The Effects Of Adult Aging And Culture On Theory Of Mind

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Abstract

Objectives: Older adults tend to have poorer Theory of Mind (ToM) than their younger counterparts, and this has been shown in both Western and Asian cultures. We examined the role of working memory (WM) in age differences in ToM, and whether this was moderated by education and culture (UK versus Malaysia). Method: We used two ToM tests with differing demands on updating multiple mental states (false belief) and applying social rules to mental state processing (faux pas). We also looked at the role of education, socioeconomic status (SES), and WM. A total of 298 participants from UK and Malaysia completed faux pas, false belief, and WM tasks. Results: Age effects on some aspects of ToM were greater in the Malaysian compared to the UK sample. Malaysian older adults were poorer at faux pas detection, aspects of false belief and WM compared to young adults. In subsequent moderated mediation analyses, we found that, specifically in the Malaysian sample, the mediating effects of WM on the age and ToM relationship occurred at the lowest levels of education. Discussion: This pattern of results may reflect changes in the familiarity and cognitive load of explicit mental state attribution, along with cultural differences in the pace and nature of cognitive aging. Cultural differences in education and working memory should be considered when researching age differences in theory of mind.

Keywords
Culture, Theory-of-Mind, Executive Function, Working Memory
Introduction

Theory of Mind (ToM) is an umbrella term that includes many different facets of mental state processing. Understanding another person’s beliefs, and in particular working out that someone else can have a false belief about the world, has been the cornerstone task in conceptual development of ideas about ToM (Perner, 1991). A typical false belief task involves a mismatch between an observer’s knowledge of reality (we see a woman moving a pen into a box) and a protagonist’s mistaken view of the world (a man thinks the pen is still in the pencil case where he put it earlier). Studies have shown that older adults perform worse than young on many different false belief tasks which included visual, audio and multimodal variants (Bailey & Henry, 2008; Phillips et al., 2011). There is some disagreement in this literature as to the role of cognitive components in the age differences in ToM. For instance, it is unclear whether age effects are greater for false belief compared to true belief conditions (Henry et al., 2013). However, specific executive functions such as working memory (WM) updating have been found to partially mediate age differences in false belief reasoning (Phillips et al., 2011). Executive function refers to a set of higher-order processes specialized in controlling other cognitive and motor processes aimed at achieving specific goals, and relying on a fronto-parietal network (Friedman & Miyake, 2017). Most studies of ToM and executive function are of Western samples, however Li et al. (2013) also reported age-related declines in false belief reasoning in a Chinese sample, influenced by education levels and WM capacity. It is notable that there is a lack of cross-cultural comparisons of effects of adult aging on ToM.

Another key task in the literature on ToM involves understanding appropriate social behavior, including the capacity to detect an embarrassing social blunder – a so-called ‘faux pas’. Some studies have reported no age differences in faux pas reasoning (MacPherson et al., 2002), while others report that older adults perform worse on some aspects of the task, and that this is particularly related to WM capacity (Bottiroli et al., 2016). Others found that older adults have poorer understanding of social transgressions (Halberstadt et al., 2011), have a tendency to display more socially awkward behavior (Henry et al., 2009) or instead react differently to socially inappropriate behaviors compared to younger people (Stanley et al., 2014). Similar to the Western population, Asian older adults are less able to perceive social transgressions compared to young (Li et al., 2013; Wang & Su, 2006; Zhou et al., 2019) and they performed worse than young in faux pas understanding, unless specific motivational manipulations were included which benefited the older adults (e.g. perceived closeness) (Zhang et al., 2012). No previous studies have compared the effects of aging on ToM measures such as faux pas or false belief across Western and Asian cultures, and that is the aim of the current study.

Literature investigating the potentially interacting effects of age and culture on basic cognitive processes indicates that two different patterns can be seen. Some studies indicate very similar age effects on processing speed and memory in Western and Asian cultures (Chua et al., 2006; Park et al., 1999). This is argued to reflect biological age-related changes in fundamental cognitive processes, which are not strongly influenced by culture (Park et al., 1999). In contrast, the influence of age on some aspects of WM such as a backwards digit span task is greater in Asian (Chinese) compared to Western (US) samples (Hedden et al., 2002). Na et al. (2017) also found greater aging effects in an Asian (Singaporean) compared to a Western (US) sample on a category judgment task. They argue that this occurs because these tasks involve processing styles which are...
not the cultural norm in Asian societies, and while younger adults have enough cognitive capacity to overcome this, older adults do not (Na et al., 2017).

Developmental literature indicates that ToM acquisition differs across cultures. One review indicated that children from Asian cultures have a delay in the development of false belief reasoning compared to those in Western societies (Aival-Naveh et al., 2019). This may reflect a qualitatively different pattern of false belief acquisition, rather than simply a slower pace of development (Shahaeian et al., 2011). In Asian cultures making individual mental state judgments could be an unfamiliar task (Chu et al., 2019; Fung, 2013), which then may increase the cognitive load of ToM judgments. This leads to the prediction that adult age effects on ToM may be greater for Asian compared to Western samples because older Asian adults have to overcome additional capacity limitations to carry out individual mental state attributions. It is therefore important to investigate links between age, culture and WM in predicting ToM performance. Also any cultural differences in age effects due to different trajectories in acquiring ToM skills across cultures may relate to socioeconomic status (SES) or educational experience. Kuntoro et al. (2013) showed that SES may be important in influencing cultural differences in a range of ToM tasks between children in Indonesia and Australia. There is evidence of the potential importance of education levels in ToM performance amongst older adults, though this has not been investigated cross-culturally (Li et al., 2013; Lövdén et al., 2020). We looked at two different measures of ToM (false belief and faux pas reasoning) in order to investigate whether consistent patterns would be found across quite different tasks.

**Present Study**

To our knowledge, no previous studies have examined cross-cultural differences in the effects of aging on ToM tasks. Given that past evidence has shown interacting effects of age and culture on WM, coupled with culture-differentiated trajectories in ToM acquisition, we aim to investigate the interacting effects of adult age and culture in predicting ToM performance on two different tasks. We also specifically look at the role of WM in age differences in ToM, and whether this was moderated by education, SES and culture.

We therefore predict that (1) there will be greater age effects on ToM in Malaysian compared to UK samples, given the purported lower familiarity of mental state judgements in Asian culture. Given the possibility that capacity limitations may be an important factor in how culture interacts with aging, we predict that (2) differences in WM capacity may largely account for how culture predicts ToM performance in older adults. Effective faux pas understanding requires participants to recruit WM processes in order to update information in memory and maintain mental state information about multiple characters. Likewise, false belief tasks that have been designed for adults involve remembering and integrating several perspectives simultaneously. If the attribution of mental states amongst older Asian adults is more resource-intensive then WM may mediate any age effects found. We also wanted to explore whether the indirect effects of age on these tasks through WM were dependent on education, SES and culture, given that these factors are important in ToM (Kuntoro et al., 2013; Li et al., 2013).
Methods

Participants

A total of 316 participants took part in this study and they were recruited from two locations; UK (n = 145) and Malaysia (n = 171). The Malaysian sample was recruited from the capital city while the British sample was recruited from northeast Scotland. They were recruited from existing databases, university services and wider community, and references from other participants. All participants had normal or corrected-to-normal vision, self-reported as being currently healthy with no neurological diagnoses, and were living independently in the community. While there were no outliers on either ToM task we removed from the dataset 8 young and 10 old outliers in the WM task (3SD below mean). The final sample in our study was 298 participants (see Table 1). We obtained ethical approval from both institutions (SUREC2018/040 and PEC/3904/2018/6) and all participants provided written consent before commencing the study.

<< insert Table 1>>

Stimuli/Procedure

All participants completed a set of questionnaires including demographics and the MacArthur Ladder Scale to measure subjective SES (Adler et al., 2008), and three computerized tasks (outlined below) in a counterbalanced order. We used a subjective SES measure to allow for cultural and ethnicity factors that may affect how an individual perceive themselves in the wider community (Rubin et al., 2014). Our older adults did not indicate mild cognitive impairment as per their MoCA scores (Nasreddine et al., 2005). Other tasks and questionnaires not considered here were also completed.

Faux Pas ToM Task. We adapted the written vignette Faux Pas task (Stone et al., 1998) to have a brief multiple-choice questions (MCQ) format. The MCQ answers were constructed using a large bank of free-response answers scored from previous study (Phillips et al., 2015). To reduce language load and increase contextual support, we commissioned cartoon drawings from a Malaysian artist to depict the main events in each story with people of various ages and ethnicities (see S1). Once the materials were prepared we asked 5 younger and 2 older Malaysian participants to evaluate their cultural appropriateness and the familiarity of the scenarios. This indicated that both the settings and the faux pas in the stories were considered culturally appropriate for Malaysia.

Each story was separated into three scenes which could be viewed by participants at their own pace. Once participants moved onto the next scene they could not go back to the previous one. Participants were told to pay attention to the names of each character. After viewing each story, five MCQs with four options each were presented (see Table S1). Question 1 and 2 assessed whether participants could detect whether a faux pas had been committed and by whom. Questions 3 and 4 assessed whether the perceiver understood the mental state of the listener (i.e. the recipient of the faux pas) and speaker (i.e. the individual delivering the faux pas). We calculated percentage accuracy for detection and understanding faux pas. Response and viewing time to each story and question
was unrestricted. Participants completed two practice trials followed by 20 experimental trials, of which ten contained a faux pas.

**False Belief Task.** This video-based task showed protagonists placing an object (paper or teabag) into one of three locations on a table (boxes or cups labelled as 1, 2, or 3) in two scenarios: an office and a coffee room. The videos were created at the University of Aberdeen (see S2 and S3) using young and older adults from the UK and Malaysia. There were two false belief conditions. (1) *Unseen Switch* - the first protagonist placed an object in one of three locations prior to leaving the room. During their absence, a second protagonist entered the room and moved the object to a different location prior to leaving. Then the first actor re-entered the room and headed to the table. (2) *Lie Deception* – similar to the Unseen Switch except that at the end the second protagonist misled the first protagonist about the true location of the object by pointing to a different location. Each condition had eight trials. The task also included 22 trials with either (3) no movement of the object (six trials), (4) both protagonists witnessed the object moving (eight trials), or (5) the second protagonist provided accurate information about the new location (eight trials). These acted as catch trials to ensure that participants paid attention, and are not further analyzed here.

The identity of protagonists entering each scene was counterbalanced across conditions. After each clip, participants were probed with four questions; (1) Where will s/he look for their object?, (2) Where will s/he think s/he will look for his/her object?, (3) Where is the object now?, (4) Where was it originally? Response time was unrestricted. The task was separated into two blocks of 19 trials. Participants completed two practice trials at the beginning of block 1. We totalled the number of correct responses to Q1 (one point) and Q2 (one point) in both blocks to determine whether participants understood the self/other perspectives. Scores ranged between zero to four for each condition.

**Working memory.** Participants completed 78 trials of a 2-back WM task. On each trial a single digit was presented on screen and participants had to respond to each digit with a keypress to indicate whether it matched the digit presented two positions back in the sequence. We reported the stimuli and procedure in another paper (Phillips et al., 2021). Performance was calculated based on percentage of correct responses in the 2-back trials.

**Data analysis**

We analyzed whether effects of age and culture were present in education and SES. We then included them as covariates in analyses of covariance (ANCOVAs) looking at effects of age (young, old) and culture (British, Malaysian) on measures from the faux pas and false belief ToM tasks. To investigate the role of WM in age and culture effects on ToM we used moderated mediation analysis. The moderated mediation analysis (model 75) was conducted using PROCESS (v 3.3) macro by Hayes (2017) in SPSS version 25 using a percentile bootstrap confidence interval (CI) which was generated using 5,000 samples. This model does not provide an index of moderated mediation, and instead we probed the moderated mediation effect by examining the conditional indirect effects.
Results

Education and SES

We ran a series of 2 (Age: young vs old) x 2 (Culture: British vs Malaysian) analyses of variance (ANOVA) with each socio-demographic variable (years of education, SES) as the dependent variable. There was significant main effect of age on years of education and SES (both $p < .037$), with older adults reporting more years of education and higher SES than the young. There were also main effects of culture showing that the British sample had more years of education and higher SES compared to the Malaysians (both $p < .001$). There was a significant interaction of age and culture in predicting SES, $F(1, 290) = 9.435, p = .002, n_p^2 = .032$, but not education, $p > .06$.

Faux pas

Faux pas detection. Following the earlier analyses, we included both education and SES as covariates in subsequent ANCOVAs. We conducted a 2 (Age) x 2 (Culture) ANCOVA with faux pas detection as the dependent variable. Older adults performed worse than young, $F(1, 286) = 17.796, p < .001, n_p^2 = .059$ but there was no difference between Malaysians and British participants, $F(1, 286) = .194, p = .660, n_p^2 = .001$. These main effects were qualified by an interaction between age and culture, $F(1, 286) = 4.398, p = .037, n_p^2 = .015$. Post hoc comparisons showed that older Malaysians performed worse than young ($t = 3.758, p < .001, d = 0.58$). However, no age difference in performance emerged between British young and older adults ($t = .90, p = .37, d = 0.15$). Education was a significant covariate, $p = .003$, with higher education predicting better ToM, but SES was not, $p = .071$.

Faux pas understanding. We analyzed faux pas understanding using similar 2 x 2 ANCOVA. British participants were better at faux pas understanding than Malaysian, $F(1, 286) = 4.521, p = .034, n_p^2 = .016$, and older participants performed more poorly compared to young adults, $F(1, 286) = 15.501, p < .001, n_p^2 = .051$. However, there was not a significant interaction between age and culture, $F(1, 286) = 1.264, p = .262, n_p^2 = .004$. Similar to faux pas detection, education was a significant covariate, $p = .012$ but not SES, $p = .101$.

False belief task

Unseen switch. We did not find effect of age, culture or an interaction between age and culture, all $p > .067$. Education was a significant covariate, $p = .004$ but not SES, $p = .323$.

Lie deception. We found an effect of age, $F(1,259) = 14.888, p < .001, n_p^2 = .054$, with young adults performing better than older adults, and an effect of culture, $F(1,259) = 35.578, p < .001, n_p^2 = .121$, with Malaysians performing worse than British participants. There was also a significant age by culture interaction, $F(1,259) = 6.348, p = .012, n_p^2 = .024$. Post hoc tests showed that Malaysian older adults were poorer in this task compared to the young adults, $t = 3.851, p < .001, d = .65$ while no significant difference was found for the British sample, $t = 1.949, p = .054, d = .34$. SES was not a significant covariate, $p = .589$ but education was, $p = .04$. 
**Working memory**

Results showed an effect of age, $F(1, 286) = 61.561, p < .001, n^2_p = .177$, in that young adults had higher WM accuracy compared to older adults, and an effect of culture, $F(1, 286) = 9.503, p = .002, n^2_p = .032$, showing lower accuracy scores among Malaysians compared to British participants. These main effects were qualified by an interaction between age and culture, $F(1, 286) = 31.608, p < .001, n^2_p = .10$. The older adults in both British ($t = 1.98, p = .05, d = .33$) and Malaysian samples ($t = 7.384, p < .001, d = 1.09$) performed more poorly compared to young adults in this task. Education was a significant covariate, $p < .001$ but not SES, $p = .643$.

**Moderated mediation analyses**

In our earlier analyses, we found that Malaysian older adults were poorer at faux pas detection, the lie deception task and WM compared to young adults. Correlational analysis showed that age was negatively correlated with all variables except for unseen switch (see Table 2). Education was positively correlated with all ToM measures, but SES was not. We then examined the mediating role of WM in the relationship between age and ToM, and also investigated the moderating role of culture and education. We conducted a moderated mediation analysis with age as a predictor, WM as mediator, culture and education as moderators. All were continuous variables except culture which was dichotomous. As education is a continuous variable, it was mean-centered prior to the mediation analysis. The values of education at which we probed the indirect effect referred to three centerings: low (mean - 1SD = -2.617), medium (mean = .00) and high levels of education (mean + 1SD = 2.617).

<< insert Table 2>>

**Faux pas detection.** The moderated mediation results showed that the direct effect of age on faux pas detection was not significant, $b = -.0432, p = .1577$. The conditional indirect effect (mediator) of WM on the relationship between age and faux pas detection was significantly moderated by culture and education. Results showed significant effects of WM in the Malaysian sample but not for the British sample (all CIs contained zero). Specifically, in the Malaysian sample, the mediation effect of WM on the age-ToM relationship, was significant at low (centering on M-SD; $b = -.1668$, bootstrap SE = .0421, 95% bootstrap CI [.2474, -.0832]), medium (centering on M; $b = -.1457$, bootstrap SE = .0504, 95% bootstrap CI [-.2345, -.0405]), and high levels of education (centering on M+SD; $b = -.1238$, bootstrap SE = .0645, 95% bootstrap CI [-.2426, -.0004]) (see Fig 1A). Education and culture moderated the mediation effects of WM on the age-ToM relationship such that the strength of this indirect association was highest at lower levels of education in the Malaysian sample.

**Faux pas understanding.** Following a similar analysis, we found no significant age on faux pas understanding, $b = -.0601, p = .1547$. Again, the mediating effect of WM on the relationship between age and faux pas understanding was significantly moderated by culture and education. For the Malaysians, the mediation effect of WM was significant at low ($b = -.1845$, bootstrap SE = .0424, 95% bootstrap CI [-.2635, -.0971]), medium ($b = -.1737$, bootstrap SE = .0540, 95% bootstrap CI [-.2692, -.0583]), and high levels of education ($b = -.1578$, bootstrap SE = .0741, 95% bootstrap CI [-.2964, -.0169]) (see Fig 1B). Again, this result showed that the mediation effect of WM on age differences in faux pas understanding was higher for lower educated participants in the Malaysian sample. There were no moderating effects in the British sample (all CIs contained zero).
**Lie deception.** We found that the direct effect of age on lie deception detection was significant, $b = -.0056$, $p = .0193$. The mediating effect of WM on the relationship between age and lie deception was significantly moderated by culture and education, with the effects of education in the Malaysian sample only. The mediation effect of WM was significant at low, ($b = -.0090$, bootstrap SE = .0030, 95% bootstrap CI [-.0155, -.0037]) and medium levels of education ($b = -.0081$, bootstrap SE = .0027, 95% bootstrap CI [-.0131, -.0026]) but not for high levels of education ($b = -.0064$, bootstrap SE = .0029, 95% bootstrap CI [-.0112, .0000]). No moderating effects were found in the British sample (see Fig 2A).

**Unseen switch.** Again, we found that the mediation effect of WM on the relationship between age and unseen switch performance was significantly moderated by education in the Malaysian sample only. The mediation effect of WM was significant at low, ($b = -.0083$, bootstrap SE = .0024, 95% bootstrap CI [-.0133, -.0038]) and medium levels of education ($b = -.0070$, bootstrap SE = .0025, 95% bootstrap CI [-.0117, -.0019]) but not for high levels of education ($b = -.0052$, bootstrap SE = .0026, 95% bootstrap CI [-.0100, .0002]) in the Malaysian sample. Again, no moderating effects were found in the British sample (see Fig 2B).

These results clearly show the differences between the two cultures (British vs Malaysians), in that the age-related variance in faux pas and false belief tasks were accounted for by WM capacity only in the Malaysian sample. Further, the greatest role for WM in age-ToM relationships was seen amongst those Malaysians with the lowest levels of education.

**Discussion**

On two different theory of mind tasks, we found evidence that age effects on performance were greater in a Malaysian sample compared to a British sample, and that these age differences in the Malaysian group were mediated by WM and education levels. For the faux pas task we found that the Malaysian older adults were less accurate compared to young in detecting social transgressions. In contrast, there were no age differences in the British sample. For the measure of understanding the faux pas, there was an age effect which did not interact with culture. While this is the first study using this cartoon-based method of investigating faux pas comprehension, previous studies have also indicated no age differences in faux pas comprehension in the UK using the original free response verbal task (MacPherson et al., 2002), or on a verbal multiple-choice version of the task (Phillips et al., 2015). This is the first study to look at faux pas comprehension in Malaysia. Previous studies in China also reported age-related declines in faux pas performance (Wang & Su, 2006).

On the false belief task there was also an interaction between age and culture in predicting older adults’ performance on trials which involved potential deception. Similar to the faux pas task, the Malaysian older adults were poorer in this compared to the British sample. Unexpectedly, there were no age differences in performance on the unseen switch trials. This was contrary to predictions, given previous evidence that older adults usually struggle to work out the false beliefs of another in tasks where an unseen switch is involved (Henry et al., 2013). In contrast, where the trials
included an element of deception, age and culture interacted, with much greater age differences in performance seen in the Malaysian sample.

Why were older Malaysians showing this pattern of particularly poor ToM ability across both tasks? We predicted that WM capacity might play a crucial role. There is a possibility that in Asian cultures there is less of a tradition of making explicit mental state judgements about others compared to Western cultures (Aival-Naveh et al., 2019; Shahaeian et al., 2011). In particular, for older Malaysians, being asked to make decisions about another individual’s beliefs or motives may be quite unusual, and therefore be particularly demanding of WM capacity. Supporting this hypothesis, we found evidence that WM mediated age variance in ToM performance in each of the different ToM measures, but in the Malaysian sample only. This could occur because cognitive resource limitations amongst older Malaysians make it difficult to adapt to an unfamiliar task, or because there are generational differences amongst Malaysians in the experience of Western culture. Alternatively, younger Malaysians might perform well on the ToM tasks either because they have sufficient cognitive capacity to carry out a task which is culturally-challenging, or because they are more adapted to Western culture and therefore making individual mental state attributions is a familiar task which does not overload cognitive resources. We cannot tease these possibilities apart in the current study.

The older Malaysians had poorest performance on the WM task compared to the other age-culture groups. It is therefore plausible that the older Malaysians were showing more accelerated processes of cognitive changes with age, reducing the capacity of WM and ToM performance. This might have occurred because the older Malaysians in the current sample had experienced more restricted healthcare during their lifespan, and had fewer opportunities to experience the protective factors of cognitive reserve such as complex occupations (Lövdén et al., 2020). Or there may be larger generational differences in cognitive capacities in Malaysia than in the UK, given different historical trajectories towards industrialization (The World Bank, 2021). It is likely that Malaysian older adults did not experience similar exposure in their formative years compared to the British to early-life general cognitive stimulation, education, occupation, physical exercise, leisure activities or social engagement, which can all be protective factors against cognitive aging.

Another factor shown to be important in our analyses was education. Li et al. (2013) provide evidence that education may be an important factor in age differences in ToM in a Chinese sample. In our Malaysian sample, the older adults reported more years of education than the young, so group differences in education could not explain the age effects on ToM. Instead, our analyses indicated that within the Malaysian sample, education levels moderated the mediating relationship between age, WM and ToM. Specifically, at the lowest levels of education WM capacity strongly mediated the relationship between age and TOM, whereas for those with highest education this mediation effect was much smaller or non-significant. This indicates that for Malaysians, high levels of education may provide a protective effect against capacity-related age differences in theory of mind skills, as discussed in relation to the protective effects of education for cognitive reserve (Lövdén et al., 2020). In contrast, for older Malaysians with lower levels of education, reduced WM capacity becomes important in predicting poorer ToM skills.

Previous studies focusing on the link between executive function and social cognition in older adults have produced a range of results when looking at the relationship between WM and
ToM. Some studies report that WM capacity cannot explain age differences in ToM (Cavallini et al., 2013), others partial mediation (Li et al., 2013; Phillips et al., 2011), and others full mediation (Bottiroli et al., 2016). Our current results suggest that differences between samples in terms of cultural and educational background may be one factor contributing to the breadth of findings on this topic. Specifically, only in the Malaysian group was WM a mediator of the age-ToM relationship, and this was a stronger mediation effect in those with lower levels of education.

Potential limitations of the current study include the sampling, which as outlined above is not representative of the typical younger or older people in either country. This is a really tricky problem in the majority of cognitive aging research: the people who are willing to take part in lengthy cognitive testing batteries are usually those who are highly educated and have relatively high SES, and this was also the case for our samples here. Given that all four of our participant groups were highly educated, yet we still found an important role for education, this does make it important that future research finds a way to engage participants with lower SES and education profiles. We also used novel ToM tasks—though based on paradigms which have previously been widely used and found them to be valid measures of mental state understanding in different cultures (Li et al., 2013; Wang & Su, 2006). The reason that we adapted the tasks into the novel formats was to reduce complex linguistic load, and to increase cross-cultural representation in the stimuli. Note that we do have evidence that the ToM tasks were correlated with each other (see Table 2), providing some evidence of convergent validity. However, it would be useful to carry out further validation studies of these novel ToM tasks in a range of cultures.

Many studies of ToM have only included one very specific task, and here we tried to broaden any conclusions that could be drawn from the data in the current study by including two very different tasks of ToM. However, both of these tasks required explicit mental state judgments in complex tasks which contained a lot of information to be maintained in WM. In order to understand in more detail whether any cultural differences in age effects on ToM reflect less tendency to engage in individual mental state processing more broadly, it would be useful to use more implicit measures of ToM. For example, one study used eye-tracking to show that there were no age differences in the implicit tendency to look at a location cued by a false belief scenario (Grainger et al., 2019). It would be useful in future research to use eye-tracking to look at attentional focus during performance of both the visual tasks used in the current study, in order to see whether younger and older people attended differently to the information in the UK and Malaysia.

Conclusion

To conclude, we found that there were cultural differences in the effects of age on theory of mind performance. In two different ToM tasks, Malaysian older adults showed poorer ToM compared to their younger counterparts, and these age differences were much greater than in the British sample. In the Malaysian group, age differences in ToM were mediated by WM capacity, and this mediation effect was strongest for those Malaysians with lowest levels of education. The pattern of results found may reflect generational changes in the familiarity and cognitive load of explicit mental state attribution, or cultural differences in the pace of cognitive aging. Overall, this emphasizes the importance of cultural differences in education and WM when considering adult age differences in social cognition.
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References


Tables and figure captions

Table 1: Participants demographic information with means and standard deviations in brackets \((n = 298)\)

Table 2: Means, standard deviations and correlations for study variables for the whole sample

Fig 1. Moderated mediation analyses in the whole sample for faux pas detection (1A) and understanding (1B)

Fig 2. Moderated mediation analyses in the whole sample for false belief; lie deception (2A) and unseen switch (2B)
Table 1

Participants demographic information with means and standard deviations in brackets (n = 298)

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<th></th>
<th>British</th>
<th>Malaysia</th>
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<td></td>
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<td>Old (n=68)</td>
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<td>Mean Age</td>
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<td>Faux pas understanding</td>
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Note: SES = socioeconomic status, Montreal Cognitive Assessment, †42 adults only, *p < .05, **p < .01, ***p < .001
Table 2

Means, standard deviations and correlations for study variables for the whole sample

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<td>9. Unseen switch</td>
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* p < .05, ** p < .01
Figure 1

(A) Faux pas detection

(B) Faux pas understanding
Figure 2

(A) Lie deception

- C → WM: -0.2117***
- WM → Lie deception: -0.3783*
- WM → Age: -0.0056*
- Lie deception → E: 0.0182
- Age → Lie deception: -0.0326

(B) Unseen switch

- C → WM: -0.2117***
- WM → Unseen switch: -0.3783*
- WM → Age: -0.0026
- Age → Unseen switch: 0.0026
- Lie deception → E: 0.0017
- Unseen switch → E: 0.0010