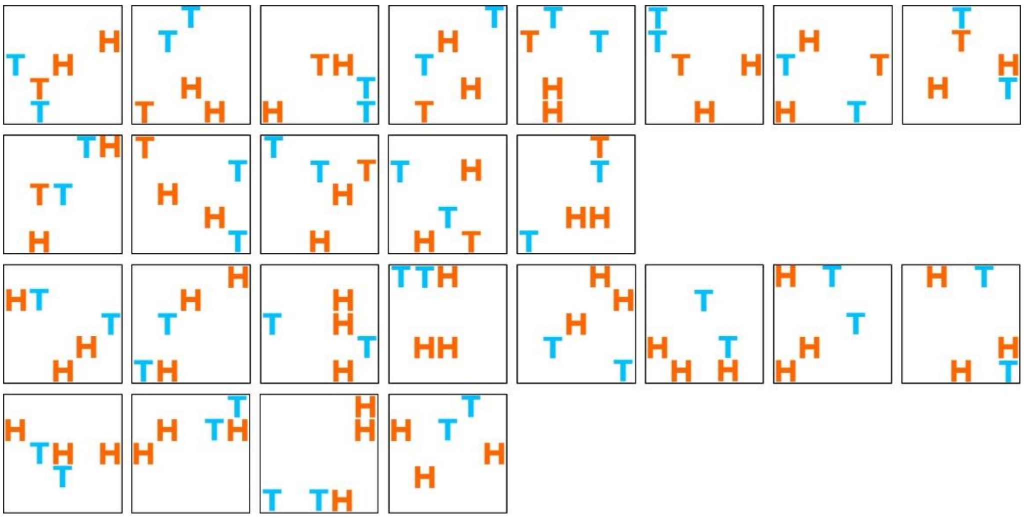
Stimuli for array size 5 in feature search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K2.

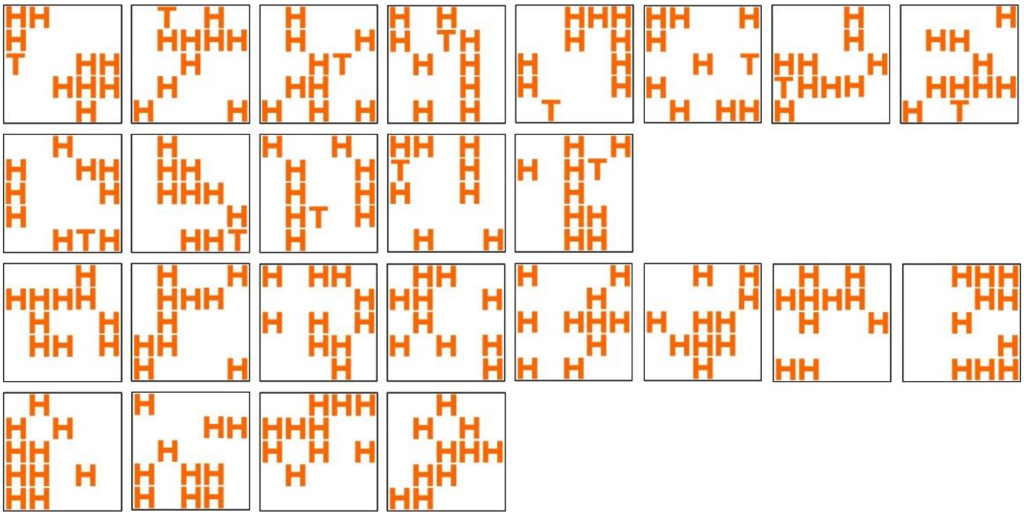
Stimuli for array size 5 in conjunctive search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K3.

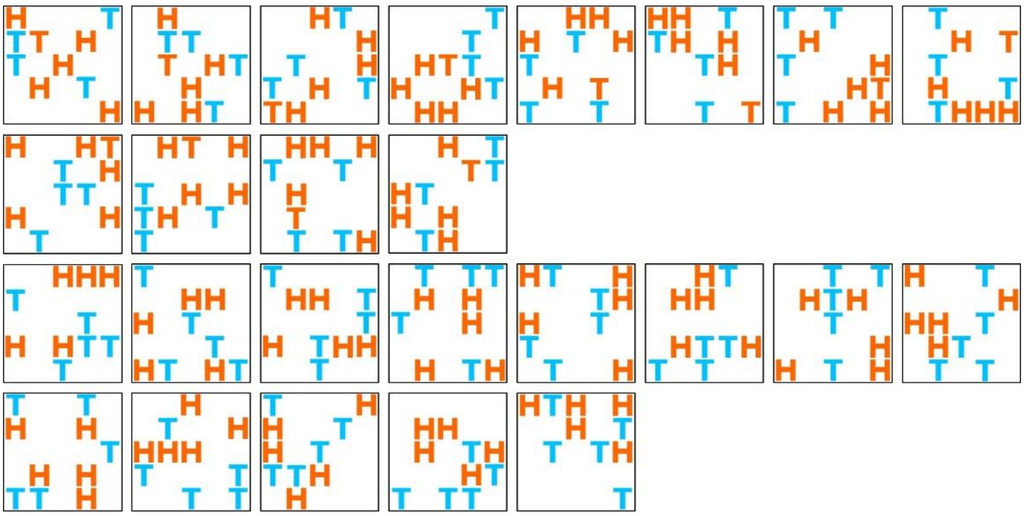
Stimuli for array size 10 in feature search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K4.

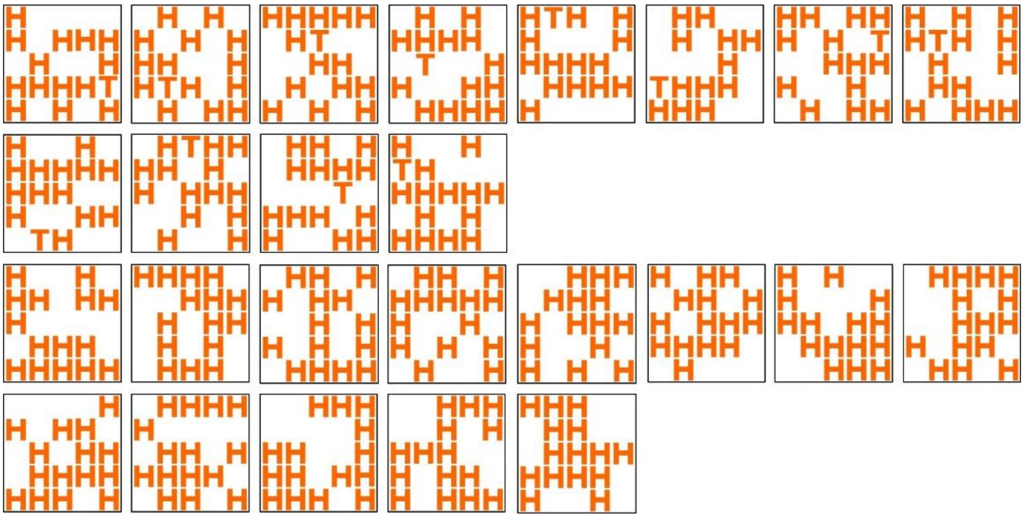
Stimuli for array size 10 in conjunctive search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K5.

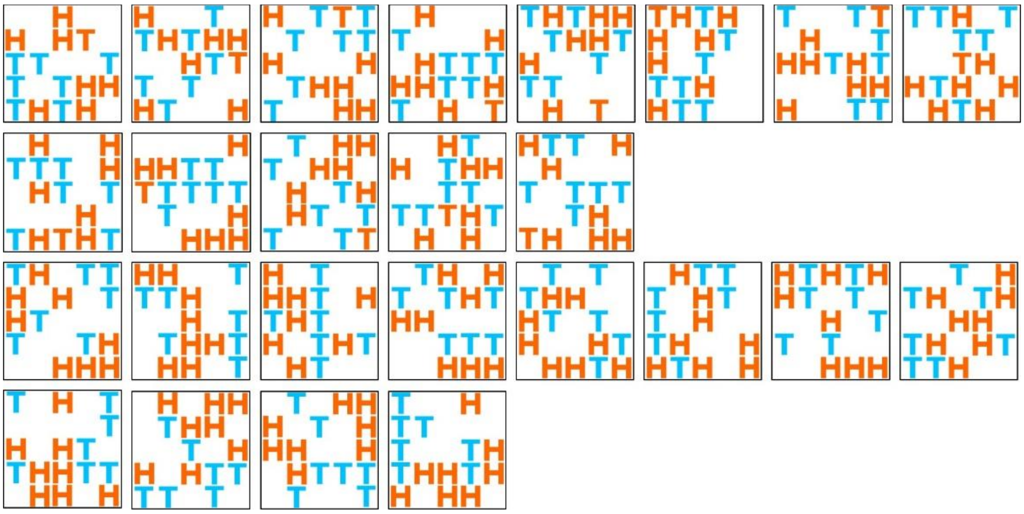
Stimuli for array size 15 in feature search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K6.

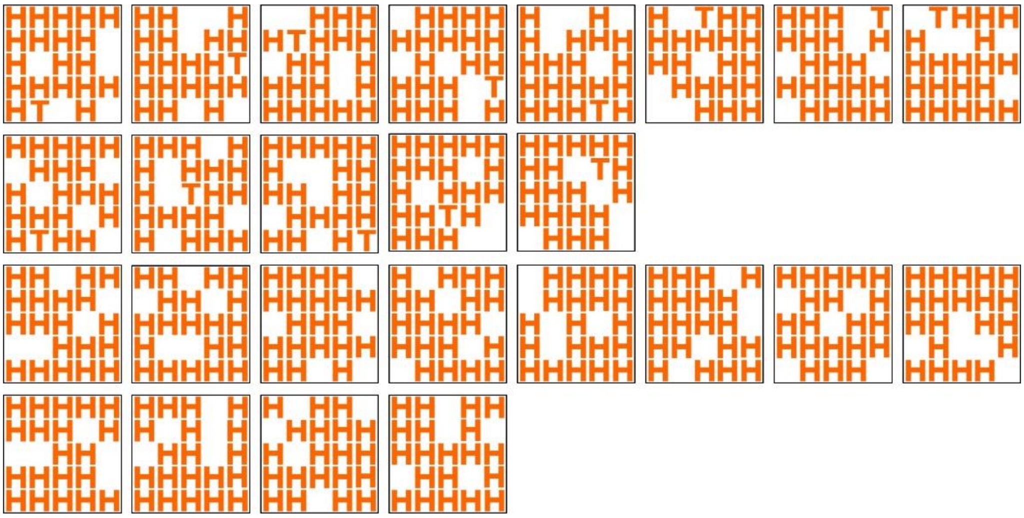
Stimuli for array size 15 in conjunctive search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K7.

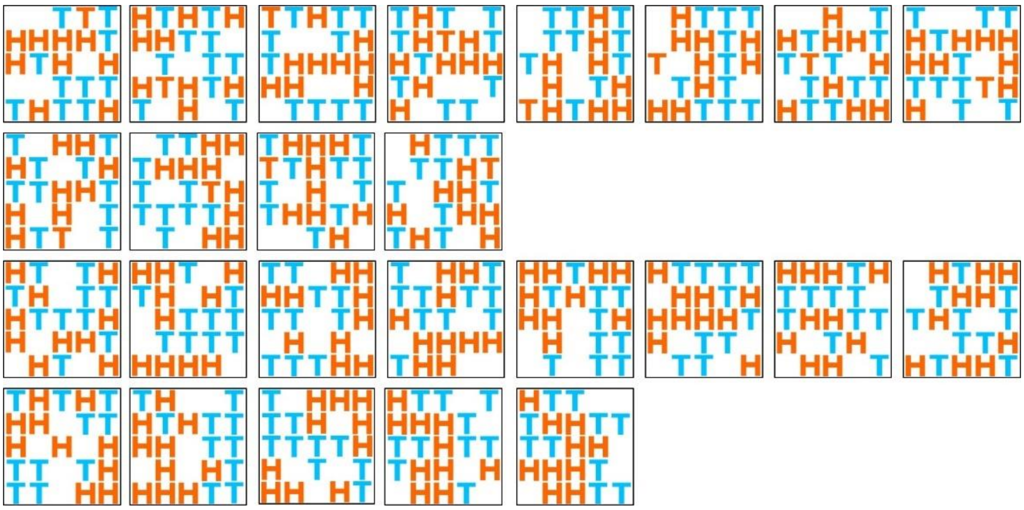
Stimuli for array size 20 in feature search.



Note. Top two rows = target present; bottom two rows = target absent.

Figure K8.

Stimuli for array size 20 in conjunctive search.

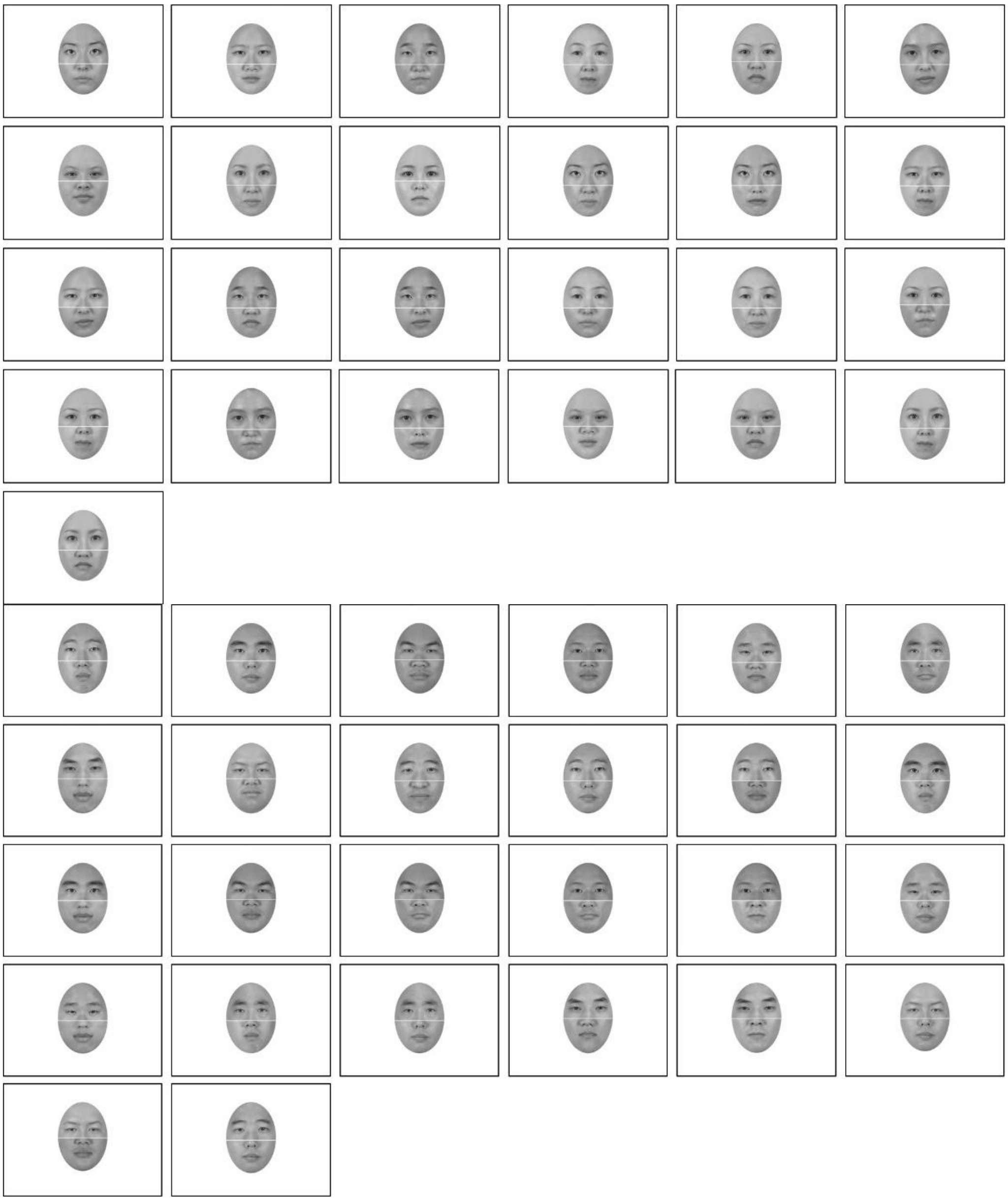


Note. Top two rows = target present; bottom two rows = target absent.

List of stimuli used in FCT.

Figure K9.

Aligned Asian face stimuli for FCT.



Note. First five rows = female stimuli; next five rows = male stimuli.

Figure K10.

Misaligned Asian face stimuli for FCT.

Note. First five rows = female stimuli; next four rows = male stimuli.

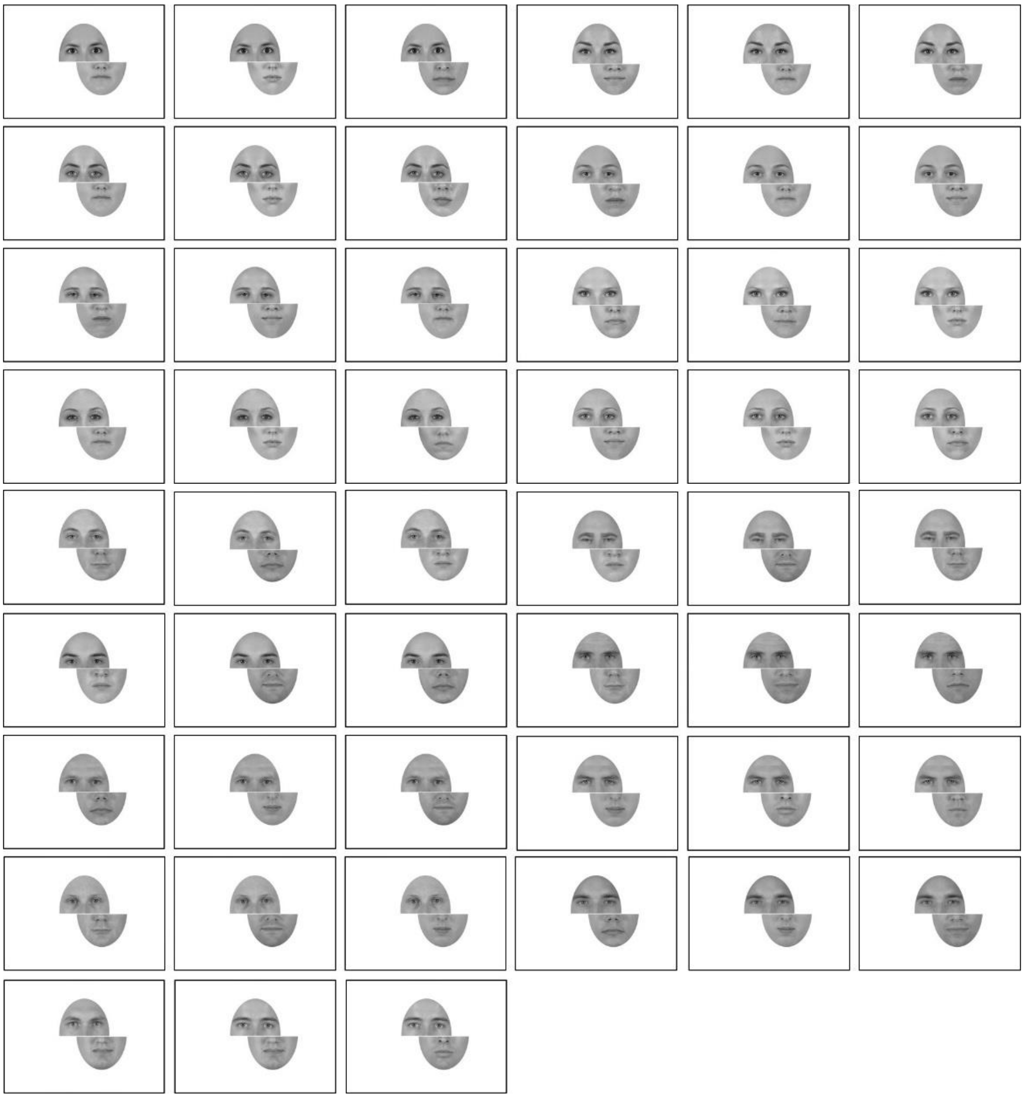
Figure K11.

Aligned White face stimuli for FCT.

Note. First five rows = female stimuli; next four rows = male stimuli.

Figure K12.

Misaligned White face stimuli for FCT.



Note. First four rows = female stimuli; next five rows = male stimuli.

Appendix L

Supplemental Analyses Completed in Chapter 5

Table L1.

Descriptive statistics and 2x2x2 mixed ANOVA for ORB in accuracy on FCT stimuli.

Variable	Malaysians (SD)	British (SD)	ANOVA				
			Effect	F ratio	*p*	df	η^2p
Stimuli Alignment			A	1.16	.28	1, 129	.009
Aligned	36.66 (.86)	36.41 (.60)	E	0.02	.90	1, 129	.000
Misaligned	36.20 (.97)	36.27 (.68)	G	.007	.93	1, 129	.00
Stimuli Ethnicity			A x E	4.29	.04	1, 129	4.29
Asian	36.62 (.86)	36.19 (.60)	A x G	0.33	.57	1, 129	.003
White	36.24 (.98)	36.49 (.68)	E x G	1.38	.24	1, 129	.01
Stimuli Alignment x Stimuli Ethnicity			A x E x G	0.01	.94	1, 129	.00

Aligned x Asian	37.12 (5.57)	36.55 (5.71)
Aligned x White	36.21 (5.73)	36.27 (6.64)
Misaligned x Asian	36.12 (6.12)	35.83 (6.55)
Misaligned x White	36.28 (6.68)	36.70 (7.22)

Note. N = 131; ANOVA = Analysis of Variance; ORB = Other Race Bias effect; A = stimuli alignment (aligned x misaligned); E = stimuli ethnicity (Asian x White); G = group (Malaysian x British).

Table L2.

Descriptive statistics and 2x2x2 mixed ANOVA for ORB in MRT on FCT stimuli.

Variable	Malaysians (SD)	British (SD)	ANOVA				
			Effect	F ratio	*p*	df	η^2
Stimuli Alignment			A	.01	.91	1, 129	.00

Aligned	0.83 (.05)	0.77 (.03)	E	.20	.66	1, 129	.002
Misaligned	0.83 (.04)	0.77 (.03)	G				
Stimuli Ethnicity			A x E	.004	.95	1, 129	.00
Asian	0.83 (.05)	0.78 (.03)	A x G	.03	.86	1, 129	.00
White	0.83 (.04)	0.77 (.03)	E x G	1.40	.24	1, 129	.01
Stimuli Alignment x Stimuli Ethnicity			A x E x G	.74	.39	1, 129	.006
Aligned x Asian	0.81 (.06)	0.78 (.04)					
Aligned x White	0.84 (.05)	0.77 (.04)					
Misaligned x Asian	0.85 (.05)	0.78 (.03)					
Misaligned x White	0.81 (.04)	0.77 (.03)					

Note. N = 131; ANOVA = Analysis of Variance; ORB = Other Race Bias effect; A = stimuli alignment (aligned x misaligned); E = stimuli ethnicity (Asian x White); G = group (Malaysian x British).