Measuring Anxiety about Ageing and Ageism: Eye-Gaze Patterns, Facial Ageing Trajectories and Implicit Associations

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Abstract

This study aims to investigate ageism and anxiety about ageing among young adults via the Brief Implicit Association Test (BIAT) and eye-tracking, where gaze patterns towards faces of different ages and identities are analysed. Thirty-four female undergraduates (M_{age} = 20.68) completed the self-reported ageism and ageing anxiety scales, BIAT and a passive-view eye-tracking paradigm in which they viewed the age-manipulated faces across three facial identities (the self, familiar "friend" and the unfamiliar "other"). One sample *t*-tests against the cut-off scores of the respective scales indicates that participants reported significantly more positive attitudes towards older adults and marginally low ageing anxiety, on average, via self-reported measures. However, via the BIAT, on average, participants held ageist attitudes towards older adults. The attitudinal discrepancies between implicit and explicit measures of ageism supports the precedence of implicit attitudes under cognitive load. Regardless of facial identities, participants fixated significantly longer and more frequently at the eye regions compared to other facial regions, especially for old-aged faces. Old-aged faces were rated the least pleasant but most arousing. Facial images of the self were rated the most arousing. Though explorative in nature, findings of gaze patterns are consistent with the crucial roles of eyes and the Expert Hypothesis of facial processing. This sheds light on visual processing when viewing faces of different ages and identities, besides highlighting the attitudinal complexities of young adults towards older individuals. Findings also opens potential avenues for the integration or micro-behaviors and non-verbal communication strategies to supplement existing intergenerational efforts in mitigating ageism.

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Chapter 1 – Introduction and Literature Review

Current Population Age Structure

Development across the lifespan involves not only biological and cognitive ageing, but also social landscape changes (Bratt et al., 2018). Population ageing is one of the most significant social transformations globally as the proportions of older adults (individuals aged 65 and above) is projected to increase from 10% (2022) to 16% (2050) (United Nations Department of Economic and Social Affairs [UNDESA], 2022; World Health Organisation [WHO], 2023). By 2050, 1.5 billion people globally will be over 65 years (UNDESA, 2020). Relative to other world regions, the population dynamics in Asia and Pacific regions drive the population trend at global levels as they constitute countries with both the lowest fertility rates and with the highest life expectancies (United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP], 2023). This projected increase of the older population in coming decades is also evident among populations with relatively young age structures (UNESCAP, 2023). The rate of ageing is predicted to be most prominent among developing countries with a forecasted spike of more than 250% relative to 71% increase among developed countries (Khazanah Research Institute, 2015).

The rise in the population size of older adults in Malaysia is evident, echoing the trends of rapid population ageing in Asia as seen in the steady increase from 2019 to 2023 (see Table 1). By 2050, older adults will comprise 16% of the Malaysia's population (Khazanah Research Institute, 2015; Ferucci et al., 2008; UNDESA, 2022; International Council on Management of Population Programmes [ICOMP], 2017). This is currently reflected in the decline among Malaysian younger population, while the working adults and the population median age across these five years is steadily increasing. Given that the United Nations qualifies a country as an

ageing nation when 7% of the populations are aged 65 and above, Malaysia has achieved the status of an ageing nation (ICOMP, 2017).

With Malaysia becoming an increasingly age-diverse country, this rapid pace of ageing and demographic transitions gives little to no time in making the necessary adjustments to accommodate the growing needs and wellbeing of current and future older adults (UNESCAP, 2023). This gives rise to various social and economic challenges, with ageism – defined as the stereotype (how we think), prejudice (how we feel) and discriminatiojn (how we act) towards the self or others based on chronological age (Butler, 1969) being an increasingly prevalent and prominent societal challenge with current demographic trends (UNDESA, 2021; WHO, 2021).

Table 1

Malaysian Age Structure, Fertility Rate and Average Life Expectancy from 2019 to 2023 (Department of Statistics Malaysia; DOSM, 2019; 2020, 2021, 2022, 2023)

Year	Young Adults (%)	Working Adults (%)	Older Adults (%)	Median Age (years)	Fertility Rate	Average Life Expectancy
2019	7.6 million (23.5%)	22.7 million (69.8%)	2.2 million (6.7%)	28.9	1.8	74.8
2020	7.8 million (24.0%)	22.5 million (69.3%)	2.2 million (6.8%)	29.2	1.8	74.7

2021	7.7 million (23.6%)	22.6 million (69.4%)	2.3 million (7.0%)	30.1	1.7	74.0
2022	7.6 million (23.2%)	22.8 million (69.6%)	2.4 million (7.3%)	30.4	1.6	73.8
2023	7.5 million (22.6%)	23.4 million (70.0%)	2.5 million (7.4%)	30.7	1.6	74.8

Note. The age categorisation for young adults in the DOSMs is 0 to 14 years, working adults as 15 to 64 years, and older adults as those aged 65 and above.

Ageism

As defined in the previous sub-section, ageism is an ubiquitous phenomenon that can occur ambivalently and bidirectionally across the age spectrum where both the old and the young can be perceived positively and negatively by their counterpart (Bratt et al., 2020). For example, young adults can be perceived as ambitious, energetic and tech-savvy individuals, or alternatively, being lazy, selfish and materialistic (Fowler & Gasiorek, 2023). Likewise, older adults can be perceived as frail individuals, or as individuals that are experienced and wise (Mikton et al., 2021).

Ageism can be directed towards any age groups explicitly via conscious and intentional verbal expressions and deliberate actions, or implicitly through the unconscious thoughts, feelings and behaviours (Kang & Kim, 2022). It is highly prevalent, where one in every two adults hold ageist beliefs towards older adults (Marques et al., 2020; Ng & Lim-Soh, 2021). Compared to the young, older adults are often perceived negatively and are typically associated

with adverse ageing consequences (Calasanti, 2003; Cooney et al., 2021; McConatha et al., 2003; Yáñez-Yáñez et al., 2022).

Ayalon and Tesch-Römer (2018) theorised the occurrence of ageism into three main levels. The first level is micro-level ageism that is focused on the thoughts, emotions and actions of the individual. This form of ageism (interpersonal ageism) is evident in everyday interactions such as the avoidance or engagement in patronising speech when interacting with members of particular age groups. Other manifestations of ageism include self-directed (internalised ageism) where self-limiting age stereotypes are internalised by an individual (Cooney et al., 2021).

The second level is meso-level ageism, where practices of ageist behaviours occur within groups, organisations or social entities. The third level is macro-level ageism and is described as the presence of ageist behaviours that stem from cultural and societal values. These levels share some parallels with institutionalised ageism, where age-prejudices are institutionalised through policies, law and social norms of a particular culture (Cooney et al., 2021; Gutterman, 2022). Furthermore, it is probable that they are manifested and unconsciously experienced by both the perpetrator or victim as they can be very subtle or subliminally integrated in everyday interactions, or even within the organisational regulations and cultural values (Ayalon & Tesch-Römer, 2018; Lamont et al., 2015). However, it is crucial to note that these theoretical distinctions of the levels of ageism are non-exclusive as multiple levels may hold true simultaneously (Ayalon & Tesch-Römer, 2018).

This research predominantly revolves around micro-level ageism, with the specific aim of elucidating the attitudes of young adults towards older adults in Malaysia at the individual level

(Setterson, 2003). Some prominent theoretical explanations of micro-level ageism from the young against older adults can be derived from social psychology explanations, such as Social Identity Theory (SIT; Tajfel et al., 1979) and Terror Management Theory (TMT; Greenberg et al., 1997; Martens et al., 2005) and from developmental psychology such as the Stereotype Embodiment Theory (SET; Levy, 2009).

Social Identity Theory (SIT; Tajfel, 1979)

Social Identity Theory (SIT; Tajfel, 1979) suggests the naturalistic tendencies of categorising things into various generalised groups or categories to establish a system for self-reference of one's standing in their society. Once these categorisations are determined and established, social identification and adoption of salient normative behaviour in compliance with the group membership follows. SIT posits that ageism occurs due to the desire of the younger age groups to distinguish themselves from the old (Lev et al., 2018). This approach enhances both personal and group membership identity and status among the young (O'Connor & McFadden, 2012; Ayalon & Tesch-Römer, 2018).

Hence, when comparing one's ingroup ("us") with the outgroup ("them"), young adults tend to dissociate themselves from older adults as the latter are perceived as outgroup members due to their age differences. Such dissociation is also evident within members of the older adults age category as some may perceive themselves as being relatively younger in chronological age from other older adults (Weiss & Lang, 2012).

These intergroup distinctions and denigrations are further exacerbated by the negative age stereotypes associated with older adults (Lev et al., 2018). Some major stereotypes include being dependent, incompetent, impotent, useless, self-isolating, poverty and having poor physical appearance and mental health (Palmore, 1999). Inadvertently, this results in a perceived hierarchy of the young being of higher status and favourable at the expense of the inferior older

adults (Laws, 1995; O'Connor & McFadden, 2012; Barnett & Adams, 2018). This is consistent with the self-esteem hypothesis of the SIT in which individuals tend to cognitively accentuate the similarities of the in-group and the differences of the out-group. Therefore, with the assignation of various stereotypes towards older adults (such as the aforementioned), this creates a positive in-group value among the young that established a positive ingroup distinctiveness relative to the more negatively perceived outgroup (Martiny & Rubin, 2016). Nevertheless, when the young perpetuate ageist views, they are in fact, discriminating against their future self and group membership, given the permeability and the dynamic nature of age as a social category (Barnett & Adams, 2018; Comincioli et al., 2022).

Terror Management Theory (TMT; Greenberg et al., 1997; Martens et al., 2005)

Terror Management Theory (TMT; Greenberg et al., 1997; Martens et al., 2005) on the other hand, views ageism as the unconscious psychological defence against older adults in managing their deep-rooted fears of the vulnerability of the self to death and death-related anxieties (Ayalon & Tesch-Römer, 2018). A prominent strategy engaged by the young, middle and those of young-old age categories, TMT consists of two closely interrelated concepts - mortality salience hypothesis and the anxiety-buffer-hypothesis (Martens et al., 2005).

In the context of mortality salience, older adults are psychological threats of death. This occurs as they are directly associated with the inevitability of the body to eventually decline and die at the final stages despite being successful in avoiding accidents, disasters and recovering from various illnesses (Ayalon & Tesch-Römer, 2018; Bodmer, 2009). Besides that, they are indirect threats of animality due to decline in physical appearance. They are also a salient threat of insignificance to the young due to the diminishing physical strengths, physical beauty and

other capabilities that contribute to the self-esteem of an individual that rampantly declines with age (Lev et al., 2018; Ayalon & Tesch-Römer, 2018).

The anxiety-buffer-hypothesis acts as a counterpart of the mortality salience hypothesis in order to manage the psychological explicit or implicit threat that arises from the mere presence of older adults (Solomon, 2004; Bodner, 2009). As the anxiety-buffer hypothesis posits the strengthening of a particular psychological structure that reduces the anxieties experienced in response to the presence of a threat, in regards to ageism, they manifest in the form of symbolic defences against older adults (e.g., psychological distancing) that do not necessitate a logical or rational approach in managing death anxieties (Ayalon & Tesch-Römer, 2018; Greenberg et al., 1997). Analogous to the SIT, this theory also posits the negative evaluation, stereotyping and discrimination against the old by the young as a method to boost self-esteem in managing the perceived threat of older adults (Lev et al., 2018; Renkema et al., 2008; Greenberg et al., 2002; Bodner, 2009; Bodner et al., 2015).

Stereotype Embodiment Theory (SET; Levy, 2009)

Aside from SIT and TMT that revolves around interpersonal ageism, Stereotype Embodiment Theory (SET; Levy, 2009) taps on the aspect of internalised ageism and its subsequent consequences to later-life self-identity and health conditions (Chang et al., 2020). SET suggests that age stereotypes are unconsciously internalised since childhood via storybooks and media that consistently paints older adulthood in the light of a downward decline (Gawronski & Bodenhausen, 2014).

With the phase of older adulthood being of lesser relevance to younger individuals, they are very susceptible and are more likely to endorse and internalise the stereotypes associated with older adulthood (Lamont et al., 2015; Levy, 2009). When encountered with scenarios that

contradict stereotypes of older adults, they are likely to be assumed as evidence of deviation from the stereotypical norms of older adults (Comincioli et al., 2022). This occurs as the internalised preconceptions (consciously or unconsciously) are stable mental shortcuts that are hard to eradicate (Sargent-Cox et al., 2012).

This is reflected in the capabilities of children as young as aged four in perceiving and categorising individuals based on culture-specific age-related physical characteristics despite no intentions to age-discriminate (WHO, 2021; Montepare & Zebrowitz, 2002). As the young progresses into older adulthood, various health conditions (discussed at the next sub-section) were reported because of the assimilation and internalisation of the stereotypes in influencing the health and functioning in accordance with self-fulfilling prophecy (Levy & Leifheit-Limson, 2009; Levy, 2009). Therefore, despite the young onset of age stereotype internalisation, the SET explains later life manifestations of ageism, especially among those in the young-old and old-old age groups (Ayalon & Tesch-Römer, 2018).

Synthesis of the SIT, TMT and SET in Explaining Micro-level Ageism across the Lifespan

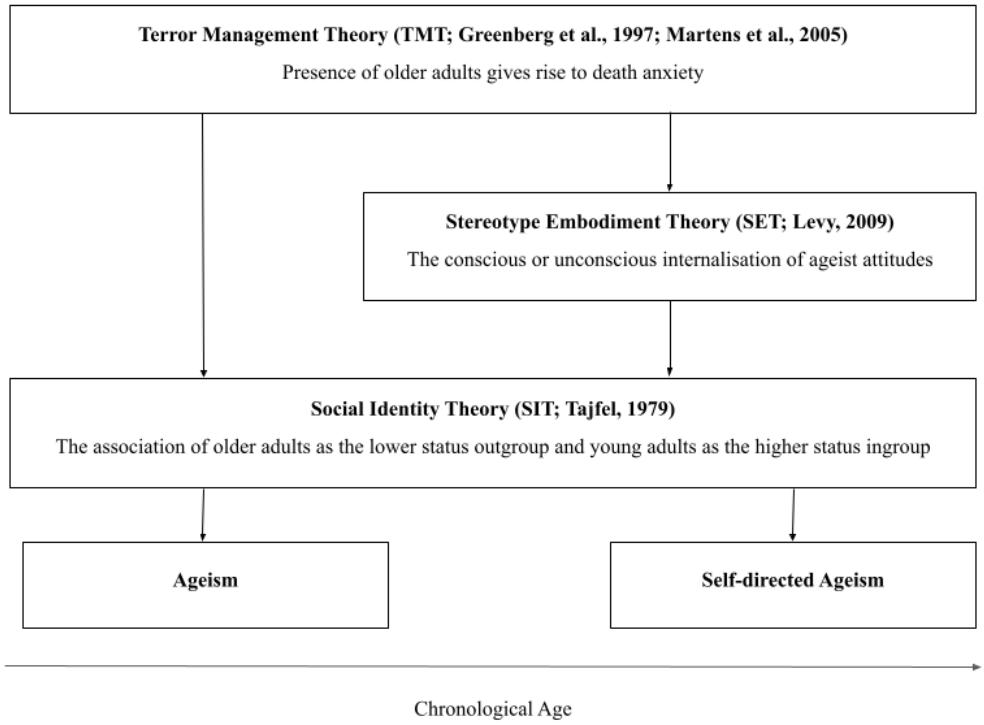
Taken together, the SIT, TMT and SET complement one another in providing a coherent and comprehensive overview encompassing the roots, relationships and consequences of individual level ageism across the lifespan (Bodner, 2009; Ayalon & Tesch-Römer, 2018) (see Figure 1). The SIT and TMT share some overlaps in terms of the denigration of older adults as the perceived outgroup to boost the self-esteem of the young adults who are perceived as ingroup (O'Connor & McFadden, 2012; Lev et al., 2018). However, the latter emphasises more on the perceived psychological threat of older adults and may not be as relevant when death anxiety and the inevitability of death gradually diminishes or is accepted (Maxfield et al., 2014).

Likewise, the interaction between SIT and SET is also evident. Contrary to the young, older adults are typically perceived to be members of a lower social hierarchy (social outgroup),

consistent with the SIT. Therefore, though the young may be more motivated to be reactive when presented with discrepancies between their self-appraisal and the less favourable external appraisals out of the reluctance of the young to view the self in a negative light (Martiny & Rubin, 2016), the contrary is true for older adults. Literature suggests that older adults are more inclined to accept and internalise the negative stereotypical beliefs, independent of the influence of death anxiety, in line with the notion of the SET (Lev et al., 2018).

Figure 1

An Integrated Model of the Three Theories of Micro-level Ageism adapted from Bodner (2009) and Ayalon & Tesch-Römer (2018)



Note. Ageism can also be explained using other micro-level theories (e.g., Montepare and Zebrowitz's (2002) Social Affordances Theory) or the meso-macro level theories, but they are not within the scope of this study.

Ageism and Its Consequences

Ageism is on a rise from 51.30% (1970-1978) to 85.30% (2010-2017) and across a range of countries such as America, Australia, China, and Germany (Chang et al., 2020). Ageism can either be a positive or negative manifestations, and the exposure to both types significantly influences older adults respectively (Horton et al., 2008; Curryer & Cook, 2021). For example, positive attitudes towards older adults and the ageing process were associated with greater life satisfactions and improved physical and mental health among older Australians (Bryant et al., 2012). However, literature suggests that ageism experienced and internalised by older adults are typically negative and they are significantly more detrimental to their health and wellbeing

(Ayalon & Tesch-Römer, 2018; Sargent-Cox et al., 2012; Meisner, 2012). Furthermore, with age also being a salient albeit dynamic social category, its consequences may compound with other social category discriminations (e.g., racial and gender discriminations; Ramirez et al., 2022).

As theorised by the SIT and SET, associations between the age stereotypes and task performances have been documented to significantly impair the performances of older adults in various physical and cognitive tasks (Kang & Chasteen, 2009; Haslam et al., 2012; Lamont et al., 2015). This is also echoed in Chasteen and Cherry (2015) where the memory tasks performance of older adults was moderated by their degree of exposure and the internalisation of negative age stereotypes. Patronising speech towards older adults with the exaggeration of intonations, pitch and politeness in communication also increases their tendency to socially withdraw and resist against receiving care (Cuddy et al., 2005). Other consequences of ageism include abuse and neglect of older adults (Bratt et al., 2018; Yunus, 2021), reduced self-esteem and the loss of autonomy among older adults (Lagacé et al., 2022).

Some health consequences of ageism include accelerated rate of cognitive decline (Levy et al., 2002), slower recovery rates from diseases (Levy et al., 2012), increased social isolation (Mikton et al., 2021), depression and anxiety (Kang & Kim, 2022), and the reduction of lifespan by 7.5 years (Nelson, 2007). The assimilation of negative age stereotypes also increases the likelihood of older adults to experience brain changes related to Alzheimer's diseases (Levy et al., 2016). This is consistent with the aforementioned notion of the SET in which the exposure and the passive internalisation of these age stereotypes and discriminations have resulted in the carry-over effects that extends into old age before manifesting in accordance with the self-fulfilling prophecies (Levy, 2009).

Longitudinal studies also reported the association between early-life ageism and poor late-life health such as cardiovascular complications (Levy, 2009) and cognitive and physical

underperformance (Lamont et al., 2015; Sargent-Cox et al., 2012). The long-term effects of ageism are also evident in Levy et al.'s (2009) study among cohorts ranging from 18 to 49 years, in which the negative age stereotypes held in early life consistently predicted increasaed cardiovascular events at old age, despite controlling for various other relevant covariates such as family history of cardiac disease. These health consequences that stemmed from interpersonal micro-level ageism also compounds into meso-level ageism as literature also reports the increasing prevalence of age-discrimination in assessing healthcare (Inouye, 2021; Cesari & Proietti, 2020). Taken together, ageism beliefs can be found across individuals of varying ages, and they may be associated with a myriad of healthcare risks in the later life when internalised (North & Fiske, 2012).

Ageism also directly implicates the economy. To the author's knowledge, only Levy et al. (2020) quantified the financial costs of ageism at the time of writing, where in 2013, 63 billion USD (15.4% of funds) were spent for healthcare across eight common medical conditions (e.g., cardiovascular disease, diabetes mellitus, mental disorders) among American citizens. Further narrowing of the healthcare expenditure relative to the types of ageism faced details to age discrimination (11.1 billion), negative self-perception of ageing (33.7 billion) and consequences of negative age stereotypes (28.5 billion). This exceeds the total expenditure spent by Americans for morbid obesity spent in the same year (Tsai et al., 2011; Kim & Basu, 2016). However, cross-nations comparison is not possible as the direct cost of ageism to the economy is heavily underexplored with other empirical research revolving heavily around the economic impacts of population ageing. Nevertheless, accumulated evidence indicate ageism is a major threat for healthy ageing among older adults, both at the personal level and economically (Marques et al., 2020; Levy et al., 2020).

Past Studies on the Attitudes of Young Adults towards Older Adults

Majority of earlier studies are in consensus that young adults from the West and lower income countries hold more ageist beliefs (Comincioli et al., 2022; Cooney et al., 2021; McConatha et al., 2003; Yáñez-Yáñez et al., 2022; WHO, 2021). However, albeit mixed findings, ageism is becoming more prevalent in the East (Vauclair et al., 2017; Yunn & Lachman, 2006; Lin & Bryant, 2009). Among Eastern countries, positive attitudes towards older adults were reported among Singaporeans as reported by Chua and Soiza (2008) and Cheong et al. (2009) via the University of California, Los Angeles Geriatric Attitude Scale (UCLA-GAS; Zanjari et al., 2022) and Kogan's Attitudes Towards Old People (KOAP; Kogan, 1961) respectively. This trend is also echoed among Koreans via a content analysis qualitative study (Jo & An, 2012), Thailand (Runkawatt et al., 2012) and Chinese students using the KOAP scale (Liu et al., 2014).

Negative attitudes were reported in other countries such as reported by Harwood et al. (1996) in Hong Kong via the Semantic Differential Scale that looked into physical and psychological traits, and also in China and Japan as measured using the Ageing Semantic Differential Scale (ASD; Rosencranz & McNevin, 1969) and the Japanese short version of the Fraboni Scale of Ageism respectively (Huang, 2013; Harada et al., 2004). Neutral or neutral-to-positive attitudes were reported among Koreans by Ha and Kim (2021) when measured using the Korean translated version of the FSA (Kim et al., 2012), Turkish as reported by Kocak et al. (2021) via the Duyan and Gelbal (2013) Turkish adapted version of Kogan's (1961) Attitudes towards the Elderly Scale, and also among Chinese students as reported by Tan et al. (2004) using the Chinese translated version of Sanders et al.'s (1984) Semantic Differential Scale.

In Malaysia, majority of studies on ageism tend to report data collected from individuals aged over 55 years old, such as Singh et al. (2018) va the KOAP, Mohammad Yunus et al.

(2016) and Rashid et al. (2016) as measured using Laindlaw et al.'s (2007) Attitudes to Ageing Questionnaire, and also via Maznah and Merriam's (2000) qualitative study. In all of the aforementioned studies, positive attitudes towards older adults were reported.

Among the handful of studies that recruited younger participants, findings are not conclusive. Man et al. (2022) via the FSA, Singh et al. (2018) via the KOAP, Ismail et al. (2023) via Reuben et al.'s (1998) Geriatric Attitudes Scale (GAS) questionnaire, Elias et al. (2020) using Kogan's (1961) Attitudes towards the Elderly Scale reported positive attitudes towards older adults among Malaysian young adults. On the other hand, the contrary was reported by Minhat et al.'s (2015) qualitative approach via a focus group interview, Damulak et al. (2015) and Saharuddin and Makhtar (2022) via the KOAP, and Griffiths et al. (2020) using the Attitudes towards Old People Scale (ATOP; Kogan, 1961).

Therefore, given the myriads of mixed findings within micro-level interpersonal ageism even within Eastern studies albeit the well-known macro-level cultural patterns of the East, this sheds light to the interactions between the macro-, meso- and micro-levels of ageism. This also evidenced that the attitudes and the subsequent behaviours towards older adults are not solely dictated by cultural influence (Runkawatt et al., 2012). Hence, this also highlights the arbitrariness of the theoretical distinctions of the levels of ageism as multiple levels may interact concurrently in influencing the attitudes of an individual towards older adults (Ayalon & Tesch-Römer, 2018).

Besides that, it is important to note that studies conducted on Malaysian young adults apart from Man et al. (2022), Minhat et al. (2015) and Muslihah et al. (2018) were conducted among healthcare undergraduates, thus limiting the generalisability of their findings. Nevertheless, the mixed results are interesting given the culture of filial piety embraced in

Malaysia that promotes high regards for older members of the society (Bochner, 1994; Huang, 2013; Vauclair et al., 2017).

Investigating Ageism via Implicit Measures

Self-report measures such as the Fraboni Scale of Ageism (FSA; Rupp et al., 2005) are commonly used in determining attitudes towards older adults across literature. Although the nature of questionnaires enables more differentiated and specific perceptions of older adults in determining attitudes (e.g., "Older adults should be encouraged to speak out politically") (Kleissner & Jahn, 2020), responses from these self-reported measures are susceptible to social desirability (Cherry et al., 2015) and do not tap into the internalised ageist beliefs (Kleissner & Jahn, 2020).

Ageism can also be examined implicitly via other non-questionnaire methods such as via stereotype-photograph pairing task (Hummert, 1994; Hummert et al., 1995; Hummert et al., 1997). Alternatively, the Implicit Association Test (IAT; Greenwald et al., 1998) is also utilised across majority of implicit ageism literature. This task operates on the premise where more closely associated target groups (e.g., "Old" and "Young") and attribute dimensions (e.g., "Positive" and "Negative") will elicit a faster response when they are associated with the same response keys. By analysing the response latency differences during rapid classification of the pairing of the target groups with the attribute dimensions to either of the assigned key response (e.g., "I" or the "E"), social desirability effect is circumvented (Yang et al., 2014).

The differences in response latencies between congruent (e.g., Pairing of "Old" target stimuli with a "Negative" attribute stimuli) and incongruent (e.g. Pairing of "Old" target stimuli with a "Positive" attribute stimuli) produces an index of implicit attitudinal difference and relative associative strengths between target-attribute associations (Malinen & Johnston, 2013).

However, unlike explicit measures such as self-reported questionnaires, the IATs only provide a relative indicator of attitudes based on the differences in response latencies for specific target words (e.g., young) and attributes (e.g., active).

Given the strengths and limitations of both implicit and explicit measures, it is advisable to administer both measures when measuring various attitudes, inclusive of ageism (Kleissner & Jahn, 2020). However, the divergence in age attitudes across these two types of measures is typically reported. Both Hummert et al. (2002) and Lin et al. (2010) found positive attitudes towards older adults with explicit measures. However, via the IAT, participants of the former held more ageist attitudes while the latter reported neutral findings. On the other hand, Chopik and Giasson (2017) reported explicit preference for young adults, but greater implicit preference for older adults. A few studies also utilised the shorter version of the IAT known as the Brief Implicit Association Test (BIAT; Sriram & Greenwald, 2009). Contrary to Chopik and Giasson (2017), these studies found implicit in-group preference for the young relative to older adults, while explicit measures indicate a neutral explicit age preference (Axt et al., 2014; Marini et al., 2021).

With studies that investigated wider age range of participants, stable negative implicit attitudes regardless of the age groups of the participants were reported by Malinen and Johnston (2013) as a significant negative bias was reported. In the aforementioned study, participants associated older adults more readily with more negative words such as “nasty”, “horrible”, “dislike”, “tragic”, “painful”, “angry”, “terrible”, “unpleasant”, “disaster” and “hate”, thus contradicting findings from the explicit measures. This contradicts He et al. (2011) that reported both the young (aged 18 to 30) and older individuals (aged 63 to 92) have positive attitudes towards older adults. However, despite the overall absence of age bias with the implicit measures in Lin et al.’s (2010), stronger implicit preference for older adults was evident among the

Western (Australians) undergraduates relative to the Eastern counterparts (Malaysian, Singaporean, and China). This contradicts Ackerman and Chopik's (2021) cross-cultural study across 68 different countries who reported significantly lower explicit and implicit ageism among collectivist countries compared to highly individualist countries.

Therefore, when the implicit and explicit measures of a construct are correlated, they are usually relatively weak (Kleissner & Jahn, 2020; Chopik & Giasson, 2017) or absent entirely (Greenwald et al., 2003; Nosek, 2015; Malinen & Johnston, 2013; Lin et al., 2010). The weak-to-no significant associations are a consistent occurrence across studies (Hummert et al., 2002; Marini et al., 2021), even among IATs studies with a pool of respondents encompassing 2.5 million across 17 target groups (Nosek et al., 2002). Therefore, in the context of this study, it is possible that findings on the respective measures suggest that young adults may hold diverging implicit and explicit attitudes towards older adults.

One possible factor for this trend of divergence in implicit-explicit attitudes is the low test-retest reliability of the IAT (Fazio & Olson, 2003; Malinen & Johnston, 2013; Hummert et al., 2002). Besides that, the implicit attitudes are usually categorised as the default, habitual "knee-jerk" response, while the explicit attitudes being the response that requires some cognitive capacity for activation (Greenwald et al., 1998). Wilson et al.'s (2000) dual-process theory argument puts forth the notion of the dissociation between consciously controlled explicit attitudes from the unconscious implicit attitudes in explaining the attitudinal discrepancies across these two measures (Karpinski & Hilton, 2001).

The dual process model suggests that an individual can hold two simultaneous opposing attitudes towards a minority group (e.g., implicit prejudiced attitudes and explicit egalitarian attitudes) (Wilson et al., 2000). These beliefs are distinct constructs governed independently. The implicit attitudes can be internalised from young via upbringing environment or cultural

influences before the development of explicit attitudes towards the target. Alternatively, it is also possible for both the implicit and explicit attitudes to develop concurrently as an individual may be explicitly exposed to a particular culture while also simultaneously developing an opposing implicit attitude based on personal encounters with target stimuli (Greenwald & Banaji, 1995; Wilson & Lindsey, 1998; Wilson et al., 2000; Lin et al., 2010).

The implicit attitudes are reported to be more stable compared to the explicit attitudes as they are unlikely to be fully eliminated by the later-learnt counter-stereotypical explicit attitude (Malinen & Johnston, 2013; Levy & Banaji, 2002; Kleissner & Jahn, 2020). It is possible for both the explicit and implicit attitudes to override one another regardless of motivation for social desirability but it is modulated by the cognitive load of the respondent. Under heavy cognitive load (e.g., short response time), the implicit attitude takes precedence over the explicit as the latter requires more cognitive capacity and motivation for information retrieval (Wilson & Lindsey, 1998).

Despite the potential dissociation between the implicit and explicit attitudes held by an individual, Wilson et al.'s (2000) dual-process model suggests that it does not give rise to feelings of attitudinal conflict or ambivalence within an individual as only one construct is expected to dominate and govern behaviour at a given time point. It is also important to note that although the dissociations between the implicit and explicit attitudes are typically the key component of implicit attitudinal constructs, they are not mandatory for the qualification of an attitude as implicit (Greenwald & Banaji, 1995). Furthermore, as both the implicit and explicit attitudes are reported to have independent predictive validities and distinct construct validity, this provides more support to the dual attitude model of the implicit and explicit construct, besides highlighting the importance of utilising both types of measures in investigating attitudes, such as ageism (Greenwald et al., 2009; Greenwald & Banaji, 1995).

Furthermore, literature also suggests an additional stress on cognitive resources when the IAT is used for attitudinal measure due to the potential need of respondents to employ conscious and effortful emotional regulatory efforts in the presence of potential implicit prejudice and stereotyping (Conrey et al., 2005; Frantz et al., 2004; Johns et al., 2008). The role of cognitive control in contributing to the IAT effect is also evident even when the IAT is scored using the recommended *D* algorithm scoring (Siegel et al., 2012). Therefore, these provides more backings to the role of cognitive resource control in influencing IAT performance.

The role of cognitive load in the IAT effect as elaborated by Wilson et al.'s (2000) dual-process theory shares some parallel with Conrey et al.'s (2005) and Sherman et al.'s (2008) Quadruple Process Model in distinguishing the cognitive mechanisms between the controlled and automatic processes of the IAT. This Quadruple Process Model taps onto the role of the working memory capacity and cognitive control, especially (a) associative activation – responsible for eliciting or inhibiting automatic spontaneous response tendencies for task-appropriate responses; (b) overcoming bias – executive control responsible to inhibit spontaneous response tendencies; and (c) discriminability – determination of task-appropriate responses independent of the response tendencies activated in accordance with the relative associative strengths between target items and their respective attributes (Siegel et al., 2012; Conrey et al., 2005; Sherman et al., 2008;).

Alternatively, the task-set switching model (Mierke & Klauer, 2001; Mierke & Klauer, 2003; Klauer & Mierke, 2005) is another model aside from the Quadruple Process Model that also revolves around the allocation of cognitive resources during complex tasks-switching such as the IAT. Nevertheless, these three models converge on the commonality of the IAT effects being mediated by executive control, where the more the cognitively demanding incongruent pairings of the IATs demands more working memory and executive function capacity, thus

resulting in the asymmetricity in the IAT effects, as manifested via the slower response latencies and increased error rates at incongruent pairings.

It is also crucial to note that the exaggeration of the prevalence of dissociations between implicit and explicit measures have also been reported (Nosek. 2007). Despite being roughly established that explicit measures such as questionnaires are based on deliberate introspection while implicit tests, such as the IAT or BIAT produces the index of attitudinal differences and relative associative strengths between target-attribute associations via response latencies (Malinen & Johnston, 2013), how they differ is yet to be clearly established (Nosek, 2007). This is true despite the IAT being heavily utilised in social cognition studies as it is still unknown what precisely is assessed via the IAT due to the lack of consensus on the cognitive and motivational structures underlying the IAT (Strack & Deutsch, 2004).

Alternative perspective to the Wilson et al.'s (2000) dual process model of explicit-implicit attitudes has been proposed by Fazio (1990) and Fazio and Towles-Schwen (1999). These authors view attitudes as a singular construct consisting of a mixture of both automatic and controlled components. This is evidenced in Olson et al. (2007) as the discrepancies between explicit and implicit measures recorded were not due to the nature of implicit measures tapping onto the unconscious constructs, but dependent on the task's instructions. Therefore, depending on the sensitivity of the domain, one's motivation and opportunities for cognitive deliberation dictates whether the spontaneous or controlled response is engaged when responding to the IAT (Fazio, 1990; Fazio & Towles-Schwen, 1999).

The opposition stems from the inabilities of current implicit measure procedures to justify the absence of awareness and the possibilities of implicit attitudes to co-exist with explicit attitudes represented in memory (Fazio & Olson, 2003). The aforementioned authors proposed that should there be discrepancies in reaction time when associating target groups with the

attributes, it may not be the case that one is unaware of the attitudes harboured (Fazio & Olson, 2003). Hence, the discordance between the implicit and explicit measures should not be inferred as evidence for an unconscious attitudinal construct, but instead as a type of implicit measure procedure technique in gauging attitudes circumventing direct questioning (Fazio & Olson, 2003).

There is also a third perspective that is theorised in terms of the relation between the implicit and explicit component. Unlike Wilson et al. (2000) and Fazio (1990) and Fazio and Towles-Schwen (1999) perspectives that are more on the distinct absent or present of relationship between the implicit and explicit measures, a more intermediary approach is put forth by Nosek (2007). This more conservative approach supports both the possibility of a conceptual overlap in attitude assessment with the implicit and explicit measures, albeit the distinctive procedural differences, while still preserving the respective differences that are unique and distinctive of the respective measures. However, this stance presents its own flaws as it sparks the question of the degree of overlap between the measured construct of the respective measures given their stark methodological contrast (Nosek, 2007).

Taken together, with implicit and explicit measures being complimentary with their strength and weaknesses in gauging attitudes, the established stability of implicit attitudes and the magnitude of implicit-explicit correlations across the lifespan (Chopik & Giasson, 2017), it will be in the interest of this study to look into these aspects in elucidating the attitudes towards older adults, both via implicit and explicit measures, among Malaysian young adults.

Ageing Anxiety

One common predictor of ageism is ageing anxiety (Rupp et al., 2005; Man et al., manuscript in preparation; Cooney et al., 2021; Lasher & Faulkender, 1993; Abdollahi et al., 2021). Defined as the fears, concerns and negative feelings induced by the anticipated loss,

negative expectations and self-perceptions associated with growing older and the ageing process (Chonody, 2019; Fernandez-Jimenez et al., 2020), this form of anxiety is unique compared to other anxieties (e.g., general anxiety or death anxiety) as it revolves predominantly around the aspects of expected deterioration in physical appearance, cognitive abilities, health and independence with ageing (Lasher & Faulkender, 1993; Lynch, 2000). The significant linear relationship between ageing anxiety and ageist attitudes is consistently reported across literature (Cooney et al., 2021; Lasher & Faulkender, 1993).

Lasher and Faulkender (1993) proposed four main dimensions of ageing anxiety:

(1) the fear of losses - taps onto the anxieties on expected losses with old age; (2) the fear of old people - concerns directed towards other older individuals; (3) psychological concerns - taps into an individual's meaning of life, purposes and contentment in adjusting to old age, and (4) physical appearance concerns - anxiety about one's expected physical deterioration with age. The first two constructs of ageing anxiety are externally focused (towards the others), while the latter two are internally focused (towards the self) (Brunton & Scott, 2015).

Age-related Changes in Physical Appearance

The extent of ageing anxieties experienced for the respective dimensions may differ depending on the relevance to the life stage of the individual, their age and gender (Brunton & Scott, 2015). Among young females, anxiety about ageing revolves predominantly on the changes in their physical appearance with age, albeit these changes being a naturally and ubiquitous process that comes with ageing regardless of gender (Cummings et al., 2000).

The initial signs of facial ageing become apparent from 20 to 30 years old (Windhager et al., 2019). Some examples of the common facial changes are tabulated in Table 2. These occur due to the cumulative age-related changes in skin, soft tissues and facial skeleton, loss of facial

volume, muscle tone and tissue elasticity together with the combined effects of gravity (Mendelson & Wong, 2020; Coleman & Grover, 2006; Dugdale, 2020; Kwart et al., 2012).

Although facial ageing changes are rather predictable and gradual, the rate of ageing of the facial structures differs across individuals as they are dependent on factors such as genetics, anatomic, environmental and chronologic processes (Friedman, 2005). With the current youth-driven culture, these physical signs of ageing are perceived negatively as they are linked with the narrative of decline (Barrett & Toothman, 2016; Chasteen & Carry, 2015).

Table 2

Example of expected facial changes with increasing age (Dugdale, 2020; Friedman, 2005; Windhager et al., 2019)

Facial Region	Facial Parts	Features	Cause
Upper third	Hair	Hairline moves upwards	Elongation of the upper third of the face due to ageing
	Eyes	Brow ptosis	Increased skin laxity, gravity & repeated downward contractile activity of the orbicularis oculi and glabellar muscle
		Grayish-white ring around cornea	Loss of pigment in the iris
	Eyelid	Baggy lower eyelids	Weakening of the orbital septum, orbicularis oculi muscle hypertrophy
		Excess lid skin	Loss of eyelid elasticity and descent of eyebrow
	Forehead	Horizontal glabellar furrow	Repeated action of the procerus muscle
		Vertical glabellar furrow	Repeated action of the corrugator supercilii muscle

		Horizontal forehead wrinkles	Repeated action of the frontalis muscle
Middle third	Nose	Boxy nasal tip	Weakening and stretching of the ligaments
		Nasal tip ptosis	Intrinsic weakening of the lower lateral cartilages
		Nasal valve obstruction	Collapse of the internal nasal due to the weakening of upper lateral cartilages
		Nasal lengthening	Enlargement of piriform aperture as bony edges recede
	Midface	Deepen nasolabial creases	Ligaments are unable to support facial soft tissue in youthful anatomic positions
		Hollowness in transition between lower eyelid and cheek	Deformity of tear trough, deepening of the nasojugal fold medially & palpebromolar groove laterally
		Midfacial ptosis	Progressive loss, shortening and straightening of muscle
Lower third	Chin	Chin ptosis	Premental fat ptosis, decreased mandibular height

		& projection, excess submental fullness, prominent submental creases
	Jowl formation	Fat accumulation in neck and subcutaneous tissue, skin ptosis, submandibular gland, superficial musculoaponeurotic system, mandible thinning
Neck	Platysmal banding	Positional changes of soft tissue
	Loss of cervicomental angle	
	Excessive submental fullness	
Ear	Earlobe elongation	Increase skin laxity
	Development of hair & hardening of ear wax	Few wax glands in ears

Although the physical deterioration with age detailed in Table 2 is universal, gender plays a role in moderating the ageing anxiety that comes with the changes in physical appearance (Abdollahi et al., 2021; Gatz & Zarit, 1999). Females, especially at young ages, typically experience greater ageing anxiety than males with physical appearance changes being one of their top concerns (Harris & Dollinger, 2001; Lynch, 2000; McGuinn & Mosher-Ashley, 2002; Cummings et al., 2000; Brunton & Scott, 2015). One possible explanation to this gender

difference can be attributed to the theory of the double standards of ageing (Sontag, 2018). This theory suggests that the deterioration in physical appearance with age erodes a social asset that is highly valued by females relative to males (Barrett & Robbins, 2008; Minhat et al., 2015; Åberg et al., 2020).

This occurs as prior to menopause, the ageing trajectories of men and women, on average, are approximately linear and parallel. However, during menopause, the rate of ageing for women becomes about twice to thrice faster than males (Windhager et al., 2019). This spikes the anxiety experienced by females as it widens the disparity between the current self and the unrealistic standards of female attractiveness culturally idealised (McConatha et al., 2004). With females experiencing the devaluing of status more sharply than males, it is highly likely for their emotional well-being to already be implicated during the onset of physical signs of ageing in their 30's (Barrett & Toothman, 2016).

This is reflected in the cosmetic industry as a ratio of nine females to one male undergoing various cosmetic surgical procedures was reported in the US and the UK despite its impermanence in achieving a youthful appearance (American Society of Plastic Surgeons, 2020; National Health Service, 2013; Chonody & Teater, 2016; Jain & Mathur, 2019). With ageing anxiety being a strong predictor for cosmetic surgeries among females (Brunton & Scott, 2015; Minhat et al., 2015), this informs the value of physical appearance to females, and how such deterioration heightens the anxieties experienced by them relative to males.

Despite ageing being a naturalistic and progressive process that becomes increasingly relevant towards later life, its implications are evident much earlier in the life course. Lynch (2000) put forth the midlife crisis theory and the pre-retirement ageing anxiety theory. These two theories are relatively similar where the former suggests ageing anxiety to peak at mid-life

(around 40s to 50s), while the latter suggests ageing anxiety to peak after mid-life but before retirement age (50s to 64 years old).

Besides those two theories, Lynch (2000) also theorised a quadratic relationship between ageing anxiety across the life course. This quadratic relationship puts forward the notion that ageing anxiety is the lowest at either ends of the life course (childhood and older adulthood) but is heightened during young and middle adulthood stages (Lynch, 2000). At childhood, ageing anxiety is low due to the lack of salience and personal relevance to the ageing experience (McGuinn & Mosher-Ashley, 2002). On the other hand, when approaching older adulthood, the decrease in ageing anxiety experienced by an individual can be attributed to the increased maturity, self-acceptance and gradual adaptation towards their personal ageing experience (Bergman & Segel-Karpas, 2021; Minhat et al., 2015; Faudzi et al., 2020).

This theory puts forward the notion that the perceptions and attitudes towards ageing are only properly developed at approximately within age eight to twelve (Fernández-Pereiro & Sánchez-Ayéndez, 1992). Approaching young adulthood onwards, the attitudes towards older adults are formed prior to experiencing their personal ageing via the increased exposure to youth-oriented media that normalises the stereotypical misconceptions of older adults (Hummert, 1990), such as being incompetent, dependent and having a poor physical and mental health (Palmore, 1999).

This perspective is consistent with most literature that reported the young to be more anxious about their ageing compared to other age groups (Lev et al., 2018; Abdollahi et al., 2021; Abramson & Silverstein, 2004). As elaborated previously, the anxiety towards ageing among the young is predominantly motivated by the unconscious threat of death and fear of getting older cued by the mere presence of older adults (Barnett & Adams, 2018). Their presence

puts into perspective the limited time remaining, and they may not be in capacity to comprehend and accept these impending physical changes (Bergman & Segel-Karpas, 2021; Minhat et al., 2015). This gives rise to the thoughts, feelings and emotions associated with their own ageing, thus spiking ageing anxiety experienced (Abdollahi et al., 2021; Abramson & Silverstein, 2004).

With the robustness of findings in that direction, coupled by the significant positive association with ageism (Man et al., 2022), this is consistent with the premise of the SIT and TMT in which older adults are assigned the outgroup status to buffer against the ageing anxiety and threat of death experienced. However, in the perspective of ageing anxiety, more emphasis is placed on the psychological wellbeing and attitudes towards one's personal ageing ("me"), in contrary to ageism that delves more into the attitudinal components of viewing the old as social outgroups ("them") (Barnett & Adams, 2018). Nevertheless, such categorisation boosts the self-esteem of the young against their future group membership and effortlessly gives rise to prejudicial feelings and discriminatory behaviours (Greenberg et al., 2002; Claypool et al., 2012). This puts into perspective the massive scope and breath of ageism as it highlights the contradiction on how longevity is celebrated, but older age is not (Curryer & Cook, 2021).

In the Asian regions, high ageing anxiety, specifically with physical appearance, has been consistently reported among Korean (Yun & Lachman, 2006), Iran (Abdollahi et al., 2021), Indian (Sachdeva & Singh, 2023), and Taiwanese (Gao, 2012) female young adults. Similar trends were also echoed in Tomioka et al. (2019) cross-cultural research where Japanese and Chinese college students were significantly more anxious about ageing compared to their American counterparts. In Malaysia, studies on ageing anxiety among young adults are relatively scarce and inconclusive. Low ageing anxiety has been reported among the young (Faudzi et al., 2020; Man et al., 2022). Only at middle-adulthood, Malaysian females expressed their concerns

of ageing anxiety with regards to their physical appearance deteriorations alongside other concerns on loneliness and welfare of their children at older ages (Minhat et al., 2015).

Taken together, ageing anxiety influences both attitudes towards other older adults, and towards one's own ageing process (McGuinn & Mosher-Ashley, 2002). Given the multidimensionality of ageing anxiety and the diversity of anticipated changes across chronological age, the current study focuses on ageing anxiety specifically in the dimensions of physical appearance, and its associations with implicit and self-reported ageism.

Valence and Arousal Ratings Across Faces of Different Ages

Aside from triggering ageing anxiety and the self-perception of one's own ageing, these physiognomic facial ageing cues interplays with first-impression formation and the stereotypical perceptions of the young towards older adults (Twele & Mondloch, 2022). This occurs as the subtle physical changes that comes with ageing also modulates the ratings of valence and arousal elicited as they are salient cues for individual perception (Hummert et al., 1997).

In terms of facial valence ratings, older adults are typically rated more negatively compared to the young (Ebner et al., 2018; Lazerus et al., 2016; Hess et al., 2023), or even across both younger and older participants (Hummert et al., 1997; Adams Jr et al., 2016). This occurs due to the link between age-prejudice and the negative stereotypic contents that associates undesirable characteristics with the aged and the ageing process (Hugenberg & Bodenhausen, 2003). For example, older adults are typically perceived as being less likeable, attractive and energetic (Ebner, 2008; Ha, 2017) as physical attraction also plays a role in influencing positive personality associations (Hugenberg & Bodenhausen, 2003).

This decrease in pleasantness rating with chronological age was also particularly evident among female faces (Hummert et al., 1994; Hummert et al., 1997; Foos and Clark, 2011;

McLellan and McKelvie, 1993; Ebner et al., 2018). This is consistent with how the self-concept and self-esteem of women were more strongly associated with youthful physical attractiveness (Allan & Johnson, 2008). However, with age, the emphasis placed on physical appearance among women gradually decreases (Barrett & Toothman, 2016). This also provides backing to Lynch's (2000) quadratic relationship between age and ageing anxiety, besides also putting into perspective the interactions between age and gender with regards to physical concerns. Hence, older adults are perceived as less pleasant given their decrease in physical attractiveness and youthfulness (Greitemeyer & Kuntz, 2013; Garrido & Prada, 2017).

This trend is still evident despite the introduction of the middle-age group. The faces of young adults were consistently rated as being the most pleasant, followed by the middle-aged group and older adulthood being the least pleasant (Foos & Clark, 2011; McLellan & McKelvie, 1993). With the erosion of youthful outward appearance increases with age, this increases the associations with strong negative stereotypes due to the perception of an individual as the an outgroup (Trawalter et al., 2008). The perception as social outgroup with age is further exacerbated, especially among females due to the double standards of ageing experienced by them relative to males, as an attempt to preserve the ingroup membership superiority of the young perceiver (Sontag, 1972; Barrett & Robbins, 2008; Minhat et al., 2015; Åberg et al., 2020) as the self-esteem and self-concept of women are very dependent on their youthful physical attractiveness (Allan & Johnson, 2008). Hence, in this context, consistent with the stereotype-congruent bias, the interplay between the bottom-up processing of facial-ageing cues, and the top-down processing via stereotype activation, and associations with preconceived mental shortcuts in moderating one's attitudes is evident (Lazerus et al., 2016; Franklin, 2023). Therefore, this explains how the subtle change in physical appearance modulates ageing anxiety, and the ratings of facial valence.

The perception of outgroup faces as a form of threat is evidenced in neuroimaging studies via the increased activation of brain regions associated with threat detection, such as the amygdala and insula (Chekroud et al., 2014). This occurs as the presence of threatening stimulus, inclusive of social threat, gives rise to fear (LaTour & Rotfeld, 1997) and greater emotional arousal with the activation of the sympathetic nervous system (Siegel & Victoroff, 2009; Schupp et al., 2004; Carey et al., 2013; Dudley et al., 2014). This is evidenced in Hugenberg and Bodenhausen (2003) where those with high racial implicit prejudice perceived the onset of high arousal emotions (e.g., anger, hostility) faster and for longer durations at the presence of outgroup faces compared to their counterpart.

As mentioned in the SIT and TMT, older adults regardless of gender, are perceived as outgroups as they are salient threat to the self-perception and the self-esteem among the young (Swift & Steeden, 2020; Lantos & Molenberghs, 2021). Therefore, regardless of older adults being categorised as real or perceived, existential, realistic or symbolic threat, this increases arousal levels due to the perceived intergroup threat and arousal (Chang et al., 2016; Stephen et al., 2009; Tabri et al., 2023). Taken together, older adults are perceived as a social threat due to their outgroup membership where they act as cues that triggers strong negative stereotypes, evidenced in the facial valence and arousal ratings (Trawalter et al., 2008).

The Human Facial Identity, Ageing and Gaze Behaviour

Facial information is amongst the most informative stimuli that is perceived and processed almost automatically. A brief exposure duration as short as 39 to 100 milliseconds (ms) would suffice in extracting various forms of social category information (e.g., ethnicity, mood, sex, age), direction of attention (Tsao & Livingstone, 2008; Bar et al., 2006), and initial impressions formation (Oliveira & Garcia-Marques, 2022). Although facial features are approximately in the same configurations across typically developing individuals (Tan et al.,

2012), past studies systematically documented how facial processing differs depending on the social category, such as the age and gender, of the face (Ebner, 2008; Kita et al., 2010). This study focuses on the influence of facial identity, and the social category of age on gaze patterns as indication of cognitive mechanisms associated with visual processing of aged facial stimuli.

Eye-movement Behaviour when Viewing Facial Stimuli Across Different Identities

Human gaze behaviour is modulated by familiarity (Zhou et al., 2021). In the social and evolutionary perspective, this ability is crucial as it aids effective cue retrieval for person-specific information for recognition and memory of specific individuals (Tan et al., 2012; Heisz & Shore, 2008). The highly specialised capacity to distinguish faces of varying degrees of familiarity (i.e., self-face, a familiar "friend" face and an unfamiliar "other" face) based on subtle differences in facial features has been reported to be present among infants as young as 12 months old (Nitta & Hashiya, 2021). This skill enables novel facial identities to become progressively more familiar after initial exposure (Heisz & Shore, 2008).

Neuroimaging studies provide evidence on the presence of distinctive neural mechanisms when processing faces of varying degrees of familiarity (Kadosh & Bonneh, 2022). Meanwhile, eye-movement studies have been used across facial perception studies to infer the underlying neurocognitive processes (Heisz & Shore, 2008; Henderson, 2003). Eye-scanning patterns for familiar and unfamiliar faces are found to be distinct and distinguishable very early upon the availability of identity information (i.e., within the first five seconds) (Althoff & Cohen, 1999; Van Belle et al., 2010).

With unfamiliar faces, more attention is allocated to the external features (e.g., hair, general facial regions) (Althoff & Cohen, 1999). With familiar faces, prominent sampling of the internal facial regions (eyes, nose, and mouth) was found despite their smaller proportions of respective internal facial regions relative to other external regions (Stacey et al., 2005; O'Donnel

& Bruce, 2001). This viewing strategy is coined as featural processing, where it posits a more analytical method of processing faces by their respective facial parts and features (e.g., evident distinction in viewing behaviours when fixating on the eyes and the mouth) (Pascalis et al., 2011; Richler & Gauthier, 2015). Based on face processing literature, featural processing typically occurs when fixations are predominantly isolated to non-central facial feature (Leong et al., 2023). In this regard, the eye region has been consistently reported to be fixated predominantly relative to other facial regions, especially with familiar faces (O'Donnel & Bruce, 2001; Althoff & Cohen, 1999; Stacey et al., 2005).

When familiarity is progressively fostered from repeated exposure and facial learning, significant transitions in sampling strategies occurs with more fixations directed to the eye regions (Heisz & Shore, 2008; Bonner et al., 2003). Prolonged fixation duration on eye region is also evident in studies independent of facial familiarity (Van Belle et al., 2010; Chakraborty & Chakarabarti, 2018). One potential reason for the increased fixations to the eye regions is due to the crucial role of the eyes as informative feature for person identification (Gold et al., 2004; Vinette et al., 2004). Besides that, the eyes also provide crucial information in gauging social cues (i.e., gaze direction) and mental states of another individual (Sullivan et al., 2007; Barton et al., 2006; Baron-Cohen, 2002). This is backed by how more eye-fixations are made by females, who are on average, are greater empathisers and have lower threshold in recognising emotions (Baron-Cohen, 2002).

Another possible reason for the prominence of the eye region is due to hierarchy of internal upright facial features viewed. The combination of eye-eyebrow at the upper regions of the face increases the contrast of internal feature information relative to the lower half of the face (Van Belle et al., 2010; Hsiao & Cotrell, 2008). This is consistent with how the eyes were fixated the most, followed by the nose and mouth regions, independent of both the age of the perceiver

and the presented facial stimuli (Firestone et al., 2007; Ha, 2017). This also indicates possible lack of age-related differences in face scanning pattern. However, Sullivan et al. (2007) and Fry et al. (2023) found otherwise, as younger facial images were associated with more fixations to the eye region, whereas the mouth is fixated more on older adults' facial images.

An alternative facial processing strategy is holistic processing. Contrary to how featural processing views the facial features by their respective parts, holistic processing posits the integration of the facial features into a gestalt and unified whole by the huaman visual system (Taubert et al., 2011; Richler & Gauthier, 2015). Hence, a more centralised fixation to the nasal region of the face is typically reported in the holistic processing of faces as this viewing strategy permits the most salient areas of the face to be perceived as a whole (Lee et al., 2022; Van Belle et al., 2010). Therefore, via holistic facial processing strategy, the facilitation of rapid facial information processing at earlier stage can occur in order to ensure the rapid detection of various faces in everyday encoutners (Taubert et al., 2011).

Alternatively, the combination of featural processing of the eyes and mouth have been reported (Schwaninger et al., 2002). Other combination of viewing strategies includes a mixture of eyes and nose-focused viewing among Malaysian Chinese participants, where fixations to the mouth regions progressively decreased as familiarity increased (Tan et al., 2012). This suggests a possibility that eye-movement behaviour changes with facial familiarity to optimise viewing strategies, albeit no consensus on specific regions of interests fixated with degree of familiarity.

On the other hand, the self-face is a type of self-referential stimuli that is the “most robust, familiar and overlearned” (Tong & Nakayama, 1999). They are processed the quickest, most efficiently with great depth and the lowest cognitive effort regardless of facial orientation (Hills, 2018). Literature indicates that the self-face is fixated the most relative to other familiar (non-self) and unfamiliar faces due to difficulties in attentional disengagement from the self-face

(Kita et al., 2010; Lee et al., 2022). Longer duration of fixation to the self-face also occurs as they are highly rewarding stimuli, and its prominence as a self-related facial information is critical for maintaining an individual's self-identity (Zhan et al., 2016).

Literature suggests that the self-face is processed featurally albeit mixed findings on the regions of fixations. For example, the lower half of the self-face, specifically the mouth, was reported by Lee et al. (2022), Greenberg and Goshen-Gottstein (2009), and Chakraborty and Chakrabarti (2018) to be fixated more and for longer durations. This is especially evident when the self-face is compared across familiar and unfamiliar faces, thus providing evidence for the enhanced featural processing with emphasis to the mouth regions for the self-face (Hills, 2018). Hence, although the information of person identifications is typically extracted from the eye regions, the lower half of the self-face seems to sustain more attention to the perceiver (Chakraborty & Chakrabarti, 2018).

Some studies report no significant differences in gaze patterns, duration or fixation count for self, familiar or unfamiliar facial identity alike as analogous holistic processing strategies were found across these faces regardless of familiarity (Blais et al., 2008; Van Belle et al., 2010; Kita et al., 2010). Alternatively, some also found a mix of regions of interests when viewing faces of varying familiarity (Schwaninger et al., 2002; Tan et al., 2012; Hills, 2018). Hills (2018) documented the combination of both featural processing of the eye regions, and holistic processing when viewing the self-face. With familiar faces, holistic processing is reported, while unfamiliar faces undergo only featural processing. These findings also indicate the importance and uniqueness of the self-face to the perceiver that necessitates the employment of both holistic and featural encoding for optimum processing (Hills, 2018).

Some possibilities for the processing differences across the self-face, familiar and unfamiliar faces could be due to the differences in daily task demands (Lee et al., 2022; Hills,

2018). Often, we view others for individual identification purposes, while we view our own faces for self-grooming purposes (Estudillo & Bindermann, 2017). The discrepancies in gaze patterns when viewing the faces across various studies could also be due to the differences in task demands of the experimental design. Featural processing was reported in passive view paradigms, but holistic processing was reported when tasked to make identity judgements (Lee et al., 2022). Taken together, this highlights the role of familiarity in moderating the qualitatively different facial perception and facial processing abilities and the respective areas of interest in gaze behaviour (Stacey et al., 2005).

Eye-movement Behaviour when Viewing Facial Stimuli Across Different Ages

There are crucial changes in facial appearance as chronological age increases (Anwarul & Dahiya, 2020). With older adults being perceived at lower social status relative to the young (ingroups) in accordance with SIT and TMT (Ayalon & Tesch-Römer, 2018), there is a possibility that the social group status of the target stimuli modulates the eye-movement behaviours of the perceivers (Simons & Levin, 1998). Analogous to the much researched own-race bias (ORB; Meissner & Bringham, 2001), the processing of the own-age faces follows similar trends as they also undergo enhanced and more thorough processing. This phenomenon is coined as the "own-age bias" (OAB; Anastasi & Rhodes, 2005).

OAB is typically evidenced by increased preference, and better recognition abilities for the own-age faces compared to other-age faces (Ebner et al., 2011; Wright & Stroud, 2002). This is evident in passive-viewing tasks where both the young and old fixated longer at own-age faces (He et al., 2011). Like the ORB, the theories behind the occurrence of OAB are still debated. The Expertise Hypothesis is one possible explanation (Rhodes & Anastasi, 2012). This theory suggests that individuals become experts in identifying and recognising faces of their age groups due to greater prior experience and frequency of contact (Wright & Stroud, 2002). With that,

holistic processing is made possible due to the repertoire of exemplars of the own-age available (He et al., 2011).

Though not directly related, the Expertise Hypothesis shares some conceptual overlaps with the self-reference effect (SRE; Symons & Johnson, 1997) as the ingroup faces are self-relevant information to an extent. With the emphasise of SRE on the self-structure relative to other concepts, self-relevant information is more elaborately encoded (Harrison & Hole, 2009). Consequently, given the heightened social-motivational component sparked by personal relevance, own-age faces are encoded and processed more efficiently (Symons & Johnson, 1997; Harrison & Hole, 2009; He et al., 2011; Ebner et al., 2011; Hummert et al., 1997; Tan et al., 2012).

Aside from ingroup facial expertise, differential gaze strategies are influenced by stereotypical references when actively scanning ingroup and outgroup visual stimuli (Henderson & Pierce, 2008; Callan et al., 2013; Anastasi & Rhodes, 2005). This is especially evident in free-viewing tasks as fixations tend to be directed to locations where one expects to find useful distinctive information ("schema-guided gaze behaviour"; Hansen et al., 2015). These areas of fixations are determined by both stimulus characteristics (bottom-up) and top-down processing (Van Belle et al., 2010).

Sporer's (2001) Ingroup/Outgroup Model (IOM) is a general model of face processing revolving around holistic-featural gaze patterns typically utilised in explaining differential gaze behaviour when perceiving ingroup and outgroup members. Despite being typically applied to ORB studies, this general model can be extrapolated to other forms of intergroup face processing, inclusive of age-based categorisations. This model posits that fixations to the nose (holistic processing) follows automatically when presented with faces of the own group (e.g.,

young viewing young). However, when perceiving outgroup (e.g., old viewing young) the presence of cues that are characteristic of the ageing outgroup (e.g., wrinkles) leads to an unconscious qualitatively different processing of faces featurally (e.g., fixations to the eyes) (Ha, 2017).

This occurs due to the innate capacity for threat detection as evidenced across real threats (Ohman & Mineka, 2001), pictures of biological threats (Ohman et al., 2001), and social threats (Fox et al., 2002). Consistent with the SIT and TMT that views older adults as real or perceived threats, eye-bias featural processing is expected as they are the most informative feature of the face (Gold et al., 2004; Vinette et al., 2004). When viewing a threat-related facial stimuli, the dwell time to the eye regions were three times greater relative to the mouth (Wells et al., 2016). Alternatively, older adult faces might also be processed with lesser individuation and efficiency or might even be cognitively disregarded (Harrison & Hole, 2009).

On the other hand, Simons and Levin (1998) proposed a conversely differentiated gaze pattern. They suggest ingroup faces undergo a feature-based manner viewing strategy as the eye-movements aim to differentiate ingroup features. Social outgroups are processed holistically to only perceive general attributes that characterises them as an outgroup with no attempts of individuating specific outgroup facial features. Nevertheless, both findings highlight the pivotal role of the abstraction of social categorical information in coding ingroup and outgroup faces and their influence in modulating eye-movement behaviour (Sporer, 2001; Simons & Levin, 1998). Therefore, the differential gaze behaviours impacted by facial age categorisation can be inferred by the presence of interactions between age of the perceiver and the age of perceived face (Wright & Stroud, 2002).

The increased fixation on the eye regions of the outgroup can be attributed to the ceiling processing of the faces of the ingroup. As the young adults have frequent encounters with their

own age groups, they are experts in processing the faces of their ingroup, thus resulting in lesser number of fixations needed to the eyes in extracting facial information (Firestone et al., 2007). Nevertheless, fixations towards the eye regions of older adults by the young suggests perceptual processing. This trend of interactions between perceiver and target stimuli facial age was reported by Strickland-Hughes et al. (2020) as both the young and the old fixated at the faces of older adults longer, suggesting an overall expertise in processing younger facial stimuli independent of the age of the perceiver.

Nevertheless, although direct evidence for the OAB was not obtained in some of the previous study, the overall differences in eye-scanning behaviours with respect to age groups provides evidence to the functional role of differential gaze patterns in facial learning and facial perception (Firestone et al., 2007). Furthermore, as these processing differences do not occur without its evolutionary adaptive roles (e.g., differential gaze patterns to identify ingroup members for ingroup altruism) (Masuda & Fu, 2015), this gives weightage to the role of social group status of age in modulating the visual scanning behaviour of facial stimuli (Firestone et al., 2007).

Valence and Arousal Ratings Across Faces of Different Identities

Valence is typically defined as how positive (i.e., pleasant) or negative (i.e., unpleasant) a particular emotion is (Stevens et al., 2016; Bestelmeyer et al., 2017). It also reflects the direction of behavioural activation associated with the particular emotion in which positive (pleasant) valence ratings reflect the approach motivation - tendency to approach a particular stimulus (Lane et al., 1999), while negative (unpleasant) valence ratings reflect the aversive motivation - tendency to escape, withdraw, repel or terminate the encounter with a particular stimulus (Bradley & Lang, 1994).

The social membership of individuals plays a role in valence judgements. Analogous to the SIT, familiar identities are more likely to be categorised as a social ingroup, and this brings rise to more favourable feelings, positive attitudes and treatments compared to an outgroup (Claypool et al., 2012). Such positive ingroup bias is widely reported and evident even in minimal arbitrary groups as seen in Tajfel's classic SIT paradigms (Tajfel et al., 1971; Tajfel & Turner, 1979). This occurred due to the top-down positivity effect elicited by the activation of ingroup concepts that resulted in a more pleasant valence judgement of the familiar ingroup (Freeman & Johnson, 2016). Therefore, given the intimate bidirectional relationship between familiarity and positive affect, more familiar facial stimuli, inclusive of neutral facial expressions, are rated more pleasant due to the selective modulation and amplification of positive affect (Carr et al., 2017). This is echoed in Chen et al. (2015) and Lazerus et al. (2016) that reported ingroup members' expressions as more positive on valence across all emotions, inclusive of the neutral facial expression.

Aside from the positive associations that arises with ingroup membership, perceptual fluency when processing familiar faces also contributes to the facial valence ratings (Bornstein & D'Agostino, 1994; Reber et al., 1998). Familiar faces are processed more easily as the mental representations of these faces are already formed during earlier encounters (Claypool et al., 2007). They are also more strongly encoded compared to unfamiliar faces (Ratner & Amodio, 2013; Reber et al., 1998). On the flip side, with novel stimulus, the processing of visual input is much more effortful as the perceiver must undergo the process of deciphering all crucial features to form a mental representation of the stimuli (Claypool et al., 2007).

Hence, the ease of processing given the reduced cognitive load may carry over, resulting in the perception of familiar faces as being more attractive, favoured, pleasant and display more positive affect overall (Bornstein & D'Agostino, 1994; Carr et al., 2017). The positive feeling

experienced by the perceiver due to the high perceptual fluency when processing familiar stimuli can be misattributed as the inherent positive quality of the stimuli (Garcia-Marques et al., 2004), liking, positivity and pleasantness (Reber et al., 1998). Therefore, this misattribution of perceptual fluency results in familiar individuals to be perceived with more positive emotions (Claypool et al., 2007; Claypool et al., 2012). The influence of carry over effect of perceptual fluency with familiarity via repeated exposure and perceived pleasantness is evident in Reber et al. (2004) and Claypool et al. (2007), and across other stimuli such as names (Greitemeyer & Kunz, 2013) and objects (Claypool et al., 2007).

On the other hand, arousal is defined as the intensity of vigour or emotional activation that increases with stimulus intensity when one faces sensory stimulation (Bradley & Lang, 1994; Gaffey & Wirth, 2014). Arousal ranges from low arousal - feelings of calmness, sleepiness or boredom to high arousal - alertness, excitement, awakeness, high energy and tension (Stevens et al., 2016; Lane et al., 1999; Niven & Miles, 2013; Bestelmeyer et al., 2017). Literature suggests that arousal levels are also modulated by facial familiarity as event-related potentials signals indicative of arousal were the greatest when viewing faces of romantic partners, followed by close friends and the lowest for strangers (Bayer et al., 2023; Guerra et al., 2012; Vico et al., 2010; Langeslag & Van Strien, 2019). Pupil dilation is another indication of arousal in which dilation increases with familiarity and social relevance (Mathot, 2018; Matyjek et al., 2021). Despite being utilised to a lesser extent (Cherry, 2017), self-reported scales follow the similar vein where familiar faces were consistently reported being more pleasant and arousing compared to stranger faces (Gobbini et al., 2004; Dobel et al., 2008).

As the self-face is the most familiar facial stimuli to an individual (Tong & Nakayama, 1999), arousal levels should be the greatest for this, followed by familiar and unfamiliar individuals (Enzi et al., 2009; Keyes & Brady, 2010; Bagnato et al., 2010). Therefore, it can be

speculated that self-face will elicit greatest emotional arousal due to its motivation, reward and personal significance value (Zhan et al., 2016). These processing outcomes of the self-face remains stable despite inversions (Bortolon & Raffard, 2018), extreme modifications and subliminal presentations (Ota & Nakano, 2021).

The relationship between facial familiarity on arousal levels could also potentially be elicited by the property of faces as a sensory visual feature of social pleasure, coupled by the perceiver's subjective judgment of facial stimuli (Berridge & Kringelbach, 2008). Increasingly familiar facial stimuli give rise to a "positive" form of arousal, the activation of motivational and reward systems for sustained attention (Suguira, 2014; Langeslag & Van Strien, 2019; Bayer et al., 2023; Guerra et al., 2012). This is supported by neuroimaging studies that found overlapping activation of brain regions associated with reward and motivations (e.g., anterior cingulate and medial insula) when observing familiar faces (Matyjek et al., 2021; Bartels & Zaki, 2004; Sabatinelli et al. 2007; Enzi et al., 2009; Ota & Nakano, 2021).

Some studies also report no difference in arousal levels across the self and familiar face identity due to the overlaps in the closeness of relationship between the two identities (Aron et al., 1991; Zhu et al., 2007; Wang et al., 2012; Myers et al., 2014; Tan et al., 2015). Taken together, consistent findings on the role of familiarity in influencing the autonomic responses and emotional arousal experienced have been reported (Matyjek et al., 2021). This highlights both the prominent role of familiarity in modulating facial perception and arousal levels, and the importance of using unique personalised facial stimuli sets, when relevant, in facial research (Bayer et al., 2023).

1.7 The Current Study

Rationale and Significance

The rise of ageism is rather paradoxical, especially given the current medical advancements and the social climate (Levy, 2017). Despite the significant objective improvements in healthcare and quality of life into old age (Satizabal et al., 2016; Lee et al., 2019; Jain & Mathur, 2019; Bajwa, 2014), the negative perception of ageing and older adults remains prevalent. In terms of the Malaysians social climate, the rampant increase in the population size of older adults potentially influence the attitudes of the young towards their future group membership.

To date, not many literatures have looked solely into facial perception with age as the social category. Most studies that looked into age-related facial processing tend to focus on aspects such as facial memory and recognition abilities (Nguyen et al., 2009; Kwart et al., 2012; Zhang & Zhou, 2019; Hu et al., 2013), perception of attractiveness (Kwart et al., 2012) and the assessment of age and fatigue-related markers for cosmetic surgical procedures (Nguyen et al., 2009). There is also a scarcity of studies that investigated the self-face aspects that are diagnostic of ageing (Kwart et al., 2012) and existing research is also yet to inform on the specific chronological age-related facial cues that triggers ageism (Bodner, 2009).

There is yet to have a study to date that investigated the concept of integrating eye-tracking with an artificially manipulated self-aged face, alongside the aged face of a familiar friend and an unfamiliar other in determining attitudes towards older adults (especially in Asia). Furthermore, limited studies investigated the simultaneous manipulations of identity familiarity within a particular social category in investigating facial perception. To the author's knowledge, only Zhou et al. (2021) tapped into this direction, albeit being a racial study. Nevertheless, it evidenced the possibility of familiarity of facial identity to overshadow the effect of social group categorisation in face recognition performance. Should it be that the findings of this study is also consistent with Zhou et al. (2021) in suggesting the potential role of facial familiarity in

overshadowing the influence of social group categorisation, this potentially create avenue for the role of quantity (Yan, 2011; Zhan et al., 2021) and/or quality of intergenerational contact as ageism interventions (Matusitz, 2012; Chonody et al., 2014; Schwartz & Simmon, 2001; Drury et al., 2016), especially with literature suggesting that familiarity can be fostered via frequent (quantity) and productive intergenerational exchanges and interactions (quality) (Allan & Johnson, 2008; Chonody et al., 2014; Schwartz & Simmons, 2001; Drury et al., 2016).

Hence, with effective communication encompassing both verbal and non-verbal components (Montague et al., 2011), intergenerational gaze behaviour is a potential non-verbal communicative avenue that can modulate social perceptions of subsequent intergenerational interactions (Cañigueral & Hamilton, 2019; Arnold-Cathalifaud et al., 2008). This is especially true given that cognitive research has established the eyes as powerful social interaction tools due to their strong innate associations with the perception of pleasantness, competency, credibility and the expression of internal emotional states that are crucial in establishing and modulating mutual common grounds in interpersonal relationships (Montague et al., 2011; Farroni et al., 2002). Taken together, these provide support that interpersonal gaze dynamics are crucial in modulating social behaviours and positive social interaction (Canigueral & Hamilton, 2019; Montague et al., 2011). Therefore, this study enables the fundamental exploration of non-verbal communication via eye-movement behaviours of Malaysian young adults towards older adults.

Aims

The first aim of this study is to determine the levels of ageism against older adults among Malaysia young adults. Both self-report measures and the shorter version of the IAT, the BIAT were utilised in investigating the attitudes towards older adults. The correlations between these two measures are also an aspect of interest, given the documented implicit-explicit attitudinal

divergence. The second aim of this study is to determine the associations between ageism (implicit and explicit) with the self-reported levels of ageing anxiety.

Furthermore, this study also explores the potentials of investigating ageism implicitly by inferring the gaze patterns via the differences in the total number and the duration of fixations when viewing facial images of varying ages and across different identities. In addition, this study also aims to determine the influence of age and identity on the ratings of valence and arousal elicited by facial stimuli.

Hypotheses

For this study, the hypotheses are as stated below: -

1. Consistent with Man et al. (2022) that previously recruited from the same study site, we predict that participants will have low levels of ageism in both self-rated and implicit measures. For the self-reported measure of ageism, a one-sample *t*-test (against the cut-off score of 69) will be conduected to determine if the recruited participants are more ageist (scored significantly above the cut-off score) or less ageist (scored significantly below the cut-off score). In terms of the implicit measure of ageism, a positive *D* score at the negative focal block would indicate that the recruited participants are more ageist towards older adults. Due to the various competing ideas on the relation between implicit and explicit measures, we opted for the simplest prediction in hypothesizing that the implicit and explicit measure will be significantly positively correlated.
2. The self-reported measure of ageism will be significantly positively correlated with the self-reported measure of ageing anxiety.
3. There are no specific directional hypotheses for the gaze patterns across facial familiarity and age group due to its exploratory nature. Should there be a difference in the gaze

patterns, they could possibly infer to either the various socio-cognitive accounts of face perception, such as the differences in motivation and cognitive resource across group membership, or the perceptual expertise theories due to the lack of familiarity of the facial perceptual system in processing faces of the outgroup (Ficco et al., 2022).

4. In terms of the ratings of facial valence and arousal, we hypothesise that facial stimuli manipulated into old-aged face will be rated as less pleasant and most arousing, while the young-aged face will be rated as more pleasant and less arousing.
5. In terms of facial identity, we expect that more familiar faces (self & friend) will be rated as more pleasant, and arousing compared to the unfamiliar (other) faces.

Chapter 2 – Methods

Design

This study employed a within-subject design. There were five areas of interests (AOIs; eyes, nose, mouth, hair, face) where participants viewed the facial stimuli across three aged-faces group (young-, middle-, and old-aged) and three identities (self, friend, and other). This gives a total 5 x 3 x 3 factorial combination for the repeated-measures analysis of variance (ANOVA). Additionally, correlational analysis is also applied in this study, particularly to examine the relationship between explicit-implicit measures of ageism, and whether they also correlate with the self-reported measure of ageing anxiety. This study is approved by the Science and Engineering Research Ethics Committee (SEREC) of the University of Nottingham Malaysia (Ethics Approval Code: KMMX210623). All participants (in the stimuli creation and experimental group) provided written informed consent before participating in the study.

Participants

Participant recruitment was conducted in pairs where each individual participant acted as the familiar "friend" identity for one another within the pairing. The inclusion criteria for participants in the experiment were similar to those in the stimuli creation group (refer the facial stimuli preparation sub-section below), except that they can be staff or students at the university (study site). All participants reported having normal or corrected-to-normal vision.

Twenty-five pairs of participants (N = 50; M age = 20.30; SD age = 1.68; age range = 18 to 24) were recruited via convenience sampling. However, data from ten participants were removed due to missing eye-tracking data, while six participants were removed due to calibration error. Therefore, this results in a total of 34 participants (M age = 20.68; SD age = 1.65; age range = 18 to 24). Post-hoc power analysis via MorePower 6.0.4 (Campbell & Thompson, 2012) using repeated-measures ANOVA with 5 x 3 x 3 as its design factors and effect of interest

indicated that the study has a power of .994, and it detected a medium-large effect size (η^2 = 0.09; alpha-criterion of .05, two-tailed) from a sample of 34 participants.

Materials and Apparatus

Facial Stimuli Preparation

Five individuals (*M* age = 23.00; *SD* age = 1.22; age range = 22 to 25) were recruited for the purpose of the facial stimuli of unfamiliar "other" identity. These participants were purposively sampled based on these inclusion criteria: (1) Malaysian Chinese female; (2) aged between 18 to 25; (3) have black or dark brown hair and (4) are not existing students or staff of the University of Nottingham Malaysia. As bodily deteriorations ahve been reported to be one of the most salient threat at old age (Bodner, 2009), and coupled by the vast literature reporting the greater physical appearance concerns experienced with age by females relative to males (Cummings et al., 2010; Abdollahi et al., 2021; Gatz & Zarit, 1999; Harris & Dollinger, 2001; Lynch, 2000; McGuinn & Mosher-Ashley, 2002; Brunton & Scott, 2015; Barrett & Robbins, 2008; Minhat et al., 2015; Åberg et al., 2020), this study is interested to explore areas of ageism and ageing anxiety specifically among females. The third criterion was set due to the limitations of the third-party software in generating simulated aged facial images for other hair colours aside from the aforementioned colours. The lattermost criterion was to ensure that they are unfamiliar individuals to the experimental group participants.

All participants were instructed not to wear any facial makeup when being photographed. This is because facial makeup is a form of cosmetic modification that can alter facial features and may influence the perceived appearance of the facial stimuli (Dantcheva et al., 2012). The presence of makeup also compromises and degrades the performance of facial-related analysis systems, such as facial landmark characterisation, aesthetic quantifications and automated age

estimation methods that are vital aspects in this study in producing artificially simulated aged facial images (Alzahrani et al., 2021). Besides, participants with long hair were instructed to tie-up their hair, and fringes that were occluding foreheads were pinned to prevent occlusion of the face. This helped ensure that a clean front-facing image was captured. They were also asked to maintain a neutral facial expression with mouth closed when being photographed.

All photographs were taken under the following conditions: grey background, same lighting conditions and camera settings (Shutter speed: 1/60; Aperture: F3.5, without flash, with area assist) using a digital single-lens reflex camera (DSLR; Camera model: Nikon D3100 AF-S DX NIKKOR 18-55mm). The camera was set on a tripod (CamLink TP-2800). Participants were photographed at a frontal position while assuming a neutral facial expression at approximately 138 centimetres (cm) away from the camera. The images were later cropped to only retain the head region of the participants.

To simulate the age-related changes, the smartphone application "YouCam MakeUp" (version 6.16.5) (Perfect Mobile Corp., 2024) was used. Images were artificially manipulated into two of the major life stages of human development - middle adulthood (approximately 45 years old) and older adulthood (approximately 70 years old) (Park & Joshanloo, 2021). The original photographed images of participants at present were used as a representation of the young adulthood as all the recruited participants were below 25 years old.

Using Adobe Photoshop 2023 (version 25.3.1) (Adobe Inc., 2023), the images were cropped according to their respective facial contours to ensure that face shape information were available (Lee et al., 2022). External facial features consisting of the hair and the ears were retained as facial recognition is not of interest in this study. These features also help in maintaining adequate ecological validity of the stimuli as real-life representation of faces contain

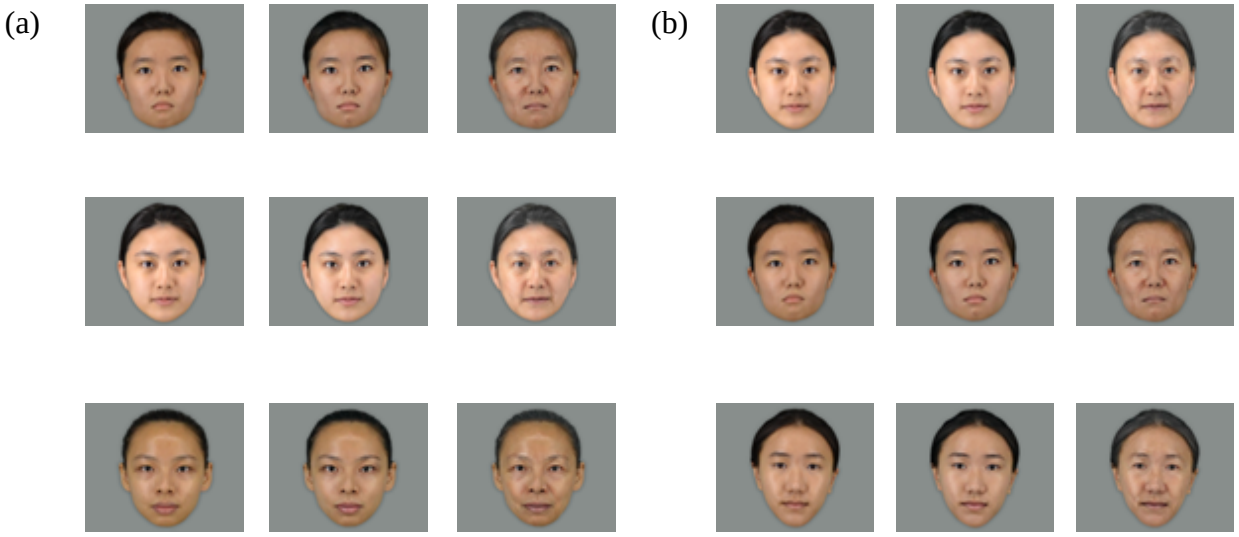
both the external and internal (e.g., eyes, nose, mouth) features (Ferreira-Santos, 2015; Axelrod & Yovel, 2010). The images were then resized into a vertical height of 25 cm before being layered over a 1280 x 1024 pixels grey background (colour hex code: #888E8C). All facial stimuli were collected and processed at least two days before the eye-tracking session.

The photographs used in this study were unique for each participant. As recruitment was conducted in pairs, the photographed self-image of each participant was used as their "self" identity image and their friends as the familiar "friend" identity image. The facial images of participants photographed from the facial stimuli creation group were used as the unfamiliar "other" facial identity. Each participant was assigned to one unfamiliar "other" identity image on a rotation basis.

Therefore, despite being recruited as a pair and viewing one another as their respective familiar "friend" identity, the unfamiliar "other" facial identity image for each individual participant differed as they only viewed one of the five unfamiliar "other" identities in their overall facial stimuli set (e.g., participant 1A viewed 1B as the familiar "friend" identity and vice versa, but the former viewed "other X", while the latter viewed "other Y" as the unfamiliar "other" identity). Taken together, each participant's stimulus set consisted of three different sets of identities (self, friend, and other) across three different age groups (young-aged face, middle-aged face, older-aged face) (see Figure 3).

Figure 3

Example of the stimuli set for each individual participant within a pair.



Note. The images within stimuli set grids (a) and (b) are ordered from young-aged (left-most) to middle-aged (centre) and older-aged (right-most). The first image (upper leftmost) in their respective grids were the self-photographs of the participants within a pairing. These images were taken as the "self" identity image and were also used as their respective "friend" identity images (second row). The third row of the respective set grids are the unfamiliar "other" identity facial image for each respective participant.

Sociodemographic questionnaire

Sociodemographic information (i.e., nationality, ethnicity, age and gender) were collected for all participants, inclusive of those involved in the facial stimuli creation.

Anxiety about Ageing Scale (AAS)

The Malaysian-adapted version of the multidimensional AAS scale (Din & Minhat, 2021) was used to measure the self-reported levels of ageing anxiety. This adapted scale is a 17-item instrument scored on a 5-point Likert (1 = strongly agree; 5 = strongly disagree) (see Appendix A). Items 13 to items 17 were reverse-coded. A greater summative score indicates higher levels of anxiety towards ageing. This adapted version of the AAS omitted three questions from Lasher and Faulkender's (1993) original AAS scale (1 item removed due to loading on a different theorised factor and 2 items removed due to low factor loading) (Din & Minhat, 2021). Some examples of questions of the AAS include "I like to go visit my older relatives (Question 2)" and "I feel very comfortable when I am around an old person (Question 4)". Examples of the omitted questions were "I fear it will be very hard for me to find contentment in old age (Question 6)", and "I have never lied about my age in order to appear younger (Question 11)". Despite these omissions, this instrument has an acceptable and improved overall fit indices with high factor loading and high construct validity (Cronbach alpha > .70 for all factors).

Model validity also confirms the ability of this adapted scale to discriminate the same intended four dimensions of ageing anxiety as the pioneering AAS scale (Din & Minhat, 2021). It also has a high total variance extracted (59.11%) that is comparable with Lasher and Faulkender's (1993) 20-item AAS scale (50.60%) and other country-validated adaptations such as among the Taiwanese (Gao, 2012) and Spanish (Fernández-Jiménez et al., 2020) populations respectively. Taken together, the revised 17-items AAS is a multidimensional measure that is psychometrically sound, reliable, valid and culturally appropriate in measuring ageing anxiety among Malaysian young adults.

Fraboni Scale of Ageism (FSA)

The self-reported attitudes towards older adults were measured using Rupp et al's (2005) revised three-factor model version of the FSA. This version consists of 23 items scored on a 4-point Likert (1= strongly disagree; 4 = strongly agree) (see Appendix B). Some of the examples of the questions are "Most old people can be irritating because they tell the same stories over and over again (Question 7)" and "I sometimes avoid eye contact with old people when I see them (Question 11)". Items 19 to 21 are reverse-coded. A greater summation of scores would indicate that an individual holds more ageist beliefs towards older adults. The main differences between the commonly used original FSA scale and the revised version are the renaming of factors "antilocution", "discrimination" and "avoidance" into "stereotypes", "affective attitudes" and "separation" respectively, and the omission of six items due to low factor loading. It has great reliability (Cronbach alphas > .70 across the three subscales) and exhibits a moderate-to-good fit structure in the confirmatory factor analysis.

Brief Implicit Association Test (BIAT)

The Brief Implicit Association Test (BIAT; Sriram & Greenwald, 2009) was opted instead of the standard Implicit Association Test (IAT; Greenwald et al., 1998). While the IAT is a widely used and well-validated chronometric measure since its introduction by Greenwald et al. (1998) for implicit attituds for various concept classfication (e.g., *Coke* vs *Pepsi)*, nominal contrasts (e.g., *Strong* vs *Warm*) and attitudinal domains (e.g., racism, sexism, political beliefs), inclusive of ageism such as those conducted by Hummert et al. (2002), Lin et al. (2010) and Chopik and Giasson (2017), fewer studies have utilised the BIAT for the purpose of investigating ageism. To the author's knowledge, only limited studies such as Marini et al. (2021), Axt et al. (2014) and Sriram and Greenwald (2009) have used the shorter and newer variant BIAT for the context of ageism despite its clear practical advantageous in terms of the reduced administration time and simplified design (Nosek et al., 2014; Sriram & Greenwald,

2009). Therefore, this study still opted to utilise the BIAT in order to add value to existing literature and to instil further confidence on the usage of BIAT for future research of similar nature (Yang et al., 2014).

Similar to Greenwald et al. 's (1998) standard IAT, the BIAT is a computerised chronometric categorisation task utilised to quantify the strength of conceptual associations via the latency contrast across conditions (Nosek et al., 2014). The main features that distinguish the standard IAT from the BIAT are that the latter contains fewer trials and only requires participants to focus on two instead of all four focal categories within a particular trial to elicit a response. These changes simplify the design (Sriram & Greenwald, 2009), facilitate easier understanding of instructions and decrease administration time (Nosek et al., 2014) without compromising on the psychometric performances and crucial design properties of a standard IAT (Yang et al., 2015).

As the BIAT can be conducted across any combined concept-attribute categories block along with its suitable contrasting categories as the respective focal and non-focal counterparts in each block (Sriram & Greenwald, 2009), for the purpose of this research, the BIAT paradigm was adapted into an age variant. The concepts of interest in this BIAT are “Young” and “Old”, while the attributes of interest are “Positive” and “Negative”. Although most studies used only a single focal attribute BIAT, a double attribute BIAT is adopted here as suggested by Nosek et al. (2014) as they may elicit different validities respectively despite being structurally identical (Sriram & Greenwald, 2019). Therefore, this enables the BIAT in this study to collect data from both possible focal attribute conditions.

The focal concept stimuli were displayed as images, whereas the focal attribute exemplars were displayed as texts (refer Table 3). This difference in presentation format for

concept and attributes were crucial for clarity (Sriram & Greenwald, 2009; Nosek et al., 2014). The stimuli for these BIAT categories were taken from Nosek et al. (2007). To ensure cultural appropriateness of the attribute exemplars, 17 Malaysian (*M* age = 22.94, *SD* age = .90; age range = 21 to 25 years old) were separately recruited to only rank the order of the attributes exemplars during the pilot phase in this study.

Table 3

Categories and the respective stimuli used for the concepts and attributes in the BIAT

BIAT Categories		Stimuli
Concepts	Old	
	Young	
Attributes	Negative	Ugly, Sadness, Weak, Pain
	Positive	Happiness, Joy, Resilient, Success

There was a total of nine blocks in the double attribute BIAT. The first block was a 16 trials practice block. The subsequent eight blocks were experimental blocks (four positive and four negative focal critical blocks). Each block consisted of 20 trials, amounting to a total of 160 critical trials (excluding practice trials). Of the eight critical blocks, the focal concept was

counterbalanced after every block, whereas the focal attributes were counterbalanced after every four blocks (see Table 4). This results in four possible counterbalanced iterations of the overall arrangement of the concepts and attributes in the BIAT. The scores of the BIAT are calculated using Nosek et al.'s (2014) recommended scoring procedures. This is elaborated in the data analyses sub-section below.

Table 4

Example of the structure of the critical combined-task blocks in an iteration of the Brief Implicit Association Test (BIAT)

Block	Number of trials	Focal Concept (Non-focal Concept)	Focal Attribute (Non-focal Attribute)
2	20	Young (Old)	Positive (Negative)
3	20	Old (Young)	
4	20	Young (Old)	
5	20	Old (Young)	
6	20	Young (Old)	Negative (Positive)
7	20	Old (Young)	
8	20	Young (Old)	
9	20	Old (Young)	

Note. The first block (practice block) was conducted with mammals and birds as the focal concepts. They were excluded in this tabulation as it is not relevant to the current study.

Eye-movement Recording

The Tobii T120 eye-tracker was used to record the eye gazes of participants while they were viewing the facial stimuli. The eye-tracker consists of an infrared camera embedded in a 17-inch thin-film-transistor (TFT) screen (1280 x 1024 pixels). The viewing distance between the eye-tracker and the participant was kept constant at approximately 62cm. A chin rest was also used throughout the study to minimise the head movement of participants (Lee et al., 2022).

Measure of Valence and Arousal

Participants rated their ratings of pleasantness (valence) and arousal (Adolph & Alper, 2010) after viewing every facial stimulus in the eye-tracking task. Both valence and arousal were rated on a 9-point Likert, where for pleasantness (1 = Very unpleasant; 5 = Neutral; 9 = Very pleasant) and for arousal (1 = Not at all aroused; 5 = Neutral; 9 = Very aroused). A greater summation of the respective scale ratings would indicate more positive valence and higher emotional arousal.

Procedure

This study consists of two parts. They were both administered in English as it is the most common language used in Malaysia's tertiary education institute (Zaaba et al., 2010). The first session is the photo-taking session held at the Face Lab at the University of Nottingham Malaysia. This session was undergone by participants from both the facial stimuli creation and experimental groups. Participants completed a short sociodemographic questionnaire administered via Qualtrics before being photographed. This session took around 15 minutes to complete.

Participants were separately contacted for the second session that commenced at least three days after the first session. In this session, participants first underwent two sets of questionnaires (FSA and AAS), a behavioural task (BIAT) and finally the eye-tracking task. The

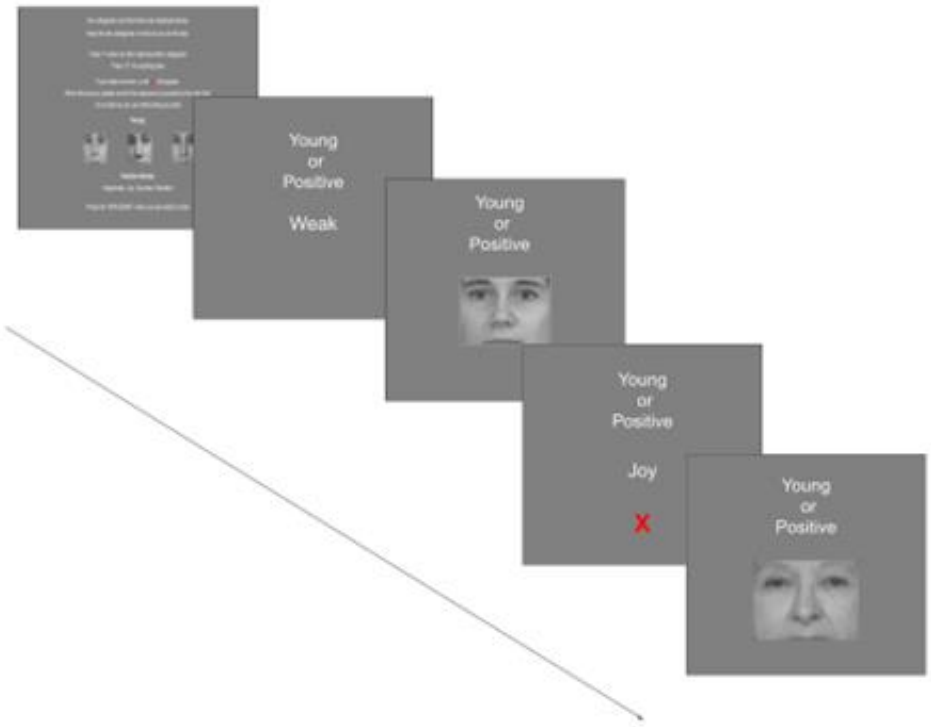
questionnaires were administered via Qualtrics. The order of presentation for each questionnaire and the behavioural task were counterbalanced. The eye-tracking task was constantly the last component for every participant to prevent the responses in the questionnaires and the reaction time-sensitive BIAT to be primed by the exposure to the facial images of varying ages (Bargh, 2006).

For the BIAT, at the start of every block, participants were displayed with the instruction page that indicated the focal categories (i.e., concepts - "Young" or "Old" and attributes - "Positive" or "Negative") and the respective stimuli for the current block. They were instructed to keep them in mind, and to subsequently respond to the upcoming stimuli for the particular block with a focal response key (i.e., the "I" key) if the centrally displayed stimuli matched the focal concepts or attributes for that particular block. Alternatively, if the stimuli do not match, a non-focal response key (i.e., the "E" key) is elicited. The response keys assignments were arbitrary and not counterbalanced as the properties of the BIAT measure are independent of the key options (Sriram & Greenwald, 2009). Participants were asked to respond as quickly as possible.

In every trial, a stimulus (concept or attribute) that is congruent or incongruent to the current focal categories appears at the centre of the screen until a response is elicited. If the response elicited is correct, the presented stimuli disappear. Only the label of the relevant focal concepts and attributes of the current block remained in-view at the upper centre half of the screen (e.g., "Young or Positive") throughout the block. There was an interval of 400 ms after a correct response was elicited before the next trial was presented. If an incorrect response was elicited, a red "X" appears at the bottom centre half of the screen and participants were required to correct the initial responses before proceeding to the next trial (see Figure 4).

Figure 4

Example of the Procedural Flow for the Brief Implicit Association Task (BIAT) for the focal category of Young and Positive



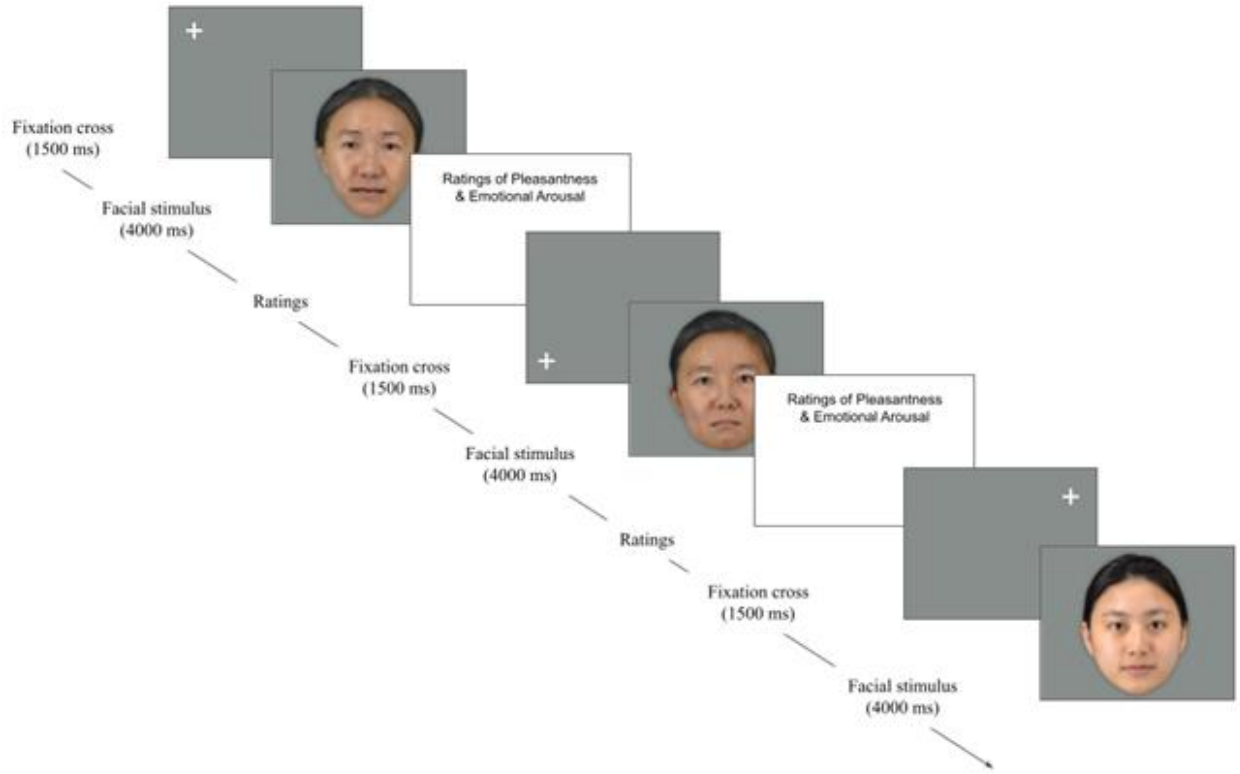
Eye-tracking

For the eye-tracking procedure, a passive-view paradigm was adopted to minimise task demands and facilitate natural gaze behaviour when viewing the facial stimuli (Caharel et al., 2002). A 9-point calibration was then conducted. Upon calibration acceptance, they were presented with the instructions. Participants were instructed to view the facial stimuli that appeared in this study as if they were looking at a photograph while keeping their head still on the chin rest throughout the session.

Prior to the onset of facial stimulus in every trial, participants were required to fixate on a white fixation cross that randomly appeared for 1.5 seconds at four corners of the grey background screen for calibration accuracy. The facial stimulus would then appear at the centre of the screen for four seconds. Participants were allowed to freely explore the stimuli as if they were looking at a photograph. After every trial, they were prompted to indicate the ratings of pleasantness and arousal via mouse clicks before proceeding to the subsequent trials (see Figure 5). Participants underwent a practice block of three facial stimuli. After that, they underwent three critical blocks. Each critical block consists of a set of nine randomly presented facial images (three identities: self, friend, and other across three age groups: young-, middle-, and older-aged faces) amounting to a total of 27 facial images across the three blocks. This session took approximately 35 to 40 minutes to complete.

Figure 5

Example of the flow of procedure in the eye-tracking passive view task



Note. The ratings of pleasantness and arousal after each facial stimuli onset are visualised here as a white slide (without their respective Likerts) to give more emphasis to the overall flow of the trials in the eye-tracking paradigm.

Data Analyses

Brief Implicit Association Test (BIAT)

Like the standard IAT, the BIAT is computed using the *D* algorithm developed by Nosek et al. (2014). The *D* measures the difference between the average response time for contrasting conditions (i.e., Positive vs Negative focal attributes) divided by the standard deviation of response latencies across conditions. It is also a form of individual effect size assessment with -2

and +2 being its theoretical minimum and maximum effect size. The steps of calculating the D scores are stated in Table 5.

Table 5

Recommended scoring practice for the BIAT

Steps	Recommended Steps in Calculating the *D* Score
1	Retention of error trials as built-in error penalty latencies improve the implicit-explicit correlations
2	Removal of the first four trials (warm-up trials) for each test block
3	Removal of trials that took more 10000 ms due to inattention
4	Discard participants that have more than 10% of trials response made faster than 300 ms due careless participation
5	Trial reaction times that were below 400 ms and above 2000 ms were recoded to 400 and 2000 ms respectively. The recoding of the upper and lower boundaries was reported to produce the best performance in reducing the impact of outlying observations.
6	The mean of latencies in condition 1 (M_1), condition 2 (M_2), and the standard deviation (*SD*) of the latencies (combination of both condition 1 and condition 2) were computed. *D* scores were calculated, $D = (M_2 - M_1)/ SD$. M_1 was always the stereotypical assumption of the association (i.e., Old and Negative for Negative focal blocks or Young and Positive for Positive focal blocks) and M_2

was the counterpart.

The *D* scores were calculated by aggregating the respective focal concepts (i.e., "Young" and "Old") for each focal attribute (i.e., "Positive" and "Negative" attributes). A positive *D* score at a negative focal block would indicate that participants had a stronger association of Old with Negative. A positive *D* score for a positive focal block indicates that the association of Young and Positive is greater.

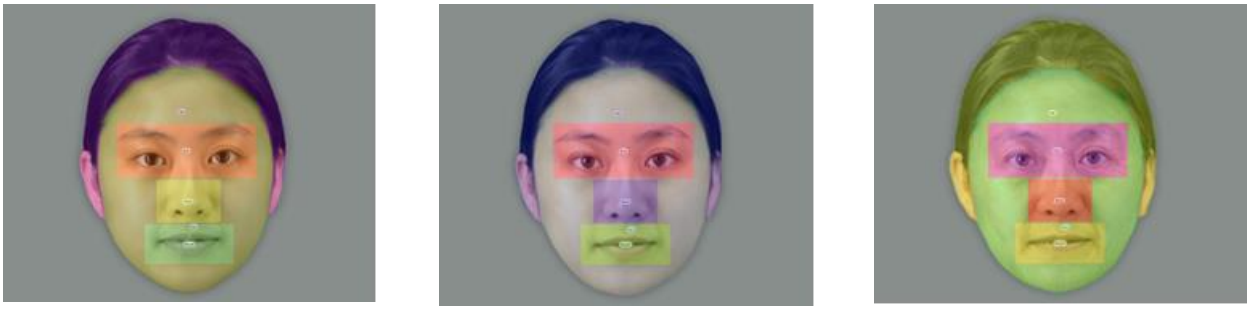
Eye-tracking

Predefined AOIs that consisted of the outlined regions for the eyes, nose, mouth, hair and facial regions were generated for each individual facial stimulus. The predefined dimensions for the first three features were obtained by averaging the dimensions (in pixels) of the eyes, nose and the mouth of the facial stimuli creation group for each respective age categories. Due to individual differences and the cumulative structural changes on the skin and tissues with ageing, this allows the dimension standardisation of the AOIs between and within facial stimuli of different identities and age groups.

The hair region in this study was inclusive of the ears as they are both external cues within close proximity of a typical face (Ferreira-Santos, 2015; Axelrod & Yovel, 2010). The face regions consisted of the general egg-shape facial region, excluding the eyes, nose, mouth and hair regions (i.e., the outline of the face). The AOIs for the latter two regions were defined according to individual facial contours (see Figure 6).

Figure 6

Example of face stimulus with its predefined AOIs



Note. The predefined AOIs (eyes, nose, mouth, face and hair) are as indicated with these differently coloured regions across young- (left-most), middle- (centre) and older-aged (right-most).

The stimuli presentation, data collection, data coding and data analyses were conducted via Tobii Studio Enterprise Edition (version 3.1.6.6744) (Tobii Technology AB, 2012). Eye-tracking data were sampled at 120 Hz, ensuring eye-movement data points to be collected at 8.33 millisecond (ms) intervals with an accuracy of 0.5°. The default Tobii Fixation Filter algorithm (Olsson, 2007) was utilised. This sets the fixation classifier at 35 pixels for both distance and velocity respectively in grouping raw gaze points as fixations, and this corresponds with a fixation threshold of 35/ (8.33 x 5) = .8403 px/ms. The two eye-tracking parameters of interest in this study are (1) the total fixation count - defined as the number of times the participants fixate on and within an active AOI, and (2) the total duration of fixation - defined as the sum of duration for all fixations on and within an AOI (seconds).

A repeated-measures ANOVA on the average total number of fixations and duration of fixations respectively were conducted using a 5 (AOIs: eyes, nose, mouth, face, and hair) x 3

(age: young, middle and older-aged faces) x 3 (identity: self, friend, and other). All post-hoc analyses were Holm-Bonferroni corrected.

Chapter 3 – Results

Descriptive statistics - AAS, FSA and BIAT

Table 6 shows the results of the descriptive analysis (N = 50) for the AAS, FSA and BIAT. One sample *t*-test on the FSA (cut-off score of 69) indicated that the recruited participants were significantly less ageist, $t(49) = -18.038$; $p < .001$; Cohen's $d = -2.557$. On the other hand, one sample *t*-test on the AAS (cut-off score of 51) only approached significance, $t(49) = -1.793$; $p = .079$; Cohen's $d = -.254$. Therefore, this suggests that participants hold significantly more positive attitudes towards older adults and are marginally less anxious about ageing, on average, when measured via self-reported measures. Findings from the double attribute BIAT indicate that on average, participants harboured more ageist attitudes towards older adults, as reflected by the positive D scores at the negative focal blocks (*D*_Negative). On the other hand, young-aged faces are perceived more positively as reflected by the positive *D* scores at the positive focal blocks (*D*_Positive).

Table 6

Range and Mean with Standard Deviation of the AAS, FSA, BIAT (N = 50)

Variables	**Minimum - Maximum**	***M (SD)***
Ageing Anxiety	28 - 70	48.94 (8.13)
Ageism	39 - 61	48.60 (4.85)
BIAT (*D*_Positive)	-0.299 - 1.08	0.35 (0.32)

BIAT (*D*_Negative)	-0.787 - 1.27	0.23 (0.45)

Note. A positive *D* score at a positive focal block indicates that the association of Young and Positive is greater. A positive *D* score at the negative focal block would indicate that participants had a stronger association of Old with Negative.

Correlations between AAS, FSA and BIAT

Shapiro-Wilk's test of normality indicated that data for the AAS, FSA and BIAT were normally distributed, all *ps* > .234. Therefore, Pearson's correlation coefficient analysis (*r*) was conducted to determine the relationship between the self-reported measure of ageing anxiety, ageism, and the BIAT (see Table 7). The self-reported measure of ageism was not significantly correlated with both the positive (r = - .079; p = .587) and negative (r = .077; p = .594) focal blocks of the double attribute BIAT. Self-reported ageing anxiety did not significantly correlate with both implicit and explicit measures of ageism, despite approaching significance with the self-reported ageism (p = .067).

Table 7

Correlation matrix between the FSA, AAS and the BIAT

Variables	**1**	**2**	**3**	**4**
Ageing Anxiety	1.000	-	-	-
Ageism	.261	1.000	-	-
*D*_Positive	-.039	-.079	1.000	-
*D*_Negative	-.025	.077	.050	1.000

Note. The AAS, FSA and BIAT were completed by all participants (N = 50).

Eye-gaze Patterns

The subsequent exploratory analyses included participants with valid eye-tracking data (N = 34). Although the duration of presentation for each facial image was four seconds per block, they were repeated for a total of 3 blocks in this study. Hence, when the eye-fixations were collapsed based on the individual facial stimuli, it amounts to a total of 12 seconds of viewing duration (4 seconds x 3 blocks). The eye-tracking parameters of interest in this study are (1) total duration of fixations; and (2) total number of fixations. Shapiro Wilk's test of normality indicated that the distribution of these two parameters were normally distributed (p = .638).

Total Duration of Fixations

A three-way 5 x 3 x 3 repeated-measures ANOVA with three within-subject factors: AOIs (eyes, nose, mouth, face, and hair), age (young-, middle-, and older-aged faces) and identity (self, friend, and other) were conducted on the total duration of fixation. Table 8 summarises the descriptives of the analysis. Greenhouse-Geisser corrections were applied for the degrees of freedom for the main effects of AOIs, identity, and for the interaction effects between AOIs and identity, AOIs and age, identity and age and also AOIs, identity and age as Mauchly's assumption of sphericity were violated (ps < .05). The assumption of sphericity were not violated for age.

There was a significant main effect on AOIs, F(1.541, 50.844) = 166.679, p < .001, ηp^2 = .835. However, the main effects of age, F (2,66) = 1.061, p = .352, ηp^2 = .031 and identity, F(1.570, 51.825) = .247, p = .728, ηp^2 = .007 were not significant. There were also no significant interaction effects between AOIs and age F(4.068, 134.235) = .974, p = .425, ηp^2 = .029, AOIs and identity F(3.589, 118.422) = .365, p = .813, ηp^2 = .011, age and identity, F(2.616, 86.316) =

2.083, $p = .117$, $\eta p^2 = .059$, and AOIs, age and identity, $F(6.474, 213.631) = .780$, $p = .596$, $\eta p^2 = .023$.

Table 8

Summary of the Descriptive Analyses for the Total Duration of Fixation across *Age and Identity*

		Age of Face					
		Young-Aged		**Middle-Aged**		**Older-Aged**	
AOIs	**lentity**	***M***	***SD***	***M***	***SD***	***M***	***SD***
Eyes	Self	6.799	1.857	6.825	1.943	6.843	2.162
	Friend	6.592	2.100	6.590	2.012	6.808	2.259
	Other	6.487	2.369	6.985	2.365	6.870	2.386
Nose	Self	1.689	213	1.440	1.046	1.548	1.180
	Friend	1.852	1.530	1.684	1.683	1.604	1.713
	Other	1.706	1.298	1.797	1.666	1.548	1.282
Mouth	Self	1.064	0.775	0.772	0.788	0.878	0.736
	Friend	0.840	0.574	0.986	1.036	0.933	0.822
	Other	0.927	0.918	0.706	0.693	0.754	0.667
Face	Self	1.381	0.981	1.557	1.337	1.319	1.104
	Friend	1.389	1.167	1.448	1.002	1.330	1.121

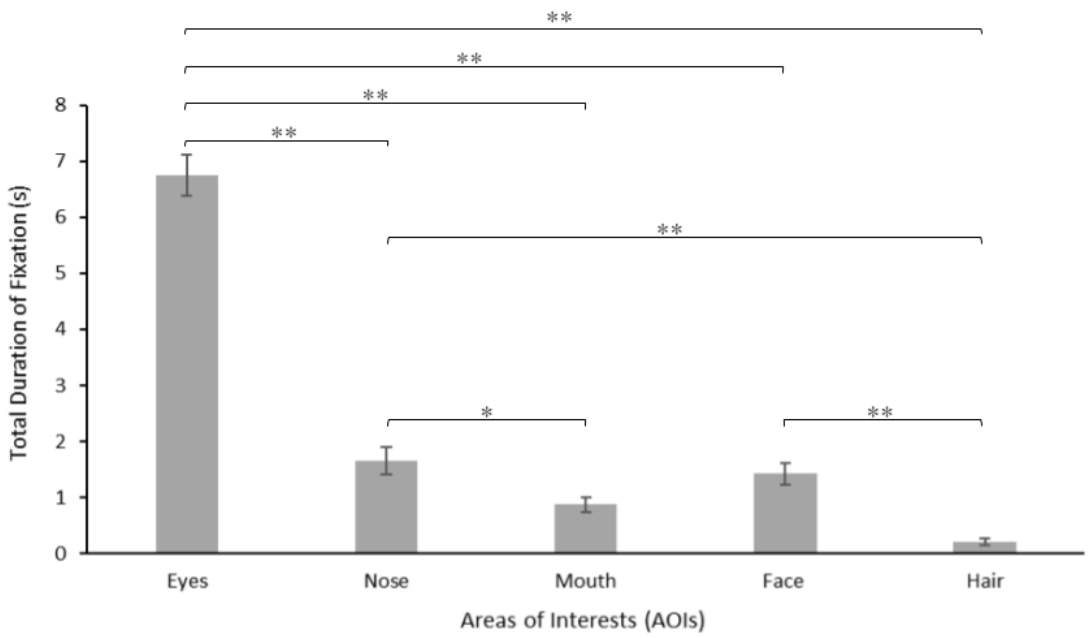
	Other	1.446	1.167	1.364	0.996	1.577	1.330
Hair	Self	0.166	0.214	0.212	0.375	0.238	0.419
	Friend	0.283	0.537	0.287	0.453	0.201	0.472
	Other	0.260	0.421	0.134	0.223	0.119	0.245

Post-hoc pairwise comparisons (with Holm-Bonferroni correction) on the main effects of AOIs (see Figure 7) indicated that the eyes (M = 6.755, SD = 2.161) were significantly fixated the longest, followed by the nose (M = 1.652, SD = 1.401; $t(33) = 17.811$, $p < .001$, Cohen's d = 3.847), face (M = 1.423, SD = 1.134; $t(33) = 18.608$, $p < .001$, Cohen's d = 4.019), mouth (M = .8733, SD = .779; $t(33) = 20.529$, $p < .001$, Cohen's d = 4.433), and hair region (M = .211, SD = .373; $t(33) = 22.839$, $p < .001$, Cohen's d = 4.932). The nose was fixated at significantly longer compared to the mouth, $t(33) = 2.718$, $p = .030$, Cohen's d = .587, and hair, $t(33) = 5.028$, $p < .001$, Cohen's d = 1.086. The general face region was fixated significantly longer compared to the hair, $t(33) = 4.231$, $p < .001$, Cohen's d = .914).

No significant differences in the average total duration of fixations were reported between the nose and face region ($p = .427$), the mouth and face region ($p = .114$), and between the mouth and hair region ($p = .067$). Despite no significant differences among those AOIs in the pairwise comparisons, when taken as a whole with other facial features considered, participants viewed the eyes the longest, followed by the nose, face, mouth and hair regions.

Figure 7

Bar Graph depicting the Total Duration of Fixation on the AOIs



Note. Error bars represent standard error

*p <. 05, **p < .001

Total Number of Fixations

A three-way 5 x 3 x 3 repeated measures ANOVA with three within-subject factors: AOIs (eyes, nose, mouth, face and hair), age (young-, middle-, and older-aged faces and identity (self, friend and other) was conducted on the total number of fixations. See Table 9 for the respective descriptive analysis. Greenhouse-Geisser corrections were applied for the degrees of freedom for the main effects of AOIs, and for the interaction effects between AOIs and identity, AOIs and age, and AOIs, identity and age as Mauchly's assumption of sphericity were violated

(*ps* < .05). Assumptions of sphericity were not violated for age, identity and the interaction between age and identity.

Significant main effect of AOIs, F (1.681, 55.479) = 172.255, p <. 001, ηp^2 = .839 and age, F (2, 66) = 5.211, p =. 008, ηp^2 = .136 were found. A significant interaction effect of AOIs and age was also observed, F(3.790, 125.077) = 3.227, p = .016, ηp^2 = .089. No significant main effect was found for identity, F(2, 66) = 2.030, p = .139, ηp^2 = .058. No significant interaction effects were observed for AOIs and identity, F(3.155, 104.155) = .306, p = .830, ηp^2 = .009, identity and age, F(4, 132) = .406, p = .804, ηp^2 = .012. No significant interaction effect was also reported between AOIs, identity and age, F(6.282, 207.298) = 1.434, p = .200, ηp^2 = .042.

Table 9

*Summary of Descriptive Analyses for the Total Number of Fix*ation across Age and Identity

		Age of Face					
		Young-Aged		**Middle-Aged**		**Older-Aged**	
AOIs	**Identity**	***M***	***SD***	***M***	***SD***	***M***	***SD***
Eyes	Self	20.088	7.132	20.147	5.327	21.176	6.058
	Friend	19.735	6.951	21.029	6.312	23.147	7.361
	Other	19.529	6.648	21.059	7.950	21.059	6.888
Nose	Self	6.059	4.177	5.382	3.585	6.059	4.390
	Friend	6.794	6.309	6.265	6.037	5.882	6.094
	Other	6.176	4.414	6.912	6.092	6.059	4.458

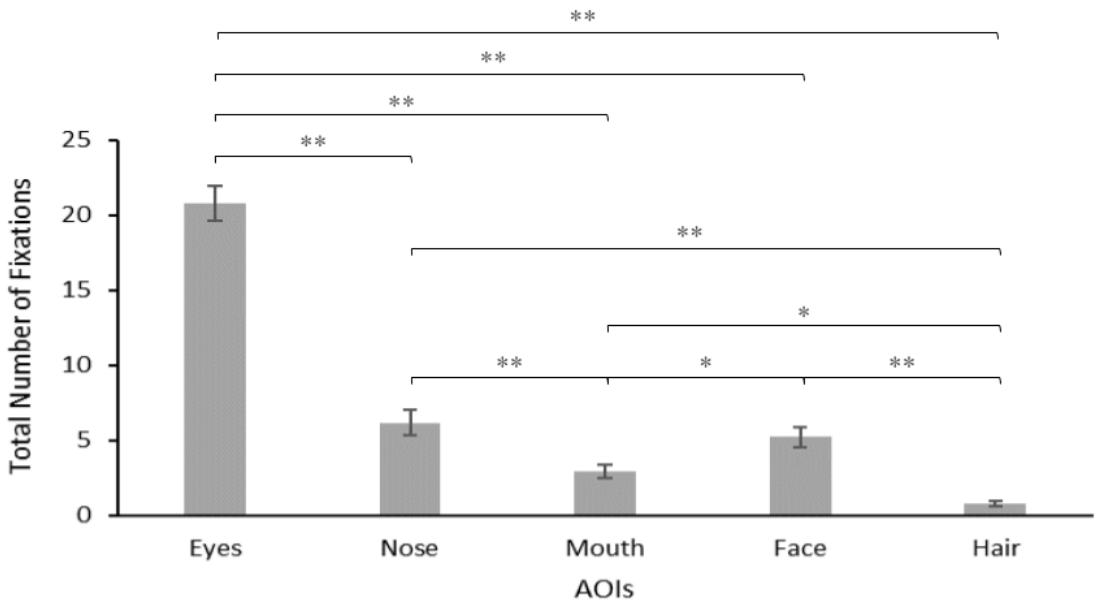
Mouth	Self	3.118	2.306	2.676	2.483	2.941	2.322
	Friend	2.706	2.111	3.147	2.976	3.235	2.882
	Other	3.029	3.080	2.412	2.258	2.794	2.579
Face	Self	4.441	2.956	5.735	4.337	5.235	4.411
	Friend	5.559	3.948	4.794	3.198	5.382	4.356
	Other	5.441	3.767	4.618	3.114	5.735	4.640
Hair	Self	0.676	0.806	0.794	1.095	0.912	1.401
	Friend	0.912	1.564	1.000	1.414	0.765	1.394
	Other	0.941	1.536	0.618	0.985	0.529	1.080

Post-hoc pairwise comparisons on the main effects of AOIs (see Figure 8) indicated that the eyes (M = 20.774, SD = 6.736) were significantly fixated the most, followed by the nose (M = 6.1764, SD = 5.062; $t(33) = 17.177$, $p < .001$, Cohen's d =3.331), face (M = 5.216, SD = 3.859; $t(33) = 18.308$, $p < .001$, Cohen's d = 3.550), mouth (M = 2.895, SD = 2.555; $t(33) = 21.038$, $p < .001$, Cohen's d = 4.080), and hair region (M = .7941, SD = 1.253; $t(33) = 23.511$, $p < .001$, Cohen's d = 4.559). There were significantly more fixations towards the nose compared to the mouth, $t(33) = 3.861$, $p < .001$, Cohen's d = .749, and hair, $t(33) = 6.333$, $p < .001$, Cohen's d = 1.228. There were also significantly more fixations to the face than the mouth regions, $t(33) = -2.730$, $p = .022$, Cohen's d = -.529). The mouth region was also fixated more compared to hair, $t(33) = 2.473$, $p = .029$, Cohen's d = .479). The face regions were fixated more significantly

compared to the hair regions, $t(33) = 5.203$, $p < .001$, Cohen's $d = 1.009$). No significant differences in number of fixations were reported between the nose and face ($p = .26$). As an overall, with other facial features considered, the order of facial features fixated the most were similar with the duration of fixation. Participants fixated at the eye region the most, followed by the nose, face, mouth and hair regions being the least fixated.

Figure 8

Bar Graph depicting the Total Number of Fixation on the AOIs



Note. Error bars represent standard error

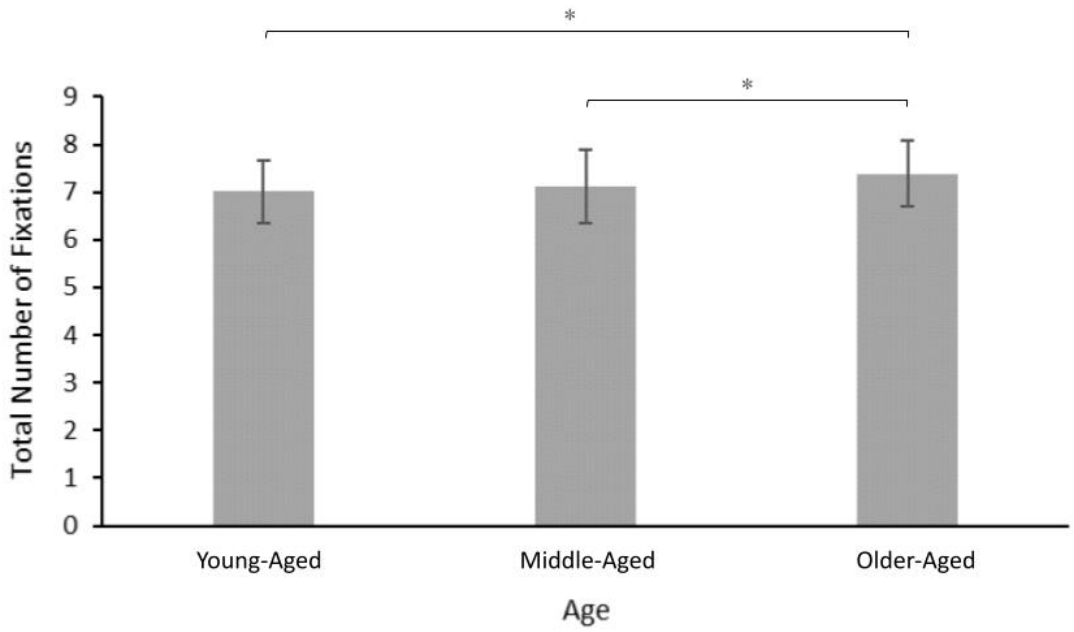
*p <. 05, **p < .001

For the main effects of age, post-hoc pairwise comparisons (see Figure 9) indicated that the old-aged faces ($M = 7.394$, $SD = 4.021$) were fixated significantly more compared to the middle-aged faces ($M = 7.106$, $SD = 3.811$; $t(33) = -2.345$, $p = .044$, Cohen's $d = -.066$) and young-aged faces ($M = 7.014$, $SD = 3.764$; $t(33) = 3.094$, $p = .009$, Cohen's $d = .087$). However,

no significant differences in numbers of fixation were reported between viewing middle- and young-aged faces (p = .456).

Figure 9

Bar Graph depicting the Total Number of Fixation across Aged Faces



Note. Error bars represent standard error

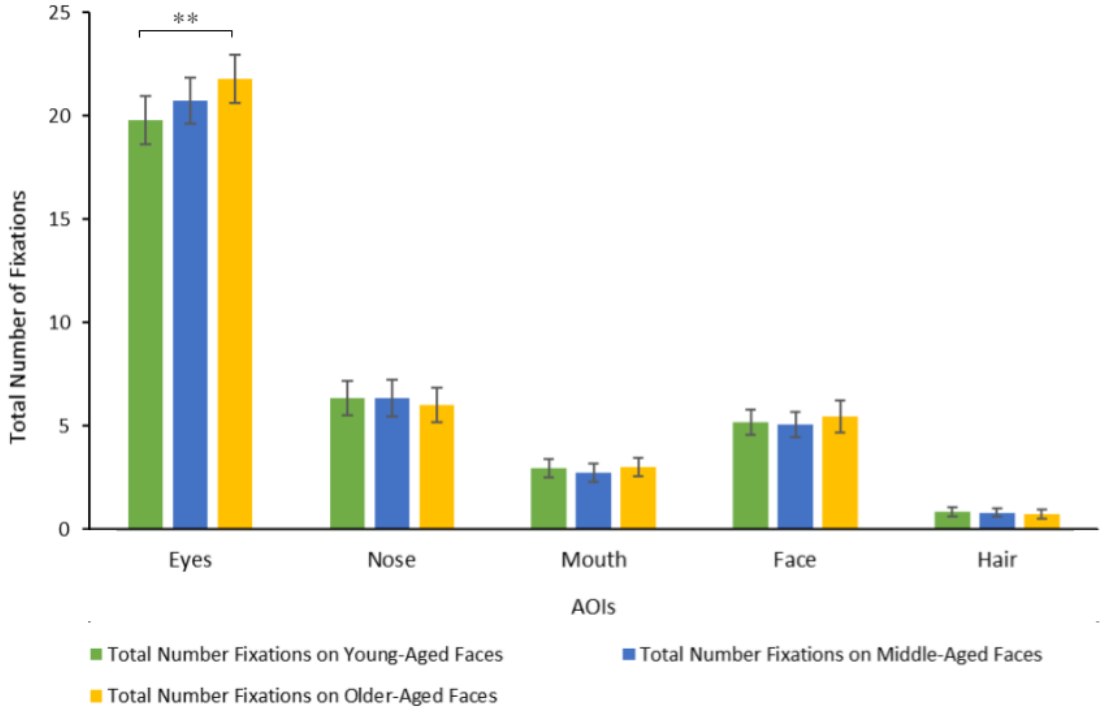
*p < . 05

Post-hoc pairwise comparison for the significant interaction effects between AOIs and Age shows that there were significantly greater number of fixations made to the eye regions of older-aged faces adults (M = 21.794, SD = 6.769) compared to the eye regions of young-aged faces (M = 19.794, SD = 6.910; t(33) = 5.627, p < .001, Cohen's d = .459. No significant differences in numbers of fixations were reported in pairwise comparisons of eye regions between the middle- and young-aged faces (p = .279), and likewise, between old- and middle-

aged faces (p = .142). These patterns of fixations were not observed in all other AOIs (see Figure 10). Based on the scope of the study, this section will only be looking into the interaction of age with respect to each individual AOIs (e.g., pairwise comparisons within eyes region specifically) and not between different AOIs (e.g., pairwise comparisons between eye and nose regions) (refer Appendix C for the full tabulation of each respective pairwise across AOIs).

Figure 10

Bar Graph depicting the Interaction Effect between AOIs and Age on the Average Number of Fixation on the AOIs



Note. Error bars represent standard error

**$p < .001$

Ratings of Valence and Arousal across Age and Identities

Table 10 shows the descriptive statistics analyses for the ratings of valence and arousal across age and identities.

Table 10

Means and Standard Deviation of Valence and Arousal Ratings across Age and Identities

Age Group Facial Stimuli	Identity	Valence	Arousal
		M (SD)	*M (SD)*
Young-Aged Faces	Self	5.088 (1.422)	4.412 (1.326)
	Friend	5.510 (1.170)	4.392 (1.118)
	Other	5.216 (.808)	4.127 (1.255)
Middle-Aged Faces	Self	4.804 (1.266)	4.7216(1.373)
	Friend	5.284 (.918)	4.510 (1.190)
	Other	5.059 (0.793)	4.343 (1.213)
Old-Aged Faces	Self	4.382 (1.596)	5.363 (1.518)
	Friend	4.676 (1.144)	5.235 (1.554)
	Other	4.922 (1.175)	4.608 (1.420)

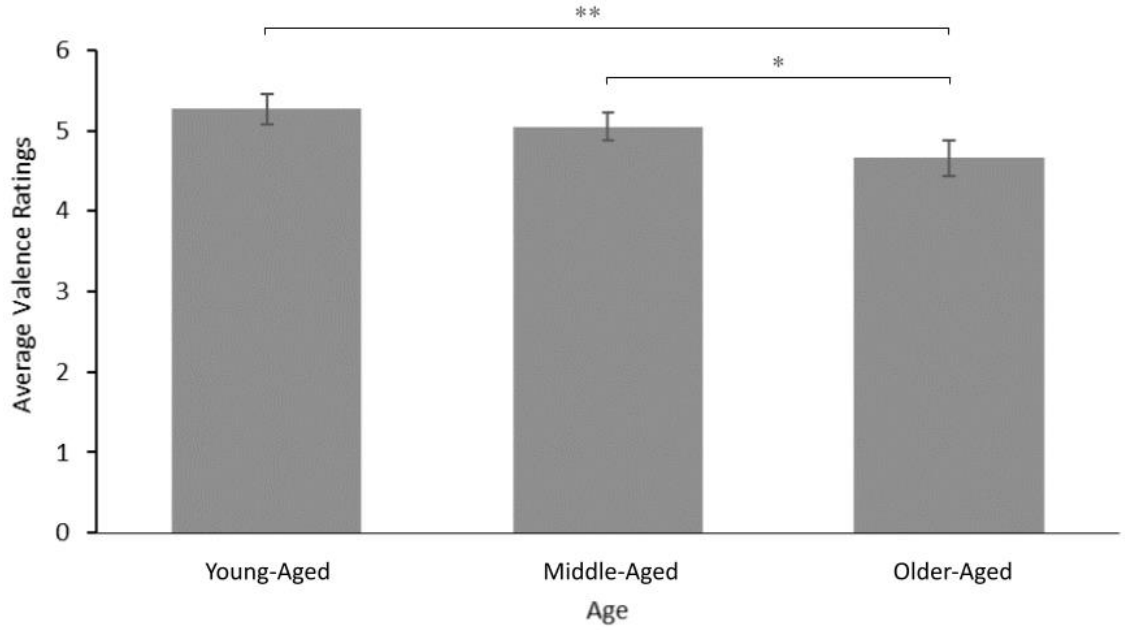
Note. As the ratings of valence and arousal were done during the eye-tracking session, the number of participants accounted for in these ratings were consistent with valid eye-tracking data ($N = 34$).

A two-way 3 x 3 repeatedmeasures ANOVA with two within-subject factors: identity (self, friend, and other) and age (young-, middle-, and old-aged faces), was conducted on the average valence ratings of the respective facial stimuli in this study. Greenhouse-Geisser corrections were applied for the degrees of freedom for the main effects of age as Mauchly's assumption of sphericity was violated ($p < .05$). Only significant main effect of age was obtained, $F(1.48, 48.83) = 9.025$, $p = .001$, $\eta p^2 = .215$. The main effect of identity, $F(2, 66) = 2.541$, $p = .086$, $\eta p^2 = .071$, and the interaction effect between age and identity, $F(4, 132) = 1.867$, $p = .12$, $\eta p^2 = .054$, did not reach statistical significance.

Post-hoc tests on the main effect of age revealed that participants rated young-aged faces ($M = 5.271$, $SD = 1.133$) to be significantly more pleasant compared to old-aged faces ($M = 4.660$, $SD = 1.305$; $t(33) = 4.197$, $p < .001$, Cohen's $d = .522$). Participants also found middle-aged faces ($M = 5.049$, $SD = .992$) to be significantly more pleasant compared to old-aged faces, $t(33) = 2.671$, $p =. 019$, Cohen's $d = .332$. Participants did not find young-aged faces to be significantly different in valence compared to middle-aged faces $p = .132$. Overall, older-aged faces were rated as the least pleasant (see Figure 11).

Figure 11

Graph depicting the Average Ratings of Valence across Young-, Middle-, and Old-Aged Faces



Note. Error bars represent standard error

*p <. 05, **p < .001

Similarly, a two-way 3 x 3 repeated measures ANOVA with within-subject factors: identity (self, friend, and other) and age (young-, middle-, and old-aged faces) was also conducted for the average arousal ratings. Greenhouse-Geisser corrections were applied for the degrees of freedom for the main effects of age and identity as Mauchly's assumption of sphericity was violated (ps < .05).

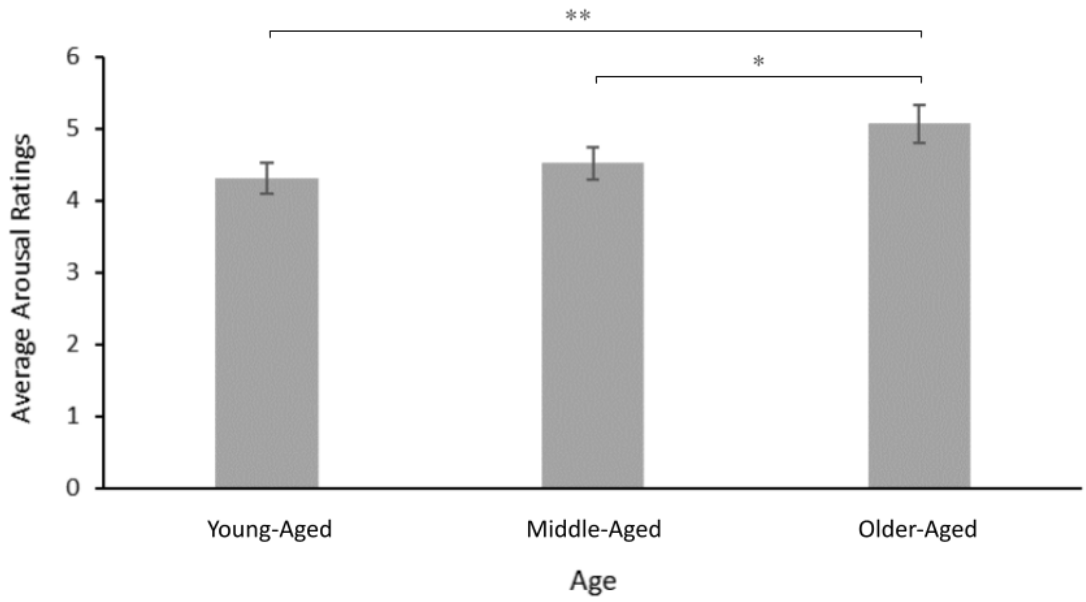
Significant main effects of both age, $F(1.240, 40.906) = 10.229$, $p = .001$, $\eta p^2 = .237$, and identity, $F(1.460, 48.169) = 4.937$, p = .019, $\eta p^2 = .130$, were observed. However, the interaction effect between the two variables was marginally significant, $F(4, 132) = 2.436$, p = .050, $\eta p^2 = .069$.

Post-hoc pairwise comparisons on the main effect of age (see Figure 12) indicated old-aged faces ($M = 5.069$, $SD = 1.497$) were rated as significantly more arousing compared to young-aged faces ($M = 4.310$, $SD = 1.233$; $t(33) = -4.384$, $p < .001$, Cohen's $d = -.567$) and

middle-aged faces(M = 4.524, SD = 1.259; t(33) = - 3.156, p = .005, Cohen's d = -.408). No significant differences in arousal ratings were obtained between young- and middle-aged faces (p =. 224).

Figure 12

Graph depicting the Average Ratings of Arousal across Young-, Middle-, and Old-Aged Faces



Note. Error bars represent standard error

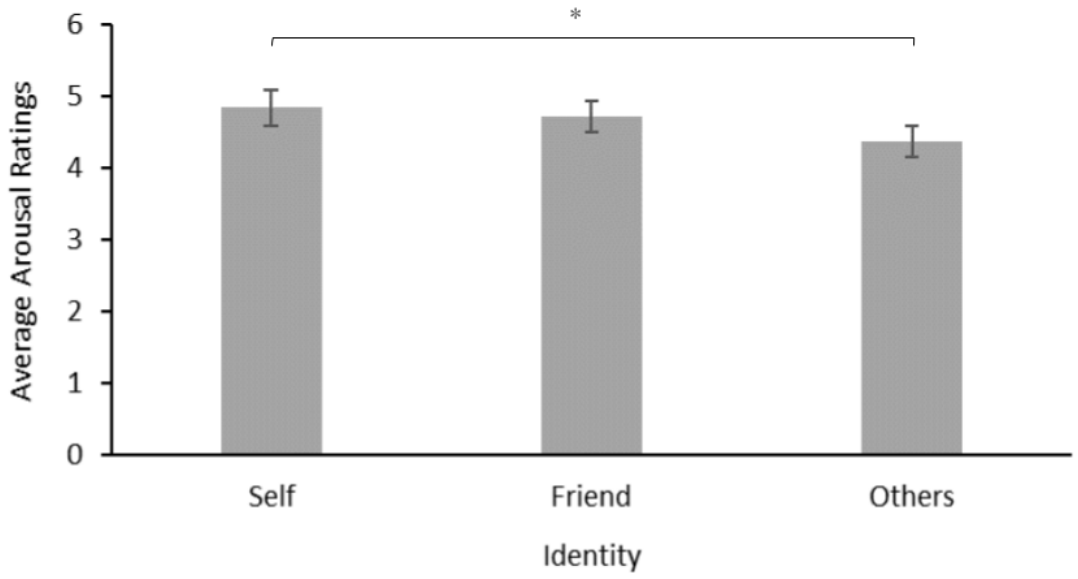
*p < . 05, **p < .001

For the main effect of identity on arousal, post-hoc tests (refer Figure 13) found that participants rated their self-face (M = 4.830, SD = 1.406) to be significantly more arousing compared to the unfamiliar "other" face (M = 4.359, SD = 1.296; t(33) = 3.019, p = .011, Cohen's d = .352) (see Figure 13). No significant difference in arousal were reported between

the self-face and familiar friend-face (p = .453). The arousal ratings between the familiar friend-face and the unfamiliar "other" face were approaching significance, p = .054. Cohen's d = .264.

Figure 13

Graph depicting the Average Ratings of Arousal across Different Identities



Note. Error bars represent standard error

*p < . 05

Chapter 4 - Discussion

This study aims to determine the levels of ageism against older adults among Malaysian young adults via implicit and explicit measures. The associations between these two measures of attitudes are also investigated. Ageing anxiety, a factor associated with ageism, was also investigated via self-report measures to be correlated with both the implicit and explicit measures of ageism. This study also tapped into the potential of investigating ageism implicitly by inferring eye gaze patterns. In particular, the number and duration of fixations when viewing facial images of varying levels of familiarities and age manipulations were explored. The relationship between age and identity on the self-rated valence and arousal elicited by the various facial stimuli is also of interest in this study.

Ageism: Self-reported and Implicit Measures

This study hypothesised that participants would hold less ageist attitudes towards older adults via both implicit and self-reported measure, and that these two attitudinal measures will be significantly correlated. Findings from the one-sample *t*-test (against the FSA scale cut-off score of 61) indicated that participants hold significantly more positive attitudes towards older adults. Furthermore, albeit only approaching significance, findings suggest a positive relationship between self-reported ageism and self-reported ageing anxiety. This potentially supports past studies reported a significant linear relationship in which individuals that are more anxious about ageing are on average, more ageist towards older adults, and vice versa (Rupp et al., 2005; Lasher & Faulkender, 1993; Lev et al., 2018; Allan & Johnson, 2008; Cooney et al., 2021).

On the contrary, with implicit measure, the positive *D* score at negative focal blocks (*D*_Negative) of the BIAT indicated that participants harboured more ageist attitudes towards older adults, as reflected by their stronger association of older adults with negative attributes.

Findings also indicated that these two measures were also not significantly correlated. Therefore, taken together, the first hypothesis is partially supported.

Furthermore, as the study opted for a double attribute BIAT as suggested by Nosek et al. (2014) and Sriram and Greenwald (2019), data on the implicit attitudes of the young towards their own age groups were also obtained via the response latencies contrast in positive focal blocks (*D*_Positive). Findings indicated that participants have positive perception of young adults. This will be discussed later below.

The positive explicit attitude towards older adults is consistent with past studies conducted among Malaysian (Man et al., 2022; Singh et al., 2018; Ismail et al., 2023; Elias et al., 2020; Muslihah et al., 2018) and Eastern young adults (Lin et al., 2010; Chua & Soiza, 2008; Cheong et al., 2009; Jo & An, 2012; Runkawatt et al., 2012; Liu et al., 2014). With Malaysia being a collectivistic East Asian country, this finding is potentially an indicator of the existence of strong cultural influence despite the rampant increase in the older population. The positive explicit attitude in this study suggests that young adults still have reverence towards older adults (Singh et al., 2018; Vauclair et al., 2017; Huang, 2013).

However, contradicting the self-report measures, findings from the negative focal blocks of the BIAT (*D*_Negative) indicates that participants held implicit ageist beliefs towards older adults. This is consistent with past ageism studies that utilised implicit measures (Malinen & Johnston, 2013; Lin et al., 2010; Axt et al., 2014; Marini et al., 2021), but contradict Ackerman and Chopik's (2021) cross-cultural findings that reported lower implicit ageism among collectivist countries.

The implicit negative attitudes towards older adults could be explained by the theoretical interaction of micro- and macro-level ageism. Modernisation hypothesis (Cowgill, 1974). Typically, those from the East are more collectivistic, on average, and they prioritise group goals

and hierarchical relationships compared to the more individualistic West (Triandis &Gelfand, 1998). This occurs due to some intersections with the teachings of Confucious's value of filial piety (Yunus & Hairi, 2020; Huang, 2013, Kocak et al., 2020; Damulak et al., 2015; Giles et al., 2002; Luo et al., 2013; North & Fiske, 2015).

However, with the rampant rate of modernisation, the erosion of the Eastern traditions occurs via the process of "Westerning" that led to the prioritisation of more individualistic values. This trend of declining Eastern values with modernisation is consistent with Palmore's (2005) "U shape" curvilinear relationship variation of the modernisation hypothesis that suggests the impact of modernisation hypothesis being especially evident among countries that are at the early stages of modernisation and industrialisation (North & Fiske, 2015; Inglehart & Baker, 2000). As Malaysia continues to strive to achieve the status of a high-income developed nation (World Bank, 2024), such rapid modernisation may have come at the cost of the respect and filial piety towards older adults as Malaysia undergoes a dynamic cultural shift (Ibrahim & Bayen, 2019; Yoo & Donthu, 2002; Luo et al., 2013; Cheung & Kwan, 2009), consistent with Palmore's (2005) modernisation variation.

Besides that, compared to the steady increase of the older population in the West, the rate of population ageing in the East is more abrupt (Ibrahim & Bayen, 2019). Therefore, given such distribution of the populations across age groups in the country, this increases societal pressure and burden among the young to accommodate for the needs of older adults, despite the old also being a resource threat to the younger generations (Vauclair et al., 2017). Hence, the rate of population ageing may risk an override to core traditional values, such as filial piety among the younger generation, even among collectivist countries like Malaysia (Ayalon & Tesch-Römer, 2018; Ng & Lim-Soh, 2021). As perceived outgroup threat also increases the negative implicit attitude expression (Hoffman et al., 2005), this potentially explains the unconscious negative

attitudes participants harboured towards older adults, and how the role of micro-,meso- and macro-levels of ageism influence the perception of the young towards older adults.

The attitudinal divergence between the implicit and explicit measures of ageism are reflected by the differences and the absence of significant correlations between these two qualitatively different measures. Such findings are consistent with the majority of studies (Hummert et al., 2002; Lin et al., 2010; Malinen & Johnston, 2013; Greenwald et al., 2003; Sriram & Greenwald. 2009; Nosek et al., 2005). This trend of findings contradicts Fazio (1990) and Fazio and Towles-Schwen (1999) that views attitudes as a singular construct encompassing both the implicit and explicit components. Instead, they provide backings to the dual-process theory of attitude (Wilson et al., 2000; Karpinski & Hilton, 2001) that distinguishes the unconscious and stable automatic implicit attitudes from the consciously monitored and adjustable explicit construct (Greenwald & Banaji, 1995) despite still being related constructs (Nosek, 2005).

With such discrepancies, literature provides more support to the findings of implicit measures relative to explicit measures given the predictive abilities, reliability and stability of implicit attitude assessments against social desirability concerns (Lin et al., 2010; Marini et al., 2021; Yang et al., 2014) and later-learnt counter-stereotypical explicit attitudes (Malinen & Johnston, 2013; Levy & Banaji, 2002; Kleissner & Jahn, 2020). In the context of this study, the attitudinal discrepancies suggest that participants were more probable to be unconsciously ageist, despite the reported positive explicit attitudes towards older adults. It is likely that the positive self-reported attitudes are from the lens of social desirability or at the expense of conforming to the current societal, cultural, and political context of Malaysia (Lin et al., 2010; Marini et al., 2021). On the other hand, the implicit negative associations reflect the actual personal attitudes

towards older adults possibly harboured based on the personal encounter of participants with older adults (Wilson et al., 2000; Wilson & Lindsey, 1998).

Furthermore, the implicit findings via the IAT and BIAT are backed to indicate the actual attitudes held relative to the self-reported outcomes due to the underlying presumptions of how these chronometric associations tests indirectly taps into the spontaneously formed mental representations based on the speed and accuracy of associating conceptual categories with the respective evaluative attributes (Marini et al., 2021). This is consistent with the claims of modern social psychology that puts forth the notion of the existence of attitudinal constructs that are active and distinct from the deliberate intentional experience (Nosek, 2007). As proposed by the dual-process theory, explicit attitudes require a certain amount of cognitive capacity to be activated, or to override the contradicting implicit attitudes. Implicit attitudes, on the other hand, are typically activated automatically upon stimulus onset regardless of the individual's cognitive capacity or motivation levels (Lin et al., 2010; Wilson et al., 2000). Therefore, given the subliminal and unconscious responses obtained via the presumption of implicit measures, it ensures the authenticity of the attitudinal responses of the participants (Levy, 2009).

In this study, the explicit measure of ageism was a self-report measure administered without time pressure. However, the implicit measure of ageism was administered within a limited time as participants were required to respond to the target stimuli and attribute pairing as quickly and accurately as possible. This puts participants under relatively heavier cognitive load in eliciting accurate responses under the given time pressure (Wilson et al., 2000). Consequently, this results in the more stable and unconscious negative ageist attitudes towards older adults to take precedence over the positive explicit attitudes when tested using the BIAT (Wilson & Lindsey, 1998). Although literature also suggests the low test-retest reliability of implicit tests as a possible factor in explaining the absence of significant correlations between implicit and

explicit measures (Fazio & Olson, 2003; Malinen & Johnston, 2013; Hummert et al., 2002), however, this aspect is not explored due to the cross-sectional nature of this study.

On the other hand, positive scores in the positive focal block (*D*_Positive) of the double attribute BIAT indicated that participants simultaneously held positive attitudes towards young adults. This is consistent with the findings of Hummert et al. (2002), Ackerman and Chopik (2021), and Greenwald et al. (2003). In line with SIT and TMT, more positive perceptions were attributed to the own age group of the young (ingroup) to dissociate from the old (outgroup) (Ayalon & Tesch-Römer, 2018). This occurs as the young derives their self-identity from group membership based on the evaluations of the self-associated and self-dissociated targets (Greenwald & Banaji, 1995).

With the mortality salience hypothesis of the TMT theorising that the mere presence of older adults gives rise to feelings of psychological explicit and implicit threat (Solomon, 2004l; Bodner, 2009), though not explicilty investigated and measured in this study, it is possible that the various images of older adults as visual input stimuli in the BIAT tasks could possibly invoke the aforementioned emotions among the participants. Besides that, analogous to the SIT, the engagement in stereotypical thinking to boost the ingroups and the derogation of outgroups in managing the anxieties and existential concerns via unconscious psychological distancing occurs (Bodner, 2009; Greenberg et al., 1997; Bodner, 2009; Bodner et al., 2015). Thus, this results in the association of positive traits with the young adults ingroup members to increase self-esteem, whereas the converse is true for older adults who are perceived as age outgroups (Scheepers & Ellemers, 2019; Tajfel & Turner, 1979).

Taken together, the divergence in the implicit and explicit measures are consistent with the SIT and TMT. This is also backed by the findings obtained via the positive focal blocks of the dual attitude BIAT that suggest positive perceptions harboured by the young towards their

own age-groups and conversely for the older outgroups. This also brings to light the possibility of the unconscious internalisation of ageist attitudes towards older adults among the young that tends to be masked by the stereotypical assumptions of Eastern cultures and values (Kleissner & Jahn, 2020). Therefore, although Malaysia is a collectivistic country that emphasises harmonious interdependence and deep-rooted respect for older generations, this does not mitigate nor indicate the absence of age bias within the country (Ackerman & Chopik, 2021).

Ageing Anxiety

Despite the well-established associations between ageism and ageing anxiety (Cooney et al., 2021; Rupp et al., 2005), no significant correlations with ageing anxiety were reported across both implicit and explicit measures of ageism. However, it is noteworthy that the correlations between the self-rated anxiety and self-rated ageism was approaching significance. Therefore, the second hypothesis was not supported.

On average, participants reported low levels of ageing anxiety. This could possibly be because our participants are highly educated. Greater levels of education are previously found to be significantly associated with lower ageing anxiety (Yan et al., 2011; Abrams & Silverstein, 2004; Barrett & Toothman, 2018). Despite not being causally related, higher educational attainments are significantly associated with greater knowledge of ageing, where the latter aids in reducing ageing anxiety (Abramson & Silverstein, 2004; Allan & Johnson, 2008; Cooney et al., 2021; Barnett & Adams, 2018).

Besides that, literature suggests that the increased years of formal education equips an individual with various cognitive and mental resources such as flexibility, rationality, and complex thinking strategies (Mirowsky & Ross, 1998). This acts as a protective factor against various forms of anxieties as it increases the resilience of an individual (Bjelland et al., 2008). This is especially true among women in accordance with the resource substitution theory as

educational attainment increases their sense of control to a greater extent relative to males across the life course (Ross & Mirowsky, 2006). Therefore, this potentially mediates the psychological wellbeing and anxieties experienced, thus reducing ageing anxiety experienced (Rojas et al., 2005). As the recruited participants were all highly educated Malaysian female young adults that are currently doing or have completed their tertiary education, their levels of education attainment could potentially attenuate the impact of ageing anxiety.

Similarly, culture can elucidate the low levels of ageing anxiety (Akhrani & Eka, 2019). Given the status of older adults within a collectivistic culture, the increased exposure in cross-age setting also possibly alleviates both explicit ageist attitudes and the fears and concerns experienced by the young about the anticipated changes in physical, social, finances, and wellbeing that comes with the ageing process (Yan et al., 2011). Therefore, with the established relationship between culture, ageism, and ageing anxiety (Rupp et al., 2005; Akhrani & Eka, 2019), this possibly explains the overall low ageing anxiety and low explicit ageism towards older adults.

The non-significance in correlations between ageing anxiety and ageism is also potentially due to the small sample size of participants. Post-hoc G*power analysis (version 3.1.9.7) (Faul et al., 2007) using the test family of *t*-tests for point biserial model correlation with medium-effect size of 0.3 (one-tail) indicated that the current number of participants ($N = 50$) only achieved statistical power of .71. To achieve significant effect ($\propto = .05$) with adequate statistical power ($1\text{-}\beta = .80$) and medium-effect size, a minimum of sixty-four participants would be required for future studies of similar nature. This might explain why the correlations between those two measures were only approaching significance in this study.

Eye-gaze Patterns on Facial Ageing & Facial Identity

Significant main effects of AOIs were reported for both the number and duration of fixations. Post-hoc analysis indicated that the eyes were fixated the most and for the longest durations, followed by the nose, face, mouth, and hair. Quality check for the parameters also indicated significant positive associations between the number and duration of fixations for eye fixations (r = .586; p < . 001), consistent with Hall et al. (2010). Findings provide backings to literature that reports eye-bias featural processing (Van Belle et al., 2010; Chakraborty & Chakrabarti, 2018; Heisz & Shore, 2008; Bonner et al., 2003; Blais et al., 2018; Firestone et al., 2007). The order of AOIs viewed is similar with findings of Firestone et al. (2007) and Ha (2017).

The significantly greater number of eye fixations can be related to the saliency and robustness of information from the eye regions (Holmqvist et al., 2011). On the other hand, the longer duration of fixations indicates more cognitive exertion in extracting information from the eyes (Salvucci & Goldberg, 2000). These can be attributed to the vital role of eyes in person-identification (Gold et al., 2004; Vinette et al., 2004) and a social cue for gaze direction and the mental state of other individuals (Sullivan et al., 2007; Barton et al., 2006; Baron-Cohen, 2002).

Furthermore, as participants were all females, the eye-bias could be attributed to the tendency of females to be more attuned to perceiving emotions of others as they have higher empathising capacity (Franca et al., 2023; Chen et al., 2018; Baron-Cohen, 2002). Therefore, despite the images being neutral facial expressions, this eye-bias remains evident as they are evolutionary adaptive and important for social interaction (Wells et al., 2016).

Besides, the significant duration and number of fixations can be due to the hierarchical contrast of facial information from the upper half combination of eyes-eyebrow relative to the lower half of upright faces (Van Belle et al., 2010). Compared to the nose that is the geometric

centre of a face, the eyes (especially in between) correspond to the central position weighted by the amount of facial diagnostic information (Hsiao & Cottrell, 2008). Especially with the crucial role of eyes in social interactions, fixations to the eye regions enable the simultaneous encoding of all salient facial features in a single representation (Orban de Xivry, 2008).

The role of eyebrows in face processing is also typically overlooked. Some studies report the presence of the eyebrow, independent of its detailed specific-high frequency details (e.g., eyebrow edges and textures) to surpass the prominent role of eyes in facial processing (Zhang et al., 2024; Sadr et al., 2003). Therefore, given that the predefined AOI of the eyes in this study also encompasses the eyebrows, this could possibly contribute to the eye-bias in the number and duration of fixations.

We found no main effect of facial identity across both the number and duration of fixations. This contradicts most facial perception findings, such as in neuroimaging studies (Kadosh & Bonneh, 2022) and eye-tracking studies (Heisz & Shore, 2008; Henderson, 2003) that reported the relationship between facial familiarity, number and duration of fixations. Nevertheless, findings echo Stacey et al. (2005), Van Belle et al. (2010), and Chakraborty and Chakrabarti (2018) that also found no difference when sampling the facial internal features. The two lattermost studies also reported significantly more and prolonged duration of fixations to the eyes independent of familiarity.

A possible explanation for the absence of the main effect of identity can be attributed to the methodological characteristics of the study (Van Belle et al., 2010) such as the reduced ecological validity in facial stimuli exposure in this study (Vinette et al., 2004). Albeit the role of passive-view paradigm in minimising task demands and facilitate naturalistic eye-movements (Caharel et al., 2002), such viewing circumstance is still qualitatively different and less realistic compared to an in-person interpersonal encounter. The facial stimuli in this study were also static

and presented in a vacuum over a constant grey background instead of a more dynamic and natural background (Hugenberg & Bodenhausen, 2003). This potentially influences the typical succession of attentional allocation across facial stimuli when viewing familiar faces (Vinette et al., 2004; Liu et al., 2002), thus possibly explain the absence of the main effect of identity across both number and duration of fixations.

Other methodological characteristics include the extent of the degree of familiarity among the pairing of participants (Van Belle et al., 2010). The lack of control for the minimum interactions and duration of knowing (e.g., pairs should interact in-person at least once a week and to have known each other for at least six months; Lee et al., 2022) may have confounded the representations and extent of personally relevant facial familiarity within the pairing of participants. The absence of these additional data on the relationship of participants as a pair for manipulation check could have attenuated the main effect of identity across both the number and durations of fixations, thus resulting in the non-significance. Future studies should consider controlling the degree of familiarity within each pairing to circumvent this potential confound.

Significant main effect of age on the number of fixations was reported. More fixations were made to the older-aged faces, followed by the middle- and young-aged faces. The latter two facial stimuli were fixated at the same frequency. When the findings of the main effects of identity and age in this study are taken together, trends contradict Zhou et al. (2021) as only the influence of age as social categorisation significantly modulates eye-gaze patterns but not identity. The greater number of fixations to the older-aged faces is consistent with the Expertise Hypothesis of the OAB. This theory suggests that individuals are more experienced in processing own-age faces due to increased exposure (Blais et al., 2018; Wright & Stroud, 2002).

Hence, with the ceiling facial processing abilities for the ingroup, young-aged faces are processed with more efficient processing strategies (Firestone et al., 2007). This also shares

conceptual overlap to a certain extent with the self-reference effect in which information that is related to the self-structure undergoes more efficient processing (Symons & Johnson, 1997). In the context of the current eye-movement data, this is evident via the significant lower number of fixations elicited when participants sample young- and middle-aged faces relative to older-aged faces (Hsiao & Cottrell, 2008).

The increased number of fixations to the older-aged faces can also be attributed to the perceived threat associated with older adults as age outgroups, consistent with the SIT and TMT (Swift & Steeden, 2020). With the associations between arousal and threat established (Stephan, 2014; Stephan et al., 1999), the positive trends obtained in the correlations between the ratings of arousal and number of fixations on old-aged facial stimuli (r = .258; p = .140) provide some backing to this speculation (see Appendix D). However, it is important to note that they were not significant, possibly due to the limited sample size. The relationship between age and arousal is elaborated in further detail at later sections.

The natural expertise in extracting facial information from the own-age faces as theorised in the Expertise Hypothesis is evident in this study as participants made significantly fewer number of fixations to the younger (young and middle-aged faces alike) relative to old-aged facial stimuli (Blais et al., 2018). Given that most participants are tertiary education students, aside from encounters with their peers within the same age group, it is also likely that they have a good amount of interpersonal exposure to other individuals in the middle adulthood (e.g., lecturers, parents). This could have also contributed to their relative expertise for both the young and middle-aged faces. Therefore, this potentially explains why old-aged faces were fixated more relative to the other two age categories.

The non-significance in number of fixations between young and middle-aged faces could potentially be explained by the relatively small differences in age gap between these two age

categories (Foos & Clark, 2011). In this study, the facial stimuli's age progression is – young-aged (ranging from ages 18 to 25), middle-aged (approximately 45) and older-aged (approximately 70) respectively. When comparing across these major age groups, the age range difference between young-middle adulthood categorisation was the least. Hence, it is reasonable to speculate that the physical changes experienced at middle adulthood are still not as drastic and are relatively acceptable as an age ingroup to not warrant a significant difference in the gaze behaviours.

In contrast to the significant number of fixations across different aged faces that provide support to the differential visual processing of faces across varying ages, no significant main effect of age was reported for the duration of fixations. This suggests no particular difference in gaze duration occurs across facial stimuli in when fixated independent of facial age. This can possibly be attributed to the duration of stimuli presentation (Van Belle et al., 2010). The duration of stimuli presentation may influence gaze behaviour due to the engagement of automatic or controlled eye-movements during passive viewing (Hansen et al., 2015). Automated, involuntary eye-movements are reported to occur during early visual stimuli onset (approximately the first two seconds). This occurs as they are driven by bottom-up processing of stimuli features (Pannasch et al., 2008) and they are typically directed at schematic locations where useful distinctive information of the stimuli is expected (Hansen et al., 2015). On the other hand, voluntary gaze patterns typically occur across longer viewing windows (four to six seconds) as they control for the early overt attention deployment that are motivated by schematic representations of the stimuli (Pannasch et al., 2008).

Similarly, the dynamic interplay between the influence of stereotype and prejudice on face perception together with the controlled and automatic eye-movements have been reported (Henderson & Pierce, 2008; Callan et al., 2013; Anastasi & Rhodes, 2005; Hansen et al., 2015).

However, in this study, each facial stimulus of varying ages (and identity) was presented for four seconds as adapted from Ha (2017). Therefore, as the facial stimuli are presented for relatively long durations, this could have possibly attenuated or masked the anticipated difference in duration of fixations across facial stimuli of different ages, thus resulting in the anticipated difference in the duration of fixations across facial stimuli of different ages. A shorter duration of stimuli presentation could potentially be adopted in future studies to elucidate the presence of differential duration of fixations when viewing aged faces instigated by the automatic schema-guided looking behaviour.

Besides that, the possible differences in the duration of fixations across facial stimuli could be attenuated by the averaging of fixation durations across the total presentation time (Van Belle et al., 2010), especially given with the relatively small age difference between young and middle-aged faces as previously mentioned (Foos & Clark, 2011). Furthermore, as the AOIs were predefined, it is possible that some extent of fixations to the AOIs were masked due to the aggregation of fixations to the nearest AOIs where attention was assumed (Van Belle et al., 2010). These arguments could also be extrapolated to explain the null interaction effects for the eye fixations of young and middle-aged faces, and likewise between the eye fixations of middle and older-aged faces.

Interaction of the Eye Region with Age

Significant interaction effects between AOIs and age with the number fixations were obtained. The eyes of the old-aged facial stimuli were fixated significantly more than the eyes of the young- and the middle-aged facial stimuli. This is consistent with Sporer's (2001) Ingroup/ Outgroup Model where the presence of cues that are characteristics of ageing lead to featural processing when viewing outgroup faces (Ha, 2017). Instead, this pattern of interaction effect echoes the relationship between intergroup age discrimination and attentional allocation of faces

in which the eye regions of the old-aged facial stimuli were fixated more than the eyes of the young-aged facial stimuli (Hugenberg & Bodenhausen, 2003; Strickland-Hughes et al., 2020; Firestone et al., 2007).

As previously elaborated on the saliency and robustness of information at the eye regions, the perception of older adults as social outgroup and threat (realistic and perceived) to the young (Swift & Steeden, 2020) with the changes that comes with age (see Table 2), and the reduced expertise of the young in processing faces of age outgroups (Rhodes & Anastasi, 2012), these factors warrant more fixations towards the eye regions. Furthermore, unlike the relatively smaller age gap difference between young- and middle-aged faces, and likewise, middle- and older-aged faces (Foos & Clark, 2011), the range of age differences is larger between the young and old-aged facial category. Therefore, echoing the significant differences in ratings of pleasantness across the young and old-aged faces, the varying intensities of facial ageing manipulations also potentially contribute to the increased sampling to the eyes of old-aged faces compared to the young-aged facial stimuli, thus resulting in the significant interaction effect.

Taken together, this interaction effect highlights the pivotal role of age as an ingroup-outgroup social categorisation, and its subsequent relationship with gaze behaviour across different aged-faces (Wright & Stroud, 2022; Sporer, 2001; Simons & Levin, 1998), despite participants being aware that the aged facial stimuli viewed were only simulations (Rittencour & Cohen, 2016).

Valence and Arousal Ratings Across Faces of Different Ages

The fourth hypothesis is supported as older-aged facial stimuli were rated as the least pleasant and most arousing, with the vice versa being true for the younger facial stimuli. Middle-aged faces were consistently rated as the intermediary-moderately pleasant and arousing relative to the younger and older-aged faces. The ratings of pleasantness of the facial stimuli with age are

consistent with past studies (Ebner, 2008; Ha, 2017; Hugenberg & Bodenhausen, 2003; Hummert et al., 1994; Hummert et al., 1997; Foos & Clark, 2011; McLellan & McKelvie, 1993).

The difference in valence ratings between young- and old-aged faces can be explained by the negative ageing stereotype (Ebner, 2008) and stereotype-congruent bias (Lazarus et al., 2016; Franklin, 2023). As part of the ageing process, the intensity of facial ageing physiognomic cues increases with age (Windhager et al., 2019). With the sensitivity of the human visual system towards subtle ageing cues, the intensities of these bottom-up "surface features" interplay with one's top-down processing (Hummert et al., 1997). Older-ages faces are typically linked with the narrative of decline due to their associations with negative age stereotypes, with the converse being evident for young faces (Kotter-Grühn & Hess, 2012). Hence, as the intensity of facial ageing increases, the association with negative age stereotypes also increases, thus influencing the valence content of perceived faces (Twele & Mondloch, 2022; Kotter-Grühn & Hess, 2012).

In this study, the age trajectory of the facial stimuli ranges from young to middle and older adulthood. Across this linear progression, the ageing cues such as the greying of hair, and the wrinkles increase in intensity (see Chapter 2 for examples of aged facial stimuli). The ratings of facial stimuli in this study also echoes Ebner et al. (2018), McLellan and McKelvie (1993), Hummert et al. (1997) and Hess et al. (2023) that found old female faces to be rated the least pleasant compared to young and middle age groups of either gender.

The influence of ageing cues also varies with respect to the attitudes of the perceiver (Ebner, 2008). This holds some parallels with the SIT where ingroups are associated with more favourable views relative to the outgroups of increasing age (Tajfel & Turner, 1979; Ayalon & Tesch- Römer, 2018). With implicit measures indicating ingroup preference among the young and ageist attitudes towards the old, this potentially explains the respective valence ratings of the facial stimuli. On the other hand, analogous to the non-significance main effect of age across

young and middle-aged faces for the number of fixations, the relatively small differences in age gap between young and middle adulthood age categories (Foos & Clark, 2011) may have led to relatively negligible difference in valence ratings.

The ratings of arousal with age are consistent with the overall trends of Garrido and Prada (2017) and Hugenberg and Bodenhausen (2003) where outgroup faces are more arousing compared to ingroup. Older-aged faces are rated as the most arousing, followed by middle-aged faces, and the faces of the young being the least arousing. However, the latter two were not rated significantly different in their arousal ratings.

The increase in arousal ratings with age is complemented by how the rating of facial pleasantness decreases as age increases. As tabulated in the aforementioned introduction, the physical facial changes that comes with age, though inevitable, increases the susceptbility of those with more intense facial ageing physiognomic cues to more stereotypical assumptions and narrative of decline by the current youth-driven culture (Barrett & Toothman, 2016; Chaasten & Carry, 2015). This also provides some literature backings to the stereotype-congruent bias as it portrays the interaction between bottom-up and top-down processing as an individual perceives and distinguishes faces of varying ages (Lazerus et al., 2016; Franklin, 2023) via the judgement of bottom-up “surface features” of the saliency and intensity of facial ageing cues (Hummert et al., 1997). Hence, consistent with the perception of older adults as a realistic (SIT; Vauclair et al., 2017) and psychological threat (TMT; Martens et al., 2005) to the young, the perception of the old-aged facial stimuli that have relatively more intense ageing cues could potentially give rise to the perceived threat (Van Zomeran et al., 2007; Binder et al., 2009). Consequently, this gives rise to medium-to-high levels of arousal as they are a threat to the ingroup membership, and potentially contribute to an extent, to the reciprocal amplification of negative attitudes towards the perceived other-aged members (Stephan, 2014; Stephan et al., 1999).

This is in line with Hugenberg and Bodenhausen's (2003) where highly implicitly prejudiced outgroup faces (but not explicitly prejudiced) are perceived as more hostile due to the stereotypical activation of outgroups. Furthermore, on top of the established negative associations with old age, considering that participants in this study are young females, perceiving the visuals of their anticipated ageing also further exacerbates the perceived threat value of the outgroup aged-faces (Chen & Zhang, 2022) as it erodes the physical assets that contribute to the social status among females (Liang et al., 2008; Barrett & Robbins, 2008; Minhat et al., 2015; Åberg et al., 2020). Therefore, with older adults viewed as an outgroup threat and the possible perceived status difference across age-group comparisons (Liang et al., 2008), this explains why aged-faces were rated significantly more arousing compared to middle and young adult faces.

Valence and Arousal Ratings Across Faces of Different Identities

The fifth hypothesis is only partially supported as familiar faces (self and friend alike) were not significantly more pleasant compared to the unfamiliar stranger facial stimuli. On the other hand, the self-face (which is still a type of familiar face) was the most arousing compared to the unfamiliar other facial stimuli.

The non-significant finding between the ratings of valence across faces of differing identities can possibly be attributed to the role of culture. Literature on processing fluency suggests that the ease of facial processing is also associated with other positive traits such as being perceived as more attractive and favoured (Bornstein & D'Agostino, 1994; Carr et al., 2017). Although physical attractiveness is a social asset that is highly favoured by females (Minhat et al., 2015), the non-significance in the ratings of pleasantness across facial identities, even inclusive of the self-face, might be attributed to the tendency of individuals from East Asian cultural backgrounds to be modest in decision-making (Lalwani et al., 2006; Vignoles et al.,

2016; Kemmelmeier, 2016; Chung & Mallery, 1999). This is unlike those of individualistic cultures that, on average, tend to make inflated and extreme responses on questionnaire scales (Lalwani et al., 2006). Therefore, given the tendency for response bias among collectivist, it may have contributed to the non-significance in the valence ratings across facial identities.

In terms of the self-rated arousal, findings report the self-face being significantly more arousing compared to the unfamiliar stranger facial stimuli. However, the self-face is not significantly more arousing compared to the familiar friend's face. Similarly, when compared with the unfamiliar face, the familiar friend's face was more arousing, albeit only approaching significance. This linear trend between the ratings of arousal and the degree of facial familiarity is consistent with past studies that utilized objective measures such as event-related potential signals (Enzi et al., 2009; Dobel et al., 2008; Keyes & Brady, 2010; Bagnato et al., 2010; Bayer et al., 2023; Guerra et al., 2012; Vico et al., 2010; Langeslag & Van Strien, 2019) and also pupillometry studies (Mathot, 2018; Matyjek et al., 2021). There are lesser studies that used self-report measures in investigating levels of arousal, though findings were still consistent with Gobbini et al. (2004) and Dobel et al. (2008).

The relationship between facial familiarity and arousal levels can also be explained by the role of personal relevance in facial processing (Bayer et al., 2023). Evidenced by neuroimaging studies and extended face processing network, literature suggests that personally relevant faces are selectively processed with more depth and robustness as they undergo both holistic and featural processing (Kloth et al., 2016; Hills, 2018). Unlike other familiar facial images (e.g., famous individuals), the facial representation of personally familiar faces is more naturalistic, realistic and emotionally relevant to the perceiver (Herzmann et al., 2014; Kloth et al., 2016). This occurs as literature indicate that the facial representations for these faces are encoded via direct interpersonal social communication, thus enabling semantic information (e.g.,

knowledge about their biography and personality traits, shared memories) to be integrated into the perceiver's facial representation (Bayer et al., 2023). Therefore, salient and personally relevant faces usually evoke stronger emotional and value associations (Perrin et al., 2015; Zhan et al., 2016; McCrackin et al., 2020), thus explaining the greater arousal ratings in accordance with the literature findings on facial familiarity and personal relevance obtained in this study.

In alignment with the self-reference effect (Symons & Johnson, 1997), the self-face of the perceiver is a type of self-referential stimulus characterised as both the most salient, familiar and most personally self-relevant to the perceiver (Zhan et al., 2016; Żochowska et al., 2021). The self-face is also very attention grabbing due to the high emotional significance to the perceiver (Brédart et al., 2006; Żochowska et al., 2021). Like the stable and robust processing advantage experienced by personally familiar individuals, the self-face processing advantage is widely evidenced across literature (Tong & Nakayama, 1999; Bortolon & Raffard, 2018; Ota & Nakano, 2021) and can be attributed to the everyday exposure as one view the self-face for grooming purposes (Estudillo & Bindemann, 2017).

Taken together, the trends of facial familiarity, personal relevance and arousal ratings can be extrapolated to the self-face. The emotional arousal evoked by the self-face is much greater compared to familiar faces due to the enhanced associations of personal relevance, emotional content, motivation and reward value in facial processing (Zhan et al., 2016). However, given that the self-face and the familiar friend face were not significantly different in arousal ratings, they are possibly attenuated by the overlaps in the closeness of relationship between the self and friend identity, thus explaining the non-significance in arousal between the self and familiar friend identity (Aron et al., 1991; Zhu et al., 2007; Wang et al., 2012; Myers et al., 2014; Tan et al., 2015).

On the flipside, the arousal ratings between the familiar and unfamiliar facial stimuli were only approaching statistical significance. This could possibly be due to the small sample size. The lack of control in the minimum amounts of weekly interpersonal encounters and duration of knowing one another can also potentially explain the non-significance in arousal between the friend and stranger faces. Similarly, the lack of control in participant pairing can possibly be extrapolated to explain the lack non-significance of identity and valence ratings. The study hypothesised familiar faces to be rated as more pleasant due to the misattribution of positivity caused by processing fluency with familiarity (Claypool et al., 2007; Claypool et al., 2012). However, given that the carry over effect of processing fluency on affective responses, like valence is dependent on facial familiarity (Carr et al., 2017), the lack of control in participant pairing may have confounded the expected findings (Dobel et al., 20078; Carr et al., 2017; Claypool et al., 2007).

Limitation and Future Directions

There are a few limitations in this study. Firstly, as the artificial simulations of the ageing effect were done via a third-party manipulation, there is an inability to control and manipulate the intensity of the various physiognomic ageing cues to give rise to the intended ageing effects. Besides that, as only the middle-aged and older-aged facial stimuli were artificially aged via the third-party application (the young adulthood faces used in this study were the orignally photographed images, albeit cropped), this may present a confound due to the differences in stimuli manipulation. Therefore, future studies can consider conduct a stimuli manipulation check in order to ensure the achievement of the intended facial age, besides standardising the procedures of stimuli manipulation in order to circumvent this confound.

In addition to the previously addressed limitations, the facial stimuli utilised in the BIAT in this study were grayscale White American faces. Future studies should consider using

culturally appropriate target images to circumvent the influence of culture in target stimuli-attribute associations (Ackerman & Chopik, 2021). Besides, only Malaysian Chinese young adult females were recruited in this study. This limited the generalisability of data. Future studies should consider recruiting more participants across a wider age range and race across both genders, besides also controlling for the amount and duration of weekly in-person interactions between pairs of participants (Lee et al., 2022).

As explicit measures often subject to social desirability bias, the Marlowe-Crowne Social Desirability Scale (MCSDS; Crowne & Marlowe, 1960) can be administered to adjust for its effects. Besides, dynamic facial stimuli with naturalistic contextual background can be used in future studies to simulate the realistic face and naturalistic intergenerational encounters in real-life interactions for better ecological validity (Hugenberg & Bodenhausen, 2003).

The majority of eye-tracking literature inferred the cognitive process by obtaining the average duration and number of fixations across the time course of stimuli presentation. Future studies can consider exploring both the impact of different presentation time and the fixation differences across individual time points (Van Belle et al., 2010; Hansen et al., 2015). These manipulations, such as looking itno the gaze patterns within 1.5 seconds (Van Belle et al., 2010), 4 seconds (He et al., 2011), 5 seconds (Ha, 2017) or 7 seconds (Hansen et al., 2010) of facial stimuli presentation, together with the attitudinal measure, be they implicit or self-reported, sheds light on the potential interactions between the levels of attitudinal biases, automated and controlled voluntary explorations when viewing faces (Hansen et al., 2015). Given that older adults have various facial physiognomic cues that signal ageing and the impending mortality to the young, this also adds values to the current literature in understanding the differential attention and the manifestations of age attitudinal biases via looking behaviour (He et al., 2011; Montague et al., 2011). The separation of the eyebrows and eyes as two separate AOIs can also be

considered to disentangle their respective roles and interaction in face-related processing (Zhang et al., 2024).

Implications and Conclusion

In conclusion, participants hold less ageist attitudes towards older adults on explicit measures, despite implicit measures suggesting otherwise. Participants were also less anxious about ageing as they scored below the cut-off scores of the scale. Although exploratory in nature, eye-tracking data suggest that featural processing was engaged as the eyes were fixated the most, and for the longest duration. Old-aged faces, especially at the eye regions, were also fixated the most compared to younger-aged faces despite being aware that the images were only artificially aged. Gaze behaviours across participants were not modulated by the degree of familiarity. Ratings of valence and arousal across age and identity found that the faces of the young were most pleasant while faces of older adults were most arousing. Participants also found the self-face as more arousing but no significant differences in the ratings of valence across varying identities.

Given the prevalence of ageism and population ageing, our findings highlight the complexity of the divergence in the explicit and implicit attitudes of the young towards older adults (Lin et al., 2010; Marini et al., 2021). This study sheds light on the visual processing of faces across varying ages and identities, and it also demonstrates the attitudinal complexities of young adults towards older individuals. This study also explored the usage of eye-tracking as a possible objective measure of ageism and ageing anxiety. Findings of gaze behaviours, though explorative in nature, also sheds light on the visual processing of age-manipulated faces across varying facial identities and its potential relationship with attitudes of Malaysian young adults towards older adults.

Furthermore, as the recruited young adults predominantly consisted of tertiary education student population who are yet to have extensive exposure to individuals of vast age ranges in professional settings (Tomioka et al., 2019), this enables the fundamental exploration of non-verbal communication via eye-movement behaviours among Malaysian young adults when viewing individuals of varying ages across different identities (Montague et al., 2011; Arnold-Cathalifaud et al., 2008), thus contributing to the current understanding of ageism, ageing anxiety and to an extent, the facial processing across different ageing-effect manipulation intensitites and identity familiarity.

With effective communication encompassing both verbal and non-verbal components (Montague et al., 2011) being crucial in modulating social behaviours and positive social interactions (Cañigueral &Hamilton, 2019; Montague et al., 2011), findings also add value to the strategising of interventions to overcome ageism in fostering harmonious intergenerational interactions in age-diverse environments as it opens potential avenues for the integration of effective micro-behaviours and non-verbal communication strategies (e.g., encourage more eye-contact reciprocity, proportion of duration of direct and averted gaze to the eyes) (Jongerius et al., 2020; Corrington et al., 2017). Such inputs will be crucial in supplementing the much more vastly researched macro-behaviours in terms of quality and quantity of intergenerational contact as an area of interest in strategising potential interventions to mitigate ageism (Canigueral & Hamilton, 2019; Corrington et al., 2017).

(25527 words)

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Appendix A

Din and Minhat's (2021) Anxiety about Ageing Scale (AAS).

Participant ID

Participant ID:

AAS

This block of questions aims to understand **your personal experience with older adults (aged 65+) and thoughts on your own possible ageing experience.**

	Strongly Agree	Agree	Fair	Disagree	Strongly Disagree
I enjoy being around old people	○	○	○	○	○
I like to go visit my older relatives	○	○	○	○	○
I enjoy talking with old people	○	○	○	○	○
I feel very comfortable when I am around an old person	○	○	○	○	○
I enjoy doing things for old people	○	○	○	○	○
I expect to feel good about life when I am old	○	○	○	○	○
I believe that I will still be able to do most things for myself when I am old	○	○	○	○	○
I expect to feel good about myself when I am old	○	○	○	○	○
It doesn't bother me at all to imagine myself as being old	○	○	○	○	○
I have never dreaded the day I would look in the mirror and see grey hairs	○	○	○	○	○
I have never dreaded looking old	○	○	○	○	○

	Strongly Agree	Agree	Fair	Disagree	Strongly Disagree
When I look in the mirror, it bothers me to see how my looks have changed with age	○	○	○	○	○

	Strongly Agree	Agree	Fair	Disagree	Strongly Disagree
I fear that when I am old all my friends will be gone	○	○	○	○	○
The older I become, the more I worry about my health	○	○	○	○	○
I get nervous when I think about someone else making decisions for me when I am old	○	○	○	○	○
I worry that people will ignore me when I am old	○	○	○	○	○
I am afraid that there will be no meaning in life when I am old	○	○	○	○	○

Appendix B

Rupp et al.'s (2005) Fraboni Scale of Ageism (FSA).

FSA

In the following questions, we are interested in knowing **your perceptions of older people (aged 65+).**

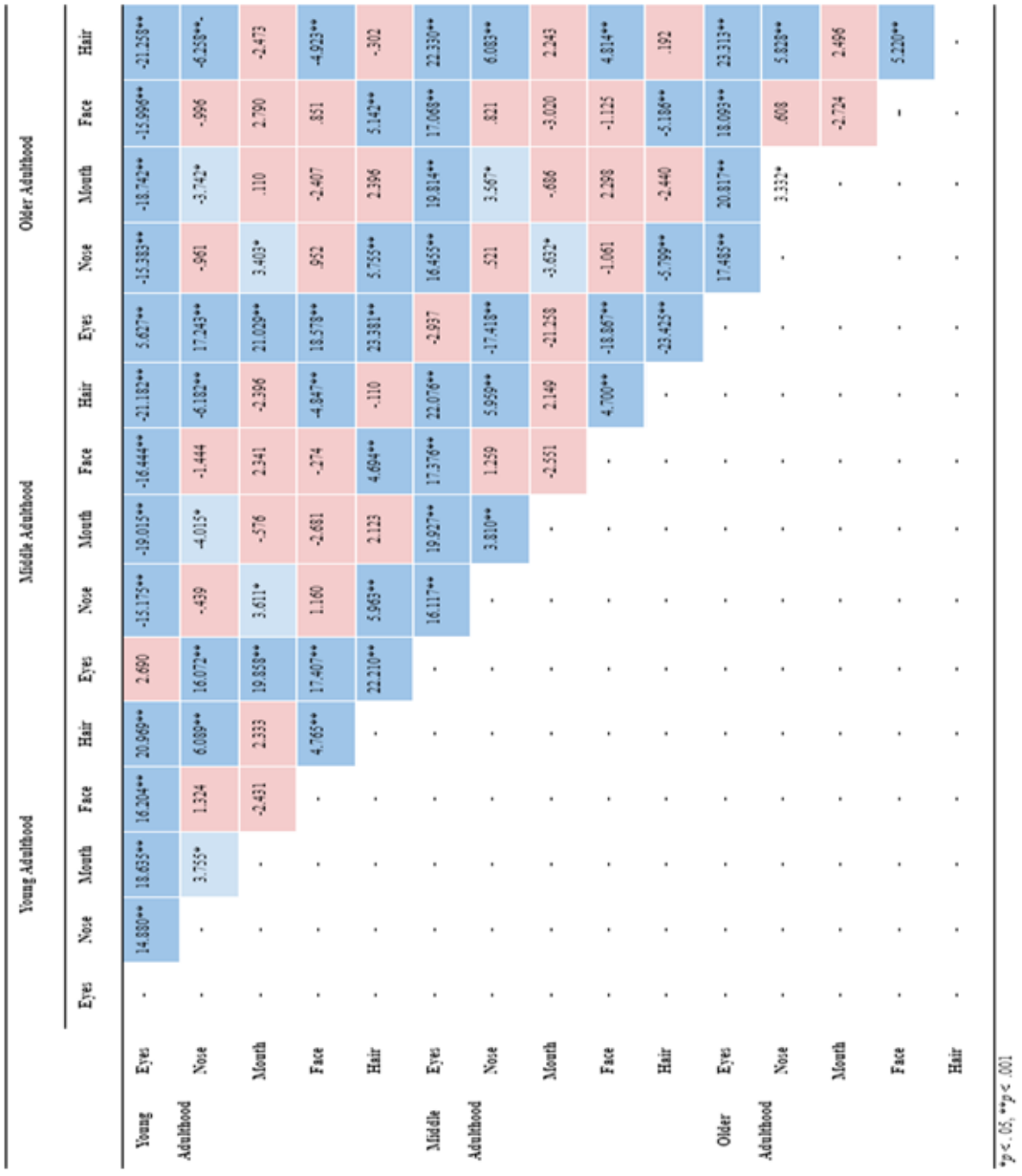
	Strongly Disagree	Disagree	Agree	Strongly Agree
Many old people are stingy and hoard their money and possessions	○	○	○	○
Many old people are not interested in making new friends, preferring instead the circle of friends they have had for years	○	○	○	○
Many old people just live in the past	○	○	○	○
Most old people should not be trusted to take care of infants	○	○	○	○
Many old people are happiest when they are with people with their own age	○	○	○	○
Most old people would be considered to have poor personal hygiene	○	○	○	○
Most old people can be irritating because they tell the same stories over and over again	○	○	○	○
Older people complain more than other people do	○	○	○	○
I would prefer not to go to an open house at a senior's club, if invited	○	○	○	○
Teenage suicide is more tragic than suicide among the old	○	○	○	○
I sometimes avoid eye contact with old people when I see them	○	○	○	○
I don't like it when old people try to make conversations with me	○	○	○	○

	Strongly Disagree	Disagree	Agree	Strongly Agree
Complex and interesting conversations cannot be expected from most old people	○	○	○	○
Feeling depressed when around old people is probably a common feeling	○	○	○	○
Old people should find friends their own age	○	○	○	○
Old people should feel welcome at the social gatherings of young people	○	○	○	○

	Strongly Disagree	Disagree	Agree	Strongly Agree
Old people don't really need to use our community sports facilities	○	○	○	○
It is best that old people live where they won't bother anyone	○	○	○	○
The company of most old people is quite enjoyable	○	○	○	○
It is sad to hear about the plight of the old in our society these days	○	○	○	○
Old people should be encouraged to speak out politically	○	○	○	○
Most old people are interesting, individualistic people	○	○	○	○
I personally would not want to spend much time with an old person	○	○	○	○

Appendix C

Pairwise comparisons of the total average number of fixations across all AOIs and aged faces (young, middle-aged, old).



		Young Adulthood					Middle Adulthood					Older Adulthood				
		Eyes	Nose	Mouth	Face	Hair	Eyes	Nose	Mouth	Face	Hair	Eyes	Nose	Mouth	Face	Hair
Young Adulthood	Eyes	.	14.880**	18.635**	16.204**	20.969**	2.690	-15.175**	-19.015**	-18.444**	-21.182**	5.627**	-15.383**	-18.742**	-15.986**	-21.259**
	Nose	.	.	3.755*	1.324	6.089**	16.072**	-.439	-4.015*	-1.444	-6.182**	17.243**	-.961	-3.742*	-.996	-6.259**.
	Mouth	.	.	.	-2.431	2.333	19.858**	3.611*	-.576	2.341	-2.396	21.029**	3.403*	.110	2.790	-2.473
	Face	.	.	.	.	4.765**	17.407**	1.160	-2.681	-.274	-4.847**	18.578**	.952	-2.407	.851	-4.923**
	Hair	.	.	.	.	.	22.210**	5.965**	2.123	4.694**	-.110	23.381**	5.759**	2.396	5.142**	-.302
Middle Adulthood	Eyes	.	.	.	.	.	.	16.117**	19.927**	17.376**	22.076**	-2.937	16.455**	19.814**	17.068**	22.330**
	Nose	.	.	.	.	.	.	.	3.810**	1.259	5.959**	-17.418**	.521	3.567*	.821	6.083**
	Mouth	.	.	.	.	.	.	.	.	-2.551	2.149	-21.258	-3.632*	-.686	-3.020	2.343
	Face	.	.	.	.	.	.	.	.	.	4.700**	-18.867**	-1.061	2.398	-1.125	4.814**
	Hair	.	.	.	.	.	.	.	.	.	.	-23.425**	-5.799**	-2.440	-5.186**	.192
Older Adulthood	Eyes	.	.	.	.	.	.	.	.	.	.	.	17.485**	20.817**	18.093**	23.313**
	Nose	.	.	.	.	.	.	.	.	.	.	.	.	3.332*	.608	5.828**
	Mouth	.	.	.	.	.	.	.	.	.	.	.	.	.	-2.724	2.496
	Face	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5.220**
	Hair	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

*p < .05, **p < .001

Appendix D

Correlations between Valence and Arousal Ratings with Number and Duration of Fixations to the Eyes across Different Age Categories

The correlations between the ratings of valence and arousal for the young, middle and older adulthood facial stimuli with their respective number and duration of fixations were conducted. The post-hoc analysis for the main effect of AOIs indicated that the eye region was fixated the most across both parameters (See Chapter 3). Hence, this supplementary correlation analysis was only conducted for the eye regions for these facial stimuli.

Correlations between Valence Ratings and Number of Fixations to the Eyes

Shapiro-Wilk's test of normality indicated that the distribution of number of fixations to the eyes for young adulthood and older adulthood facial stimuli and their respective valence ratings were normally distributed, *p*s > .461. Therefore, Pearson's correlation coefficient analyses (*r*) were conducted. Both the number of eye fixations when viewing facial stimuli of young and older adulthood were not significantly correlated with their respective facial valence ratings (see Table 11).

Assumption of normality was violated for the number of fixations to the eyes and valence ratings for middle adulthood facial stimuli ($p = .004$). Spearman's rank correlation coefficient (ρ) was conducted. No significant correlation was reported between the two variables were reported (see Table 11).

Table 11

Associations between the respective Valence Ratings and Number of Fixations to the Eyes for Young, Middle and Older Adulthood Facial Stimuli

Variables	***r***	ρ	***p***
Young Adulthood	-.061	-	.0732
Middle Adulthood	-	.031	.863
Older Adulthood	-.174	-	.325

Correlations between Valence Ratings and Duration of Fixations to the Eyes

Data distribution for the duration of fixations to the eyes for young and older adulthood faces and their respective facial stimuli valence ratings were normally distributed as indicated by Shapiro-Wilk's test of normality, *p*s > .168. Pearson's correlations coefficient (*r*) between the respective ratings of valence and duration of fixations to the eyes for the young and older adulthood facial stimuli were not significant (see Table 12).

Shapiro-Wilk's test of normality was violated for the duration of fixations to the eyes and valence ratings for middle adulthood facial stimuli ($p = .001$). Spearman's rank correlation coefficient (ρ) was conducted instead. No significant correlation was reported between the variables (see Table 12).

Table 12

Associations between the respective Valence Ratings and Duration of Fixations to the Eyes for Young, Middle and Older Adulthood Facial Stimuli

Variables	***r***	ρ	***p***
Young Adulthood	-.203	-	.251

Middle Adulthood	-	.027	.882
Older Adulthood	-.075	-	.671

Arousal

Correlations between Arousal Ratings and Number of Fixations to the Eyes

The distribution of the number of fixations to the eyes for young and middle adulthood facial stimuli and their respective facial arousal ratings violated Shapiro-Wilk's test of normality, *p*s < .021. Spearman's rank correlation coefficient (ρ) indicated. No significant correlations between the respective ratings of arousal and number of fixations to the eyes among the young and middle adulthood facial stimuli were reported (see Table 13).

The number of fixations to the eyes region for older adulthood faces and the valence rating was normally distributed ($p = .163$). Pearson's correlation coefficient (r) indicated no significant correlations between these two variables (see Table 13).

Table 13

Associations between the respective Arousal and Number of Fixations to the Eyes for Young, Middle and Older Adulthood Facial Stimuli

Variables	***r***	ρ	***p***
Young Adulthood	-	-.006	.972
Middle Adulthood	-	.078	.663
Older Adulthood	.115	-	.518

Correlations between Arousal Ratings and Duration of Eyes Fixations

Shapiro-Wilk's test of normality was violated for the duration of fixations to the eye regions for young and middle adulthood facial stimuli and the respective arousal ratings, *p*s < .012. Spearman's rank correlation coefficient (ρ) for the respective age groups found no significant correlations between the duration of fixation to the eye regions of the young and middle adulthood faces and their respective arousal ratings (see Table 14).

Test of normality indicated that distribution of duration of fixation to the eye regions for older adulthood facial stimuli and its self-rated arousal ratings was normally distributed (*p* = .163). Pearson's correlation coefficient (*r*) found no significant correlations between the duration of fixations to the eye regions for older adulthood facial stimuli and the facial arousal ratings (See Table 14).

Table 14

Associations between the respective Arousal and Duration of Fixations to the Eyes for Young, Middle and Older Adulthood Facial Stimuli

Variables	***r***	ρ	***p***
Young Adulthood	-	.037	.837
Middle Adulthood	-	.166	.347
Older Adulthood	.258	-	.140