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Long-term age of acquisition effects in famous name processing

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Abstract

The age of acquisition (AoA) effect refers to the processing advantage that words, objects, and people learnt earlier in life hold over those acquired later. We explored the long-term effects of AoA on performance, using naturally occurring famous names, acquired by participants cumulatively over three decades. We manipulated AoA by selecting celebrities who had first become known to our participants in the 1960s, 1970s, or 1980s and explored the effects of age by testing participants aged in their 40s, 50s, or 60s. Seventy-two participants made push-button ‘Yes-No’ familiarity decision judgements to the printed names of celebrities. We found a significant AoA effect. A linear increase in reaction time was uncovered, with the participants being fastest to respond to the 1960s celebrities, followed by those from the 1970s, and being slowest to respond to celebrities from the 1980s. There was no age x AoA interaction, although the AoA effect was most pronounced in the oldest participant group. Our data demonstrate the long-term persistent influence of AoA on processing speed. Moreover, they indicate that the effects of AoA are much more subtle than simply reflecting a difference between the earliest acquired stimuli in a processing domain and all later acquired items.

Keywords: Age of acquisition; name processing

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1. Introduction

Items learnt early in life are responded to more rapidly and more accurately than items learnt later. This processing advantage for early-acquired items is termed the age of acquisition (AoA) effect and has been reported on tasks involving the processing of words (see Juhasz, 2005, and Johnston & Barry, 2006, for reviews), objects (e.g., Catling & Johnston, 2006; Holmes & Ellis, 2006; Moore, Smith-Spark, & Valentine, 2004; Morrison, Ellis, & Quinlan, 1992) and people's names and faces (e.g., Moore & Valentine, 1998, 1999; Richards & Ellis, 2008; Smith-Spark & Moore, 2009). It has been argued that it is actually the frequency with which items have been encountered over a lifetime that leads to this processing advantage rather than how long ago they were acquired (e.g., Lewis, Gerhand, & Ellis, 2001; Zevin & Seidenberg, 2002). It may seem intuitive that items acquired early in life will naturally have been encountered more often than those acquired later (and, thereby, will have gained a higher cumulative frequency), but this has not been supported empirically (Morrison, Hirsh, Chapell, & Ellis, 2002). Whilst age of acquisition and frequency effects are highly correlated, cumulative frequency cannot account for the empirically recorded effects of AoA (e.g., Belke, Brysbaert, Meyer, & Ghyselinck, 2005; Cortese & Khanna, 2007; Ghyselinck, Lewis, & Brysbaert, 2004; Peréz, 2007; Stadthagen-González, Bowers, & Damian, 2004; Turner, Valentine, & Ellis, 1998), nor for computational models of the phenomenon in which frequency of encounter during training is equated across early- and late-acquired items (e.g., Ellis & Lambon Ralph, 2000). Indeed, AoA effects have been argued to influence earlier stages of processing than word frequency effects (Dent, Johnston, & Humphreys, 2008). It would, therefore, seem clear that AoA effects cannot simply be reduced to (cumulative) frequency effects and are worthy of exploration in their own right. Indeed, they should be able to inform our understanding of general learning mechanisms over a person's lifetime.

One current area of study in the AoA literature concerns this very issue, namely the extent to which AoA effects can be found across a lifetime of learning new domains of knowledge (e.g., second language learning: Izura & Ellis, 2002, 2004; Izura, Pérez, Agallou, Wright, Marín, Stadthagen-González, & Ellis, 2011; Palmer & Havelka, 2010; the learning of perceptual categories: Stewart & Ellis, 2008). We explored this question using a famous name processing task, using naturally occurring stimuli acquired by participants over the course of three decades. Given that the idea of celebrity and famous name acquisition occurs long after any critical or sensitive period of development associated with the lexical domain (Moore & Valentine, 1998), the results should help our understanding of the nature of AoA effects in a number of ways. In particular, the findings will tell us: i) how AoA effects persist over an extended range of time, ii) whether there is a strict dichotomy between early-acquired items and all later-acquired items or whether the effect is more subtle and stratified than that. Before considering these points further, we will consider theoretical accounts of AoA.

1.1 Theoretical accounts of AoA

An initial explanation of the AoA effect, placing the locus of the effect at the phonological output lexicon, was provided by Brown and Watson (1987). Their phonological completeness hypothesis proposed that the processing advantage for early-acquired words was a consequence of their being stored and represented in a more complete form than later-acquired words. When words need to be spoken out loud, it takes longer to produce those that are late-acquired than those that are early-acquired, as they require phonological reassembly before they can be produced. This process of reconstruction necessarily requires time, resulting in slower naming speeds than those produced for the more fully represented early-acquired words. This hypothesis suggests that AoA effects would occur during a critical period of language development (e.g., Lenneberg, 1967; Newport, 1990) as the representations underlying speech are acquired. However, the phonological completeness account has not stood up to empirical scrutiny (e.g., Izura & Ellis, 2002; Moore et al., 2004). In particular, an elegant study by Monaghan and Ellis (2002) provided direct evidence against Brown and Watson's (1987) hypothesis. Their participants were no quicker to phonologically segment late-acquired words than early-acquired words. Had late-acquired words proven to be more phonologically fragmented, it should have taken less processing time for them to be segmented and then produced. Robust effects of AoA in famous name and face processing also argued against an explanation of AoA solely in terms of a critical period of language development or uniquely placed at phonological output (e.g., Moore & Valentine, 1998, 1999). The processing advantage for early-acquired celebrity stimuli persists even when frequency of encounter (familiarity) and facial distinctiveness are controlled. Early-acquired items in this processing domain are learnt long after the critical period of language development, with children typically becoming aware of the notion of celebrity at around 6 years of age (Moore & Valentine, 1998). While critical period explanations may hold for other domains and tasks, they are not able to explain the people processing data.

Recent theoretical explanations have considered multiple loci of AoA effects across different processing domains as a general principle of learning (e.g., Belke et al., 2005; Catling & Johnston, 2009; Ellis & Lambon Ralph, 2000; Hernandez & Li, 2007; Moore, 2003; Moore & Valentine, 1998, 1999; Reilly, Chrysikou, & Ramey, 2007). We will now consider the two most influential of these explanations, the neural plasticity account (Ellis & Lambon Ralph, 2000; Lambon Ralph & Ehsan, 2006) and the semantic hypothesis (e.g., Brysbaert et al., 2000; Ghyselinck, Custers, & Brysbaert, 2004), together with the Set-up of a Specialized Processing System (SSPS) hypothesis (Moore, 2003; Moore & Valentine, 1999).

Ellis and Lambon Ralph (2000) proposed that AoA effects could be explained by neural plasticity. In their computational modelling simulations, a back-propagation network was trained to learn input-output patterns with half of the patterns being introduced early and the other half introduced later. Subsequently, the full set of patterns was presented to the network in an interleaved fashion, equating presentation of all items randomly over the course of training. This resulted in a reduced output error (analogous to faster RTs) on early- compared to late-acquired patterns. This processing advantage for early-acquired patterns was argued to be due to the early items configuring the structure of the network while it was ‘plastic’. As later patterns were introduced, the plasticity of the network was reduced, making it less able to accommodate new items within its existing structure. As a result, late-acquired items were not so well differentiated within the network as early-acquired items, causing greater processing error. Ellis and Lambon Ralph’s model can readily explain AoA effects found in language acquisition. Lambon Ralph and Ehsan (2006) expanded on the relationship between AoA effects and critical period effects, with their being ‘points on a plasticity continuum’ (p. 931). The authors argued that if plasticity is reduced to zero during training, then a critical period effect will be generated. They termed this an ‘extreme version of AoA’ (p. 929) in which, after a gradual deterioration in the quality of learning, the acquisition of new items is brought to an end by the closing of a critical period. In contrast to this ‘extreme version’, Lambon Ralph and Ehsan stated that a partial reduction of plasticity over the course of training will lead to AoA effects, with increasingly less effective processing of later-acquired items. In this scenario, later-acquired items can still be learnt by the network, but they will not be learnt to the same level of proficiency as earlier-acquired items.

While a clear case for the necessity of hard-wired entrenching can be successfully argued for the early acquisition of language (because of the fixed nature of such networks), it remains less clear how Ellis and Lambon Ralph’s (2000) account could explain the empirical effects of AoA across different domains (e.g., object, name, and face processing). The SSPS hypothesis was created as an initial 'talking point' to account for face processing data and other findings from the organic amnesia literature (Mayes, Downes, McDonald, Poole, Rooke, Sagar, & Meudell, 1994; Moore, 2003; Moore & Valentine, 1999). It suggested that when a person encounters something that cannot readily be processed by the semantic system, a rise in ‘affect’ is created, heightening vigilance for the same type of information. This sub-threshold level of affect occurs in response to an encounter with any new order of stimuli not readily processed by the semantic system. When sufficient encounters have occurred, the new SSPS system becomes able to process that type of information in a more shorthand (or implicit) way. While we agree that a critical period of infant language, vision, and auditory development is required to set up these processes, a 'critical period' is not the only explanation to account for the effects of AoA according to the SSPS model. This is especially true in the people processing domain, and we suggest other areas in which, we maintain, AoA effects continue over a lifetime of learning (e.g. second language learning; see Izura & Ellis, 2002). It is argued that AoA effects are caused by the first exposure to novel exemplars of information, at any age. This initial exposure allows further, similar exemplars to be processed in a more automatized fashion. According to this account, AoA reflects a temporal order of acquisition; that is to say, the first presentation of novel items in a specific stimulus domain would be the initial exemplars of new types of information to stimulate a physiological, orienting response, which would initiate the SSPS. In this way, AoA should affect both perceptual input and motor output on processing tasks for which specialized representations have been established (Moore, 2003; Moore & Valentine, 1999). Multiple loci for the effects of AoA are put forward by this account as the only explanation for the empirical AoA data on people processing and second language studies. The semantic system plays a key role in the SSPS, since the absence of relevant semantic information about a stimulus category is proposed to lead to the setting up (or reconfiguration) of the specialized processing system to deal with that type of stimulus. This interactive process creates a ‘gateway’ into the semantic system for that type of information. The parameters of distinction between the earliest encountered examples in a processing domain create a discrete state-space for representing and processing that type of information. There is, thus, some similarity between the SSPS and the neural plasticity model of Ellis and Lambon Ralph (2000). However, Moore argues that learning early exemplars may be explicit and effortful but, once access to the semantic system is created, more automatized processing would facilitate the learning of similar exemplars (Langer, 2000). Despite such facilitation, a processing advantage would remain for the early items that caused the (re)configuration. For example, infants learn to recognise faces very early in life (e.g., Barrera & Maurer, 1981), but people tend to rate their earliest awareness of celebrity status at around six years of age (Moore, 1998). Therefore, this later awareness requires the recruitment of a new processing strategy (the SSPS), or the reconfiguration of a pre-existing specific state-space, to process similar items (cf. Stewart & Ellis, 2008). The SSPS hypothesis is able to explain a range of empirically reported AoA effects on word, object, and person processing (e.g., Moore & Valentine, 1999; Moore et al., 2004; Smith-Spark & Moore, 2009; see also Stewart & Ellis, 2008) and predicts multiple loci of AoA effects. In contrast to Ellis and Lambon Ralph's reduced plasticity account, in which the learning of early-acquired items serves to restrict later learning, the instantiation of an SSPS would not reduce the capacity for learning new items but actually facilitate or enhance it.

The semantic hypothesis (e.g., Brysbaert Van Wijnendaele, & De Deyne, 2000; Ghyselinck et al., 2004a) proposes that AoA effects will emerge on tasks which require access to semantic representations. It states that there is a semantic processing advantage for early-acquired words due to their being the first to enter the representational system and thus influencing the way in which late-acquired words are represented. According to this explanation, AoA effects should be greater when a task requires greater involvement of semantic representations (e.g., Juhasz, 2005). Empirical data support the view that AoA plays a role in the semantic system (e.g., Belke et al., 2005; Catling & Johnston, 2006; De Deyne & Storms, 2007; Ghyselinck et al., 2004a; Holmes & Ellis, 2006; Johnston & Barry, 2005). The semantic locus hypothesis is also supported by computational modelling. Steyvers and Tenenbaum (2005) have implemented AoA effects within a semantic 'hub' network model. In this model, semantic nodes established early on in the network's development form 'central hubs'. The early nodes set out a basic semantic structure which permits accelerated learning of later-acquired items. The centrality of early-acquired nodes leads to the development of richer patterns of semantic connections than those developed by later-acquired nodes. The larger number of connections for early-acquired concepts should therefore result in faster responses on semantic processing tasks. According to this view, AoA effects are explicable, at least partly, by differences in semantic processing. However, within this model, the AoA effect is secondary to the number and quality of semantic connections possessed by early-acquired items compared to the relative paucity of connections for later-acquired items.

1.2 Age of acquisition and learning throughout life

Several authors (Brysbaert et al., 2000; Moore, 2003; Moore & Valentine, 1999; Yamazaki, Ellis, Morrison, & Lambon Ralph, 1997) have proposed that the AoA effect reflects the order of acquisition (OoA) of items in a specific stimulus domain, rather than the actual age at which items are first learnt. Despite the potential implications of the distinction between AoA and OoA, this issue has, until recently, been underexplored. This may, in part, be due to the difficulty in separating the two factors orthogonally. In this section, we discuss the small corpus of research into longer-term AoA effects and how research in this area has moved towards investigating OoA effects.

While generally suggestive of a critical period during which network plasticity is high and learning is at its most effective, several of the simulations reported by Ellis and Lambon

Ralph (2000) support the notion that the order in which patterns are entered into the network during training is more important than age in influencing processing speed. In Simulation 5, they entered a set of very early patterns at the beginning of training, followed by three further sets of patterns, in order to correspond more closely to the process of natural language acquisition. One of these further sets was entered after 200 epochs, another after 400 epochs, and a final set after 600 epochs. Analysis of the error scores at 5,000 epochs indicated that each set differed significantly from the next set entered. Ellis and Lambon Ralph conclude that entering patterns gradually into the network results in a 'steady worsening of final performance' (p. 1107) for later-acquired sets compared to those acquired earlier. Simulation 13 investigated what would happen if a very late set of patterns were entered into a network after it had stabilized for a set of early- and late-acquired patterns. The very late set was entered at 5,000 epochs and all patterns were trained to 10,000 epochs. Only when the very late patterns were presented much more frequently than the earlier-acquired patterns (ratios of 10:1 or 100:1 per epoch) did final performance prove to be better than that for late, low-frequency patterns. It still proved to be worse than for late, high frequency patterns and both high- and low-frequency early patterns.

Monaghan and Ellis (2010) report a simulation of natural reading development, with words being gradually entered over the course of training, reflecting the reading age at which words first occurred in the *Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvvuri, 1995). Words were thus entered at points of entry representing the course of 13 school grades plus an extra point of entry for adult reading. Monaghan and Ellis found that the order of entry into the network was important in leading to more accurate reading at the end of training.

Computational models, therefore, support the notion of long-term AoA effects, with the processing advantage for earlier-acquired words persisting over extended periods of training. But what does the experimental work tell us? There are two different experimental approaches to this question in the literature. The first (and most direct) involves investigating naturally acquired items acquired over a number of years. We have adopted this approach in this paper. The second approach presents participants with new material (such as vocabulary, either novel words or words from another language) and charts the time-course of AoA effects. With this approach, age remains static over the course of learning rather than varying as it does in investigating naturally occurring AoA effects, allowing the researcher to focus on exploring the influence of OoA in the absence of the confound of age. We will now discuss both approaches.

An early attempt to distinguish between AoA and residence time in memory was made by Gilhooly (1984), using compound words which had appeared relatively recently in the general English vocabulary (selected from the supplements to the 1959 and 1979 editions of the *Chambers Twentieth Century Dictionary*). In choosing neologisms as his stimuli, he argued that he could reduce the correlation between AoA and participant age, whilst holding residence time fairly constant across his participants. Gilhooly compared the amount of variance in word naming speed that could be accounted for by participant age (being grouped into decades between 20-60 years), rated AoA, or residence time (AoA rating minus participants' age). In separate multiple regression analyses, one of these three independent variables was added to a common set of predictor variables (word length, frequency, and rated familiarity). While all three variables were significant predictors of naming speed, Gilhooly found that AoA accounted for considerably more variance (6.4%) than either residence time (0.7%) or participant age (2.5%). However, it should be noted that many items from the latest acquisition group were compound words that comprised segments of common words (e.g., "backpack") and were, thus, not true neologisms. Furthermore, word frequency and AoA of the individual segment words were not included in the analyses.

Evidence from studies of second language (L2) learning is also consistent with AoA effects being a general property of lifelong learning. Izura and Ellis (2002) found that there was a processing advantage for words acquired early in L2 regardless of their AoA in L1 (although see Palmer & Havelka, 2010, who argue in favour of some influence of AoA on a conceptual level of representation, even it is not the only locus of AoA effects).

Order of acquisition effects in the learning of novel words were investigated by Tamminen and Gaskell (2008). Their participants were trained on three sets of novel spoken words, with there being a gap of a week between the acquisition of the early- and middle-acquired sets and a period of 18 weeks between the introduction of the early- and late-acquired sets. They found an OoA effect between early- and late-acquired words on word naming (but not lexical decision) up to 35 weeks after initial exposure to the early-acquired set. Of particular interest to our study, Tamminen and Gaskell report that while there was an initial OoA effect between early- and middle-acquired items, this disappeared by Week 19 to be replaced between Weeks 20 and 35 with an OoA effect between the two earlier-acquired sets and the late-acquired set.

An OoA effect was also found by Izura, Pérez, Agallou, Wright, Marín, Stadthagen-González, and Ellis (2011) who required their participants to learn L2 words that were introduced either on the first (early-acquired words) or on the third (late-acquired words) of six training sessions. These groups of words were equated for frequency of encounter over the training period. Significant OoA effects were evident across naming, lexical decision, and semantic categorization tasks, tested up to 35 days after the end of training.

Stewart and Ellis (2008) tested whether OoA effects would be generated in the learning of perceptual categories. Their participants, university students aged 20 to 35 years, learnt to categorise novel random checkerboard patterns over the course of five sessions. Some patterns were presented at the beginning of training, while others were presented later, with cumulative frequency of encounter equated across training. Training ran running over three to five consecutive days. At test, participants were faster to categorize early- than late-acquired stimuli. This study provides a clear demonstration of OoA effects in a controlled laboratory setting, free from potential confounds (e.g., cumulative frequency) that can arise in experimental studies (Lewis, 2006).

2. The current experiment

We wanted to see how naturally occurring AoA effects might persist over decades of an individual's life and more than ten years since the latest acquired group of stimuli were first encountered (our data collection took place in 2003). Given the robust effects of AoA on face and name perceptual classification and naming tasks (e.g., Moore & Valentine, 1998, 1999; Richards & Ellis, 2008; Smith-Spark & Moore, 2009), and the fact that celebrities are easily dateable to a particular decade in which they rose to fame, the person processing domain seemed a fertile ground in which to explore the long-term effects of AoA. Previous work on the temporal aspect of AoA (e.g., (Gilhooly, 1984; Izura et al., 2011; Tamminen & Gaskell, 2008) has focused mainly on the lexical processing domain. Our experiment, therefore, extends this research to explore whether long-term effects can be uncovered in other processing domains. Furthermore, our stimuli had been acquired by our participants over a period of decades, rather than much shorter periods, such as five days (Stewart & Ellis, 2008), three weeks (e.g., Izura et al., 2011), or 19 weeks (Tamminen & Gaskell, 2008). We investigated whether long-term AoA effects would occur with naturally occurring, carefully matched stimuli, acquired in a gradual and cumulative fashion over time; in contrast to previous work, where stimuli have been artificially divided into two sets, one of which was presented at the beginning of "training" and the other set being introduced en masse at a later point in training (e.g., Izura et al., 2011; Stewart & Ellis, 2008; although see Monaghan &

Ellis, 2010, for computational modelling of word reading, and Tamminen & Gaskell, 2008, for experimental work along similar lines to our experimental approach).

We chose to use printed names rather than faces as experimental stimuli because celebrities' names mostly remain unchanged by time; unfortunately, faces do not. For example, a participant's mental image of the US actor Paul Newman may represent his appearance when he was young, middle-aged, or old. To present a picture of a particular celebrity taken at a different age to a participant's mental representation of that celebrity may create a mismatch between individual participants and thereby introduce a potentially serious processing speed confound. We were interested in individual participants' memories for the celebrity, unconstrained by the images of that celebrity available for presentation.

The three celebrity stimulus groups were matched on familiarity. Despite the weight of empirical evidence making the distinction between AoA and frequency clear (see Section 1.0), it is nevertheless important to control for the influence of frequency when investigating AoA. Early studies employed subjective familiarity ratings to acquire a measure for frequency of encounter (e.g., Carroll & White, 1973) and, indeed, it has been argued by several researchers that rated familiarity is a superior measure of word frequency than scores derived from word frequency corpora (Gernsbacher, 1984; Ghyselinck et al., 2004b; Zevin & Seidenberg, 2002; although, for a recent opposing view, see Brysbaert & Cortese, 2011). Despite this, laboriously collected familiarity measures have been superseded by the readily available tables found in word frequency corpora. Furthermore, early studies of people processing borrowed paradigms and models from the word and object processing literature (e.g., Bruce & Young, 1986). Yet person frequency is not directly analogous to word frequency. In contrast to a word's tendency to refer to just one concept, many people share the common name combinations, such as 'John Smith' (a high frequency name in the UK). The number of times that a name is encountered will, therefore, be affected both by the number of people who have that name and how *frequently* a particular individual is encountered in ones personal environment. However, the naming of an individual is assumed to require access to a representation of semantic information about a unique John Smith and, only after this, can the full name be accessed.

A better analogy to word frequency would, therefore, be a measure of frequency of encounter or 'familiarity' with each particular John Smith. We have used this method of control (see Valentine & Bruce 1986a, b), both prior to the experiment in order to match groups of stimuli and also post hoc to validate the stimuli with ratings from those participants providing the experimental data. This process of a priori and post hoc matching is not easy, as it requires a readiness to remove celebrity stimuli if their ratings fall below an acceptable level set a priori. It is a method of assessing participants' different levels of experience with individual celebrities and is becoming increasingly important in the Digital Age with its accompanying dilution and fragmentation of audience share across a multitude of channels and media platforms. Moreover, if it were even possible to create an objective frequency database for celebrities from a very diverse range of media (e.g., print, television, radio, Internet), the transient nature of fame and use of multimedia platforms would render it obsolete before it was even compiled, let alone published. Finally, celebrity is more prone to the personal interests of participants, in a way that words are not (except for the most technical of terms). For example, a sports personality may receive frequent mentions in the media and his or her name is thus recognised by sport fans. However, to non-sports fans exposure to the very same person's name would simply be the repetition of an unfamiliar person's name. With these provisos in mind, we used the preferred method of familiarity ratings where participants rate how often they encountered each celebrity. A priori measures were derived from the Smith-Spark, Moore, Valentine, and Sherman (2006) database and used to match the stimuli across our three stimulus groupings. These a priori measures were then validated by post hoc measures taken from the individuals actually participating in the experiment. In this way, we were able to control for individual differences in exposure (or cumulative frequency) to different celebrity stimuli. As a further means of control, our celebrity stimuli were also matched for facial distinctiveness. While it may seem odd to control for this variable on a name processing task, Moore (1998) demonstrated that facial distinctiveness can influence reaction time (RT) even when names rather than faces are used.

Our task required participants to make Yes-No push-button familiarity decision judgements to the printed names of celebrities. We recruited a mature population of participants in order to create AoA groupings with sufficient separation between their acquisition ages (see Moore, 2003). Age of acquisition effects do not diminish with age (e.g., Morrison et al., 2002) and can be more pronounced in older participants (Barry, Johnston, & Wood, 2006). We opened up a further avenue of exploration of long-term AoA effects by separating our participants into different age groups, aged in their 40s, 50s, or 60s. We thus examined ‘relative’ AoA effects within each participant group, with the celebrities first becoming known to our groups of participants at different ages. This manipulation would provide a further understanding of lifelong AoA effects and how the phenomenon may be expressed at different ages. Age of acquisition was manipulated by using celebrities who first came to fame during one of three specific decades chosen for experimental manipulation (1960s, 1970s, and 1980s). Our participants would thus have first encountered each group of celebrities in the same chronological order but at different ages (see Table 1). Therefore, participant age varied, whilst Gilhooly’s (1984) ‘residence time’ (or what might be loosely described as OoA) would be relatively constant across the three participant groups.

TABLE 1 ABOUT HERE

A long-term AoA effect on a famous name processing task was predicted, indirectly (given that its focus is language processing), by the neural plasticity account (e.g., Ellis &

Lambon Ralph, 2000) and, more directly, by the SSPS hypothesis (Moore & Valentine, 1999; Moore, 2003). This effect would be apparent across all age groups and AoA groupings. That is, a main effect of AoA was predicted from the neural plasticity account and SSPS hypothesis for each AoA grouping on *all* participant groups, with there being no interaction with participant age. Finally, the semantic hypothesis (e.g., Brysbaert et al., 2000) would also predict significant long-term AoA effects on tasks involving semantic processing. Within the Steyvers and Tenenbaum (2005) semantic hub model, nodes are added one at a time to a growing semantic network. Earlier-acquired nodes would accumulate more connections to other nodes than later-acquired nodes, as a virtue of their older point of entry into the network. The greater semantic connectedness of early-acquired celebrities would, thus, lead to their being processed more rapidly. However, it should be noted that our task is perceptual rather than semantic in nature. We would thus expect there to be minimal involvement of the semantic processing system in performing this task. The presence of an AoA effect would, therefore, argue to some extent against this hypothesis in the people processing domain.

3. Method

3.1 Participants

Seventy-two adults (46 female, 26 male), native English speakers with normal (or corrected to normal) vision, were paid a small honorarium for their participation. All of the participants confirmed that they had spent most, if not all, of their lives in the UK. Twenty-four participants were recruited from each of three age bands (those aged in their 40s, 50s, and 60s). The 40-year-old group was made up of 12 females and 12 males (mean age = 44.54 years, SD = 2.98). The 50-year-old group consisted of 20 females and 4 males (mean age = 54.71 years, SD = 3.13). There were 14 females and 10 males in the 60-year-old group (mean age = 64.79 years, SD = 3.51). There was a highly significant difference between the three age groups in mean age, $F(2, 69) = 238.144$, $MSE = 10.332$, $p < .001$, partial $\eta^2 = .873$, demonstrating the clear separation of age groups. Bonferroni post hoc analyses indicated that each participant age group differed in age from every other (all at $p < .001$).

3.2 Materials

Responses were recorded via a handheld push-button response box connected to an IBM-compatible computer running the experiment generator software package E-Prime (Psychology Software Tools, 2001).

Sixty target stimuli (see Appendix) were selected from the Smith-Spark et al. (2006) database of famous names. There were equal numbers of celebrities who became famous during the 1960s, 1970s, or 1980s. This grouping was organised on the basis of mean AoA a priori ratings taken from the Smith-Spark et al. database ensuring a significant difference in AoA ratings between the groupings, $F(2, 57) = 437.109$, $MSE = .034$, $p < .001$, partial $\eta^2 = .939$. Pair-wise analyses demonstrated that the mean AoA ratings of each condition differed significantly from every other (p < .001 in each case). The stimulus groups were well matched on a number of variables known to influence processing ($p > .05$ in all cases; ratings again taken from the Smith-Spark et al., 2006, database). Table 2 shows the means for the different variables on which the stimuli were matched and manipulated.

TABLE 2 ABOUT HERE

Sixty distractor names were also drawn from the database and created by combining the first name and family name of different celebrities to create an unfamiliar name (e.g., ‘Elizabeth Gibson’ derived from actress Elizabeth Taylor and actor Mel Gibson). None of the distractor names were particularly distinctive or could cause priming of the target items.

The stimuli were presented in 18-point Courier New bold font in reverse video.

3.3 Design

Separate multilevel modelling analyses were carried out on the two dependent variables, reaction time (RT), measured in milliseconds, and accuracy of response (%).

Participant age group (participants in their 40s, 50s, and 60s) and AoA (famous names originating from the 1960s, 1970s, and 1980s) were entered as fixed factors, together with the age x AoA interaction. Celebrity stimulus and participant number were entered as random factors into the analyses. This statistical design was adopted in order to generalize the findings across both participants (F_1) and items (F_2) (Brysbaert, 2007).

3.4 Procedure

The participants gave informed consent before performing the task. They were told that they would be presented with people's names (first name followed by family name) and were asked to decide as quickly and as accurately as possible whether or not they recognised each name. The participants were required to press one of two buttons on a response box, 'YES' for a familiar name or 'NO' for an unknown name. For each stimulus presentation, an orienting '*' sign appeared in the centre of the monitor screen for 700 ms, followed by a 2000 Hz tone (250 ms in duration), followed by the printed name. The participant's response extinguished the display, recorded RT and accuracy of response, and initiated the next trial. A short practice session preceded the main experiment.

Post hoc ratings

Following the familiarity decision task, the participants rated the critical items. The instructions emphasised that there were no right or wrong answers but that each participant's personal response was very important to the experimenters. Post hoc ratings were required on the following dimensions:

AoA: Ratings of AoA were made on a 10-point scale, with one representing a celebrity the participant first became aware of before the age of 5 years old, two for a celebrity known before 10 years old, three before 15 years old, and then increasing in 10 year increments up to 10 reflecting a celebrity learnt before 85 years of age.

Familiarity: Instructions explicitly stressed that ratings should reflect how many times each celebrity had been encountered in the participant's personal daily life. Ratings were made on a 7-point scale (1 = completely unknown, to 7 = very familiar), using the method set out in Moore and Valentine (1998).

Distinctiveness: Here participants estimated how easy each celebrity would be to spot on a crowded railway platform (Valentine & Bruce, 1986a). A 7-point scale was used, with 1 representing a 'typical' face that would be hard to spot and 7 corresponding to a highly distinctive face that would be easy to pick out in a crowd. It was stressed that the distinctiveness judgement should be made solely on the basis of the celebrity's face and not on any other physical features (such as height or hair colour).

Participants were debriefed after they had completed the ratings.

4. Results

Out of a total of 4320 trials, 113 (i.e., 2.6%) were eliminated from the analysis due to their being more than 2.5 SDs faster or slower than an individual participant's mean RT. Following this data trimming, three celebrity stimuli were removed entirely from the data set due to low accuracy of responses (< 75%). These items were Nikita Kruschev (1960s, 68% correct accuracy), Gerald Ford (1970s, 71% accuracy), and Diana Spencer (1980s, 58% accuracy). Henceforth, we report the statistical analyses conducted on this reduced data set.

4.1 Post hoc ratings

One-way ANOVAs indicated that there were no significant differences between the AoA groupings in either familiarity, $F(2, 54) = 2.67$, $MSE = .171$, p = .079, partial $\eta^2 = .090$, or distinctiveness, $F(2, 54) = 1.47$, $MSE = .307$, $p = .239$, partial $\eta^2 = .052$. There was, however, a significant difference in AoA ratings between the AoA groupings, $F(2, 54) = 104.18$, $MSE = .112$, $p < .001$, partial $\eta^2 = .794$, thereby confirming our a priori grouping of stimuli by decade of initial encounter. Post hoc Bonferroni multiple comparisons indicated that there was a significant difference between each AoA grouping and every other grouping in AoA ratings (all at $p < .001$).

The stimuli were also well matched across the different participant age groups. The post hoc familiarity ratings provided by the three participant age groups did not differ significantly, $F(2, 69) < 1$, MSE = .810, $p = .917$, partial $\eta^2 = .003$. Similarly, there was no significant difference in the three groups' facial distinctiveness ratings, $F(2, 69) = 1.25$, $p < .001$, partial $\eta^2 = .035$. However, a highly significant difference in AoA ratings was found, $F(2, 69) = 73.53$, $p < .001$, partial $\eta^2 = .681$. Post hoc comparisons indicated that each participant age group differed significantly from every other age group (all $p < .001$). Mean post hoc ratings for each participant group are displayed in Table 3.

TABLE 3 ABOUT HERE

4.2 RT

4.2.1 Distractor items

Overall, the mean RT to unfamiliar names was 1316 ms (SEM = 41.74). There was no significant participant age group difference in response latencies to the distractor stimuli, $F(2, 69) < 1$, MSE = 127384.576, $p = .629$, partial $\eta^2 = .013$.

4.2.2 Target items

The overall mean RT to familiar names was 1026 ms (SEM = 4.10). There was a significant effect of participant group on RT, $F(2, 3840.506) = 25.799$, $p < .001$. Post hoc pairwise comparisons indicated that the 40-year-old participants were significantly faster to correctly identify famous names as being familiar than both the 50-year-olds ($p = .006$) and the 60-year-olds ($p < .001$). The 50-year-olds were also significantly faster than the 60-year-olds ($p < .001$). The mean RTs for each participant group are shown in Figure 1.

FIGURE 1 ABOUT HERE

There was also a significant effect of AoA on RT, $F(2, 3849.959) = 54.179$, $p < .001$. Post hoc Bonferroni pairwise comparisons indicated that the participants were significantly quicker to respond to 1960s than 1970s celebrities (mean difference = 34 ms, $p = .002$). The participants were also significantly faster to recognise celebrities from the 1960s than those from the 1980s (mean difference = 103 ms, $p <. 001$) and to recognise stimuli from the 1970s than to those from the 1980s (mean difference = 69 ms, $p < .001$). The means for the AoA effect are displayed in Figure 2.

FIGURE 2 ABOUT HERE

Table 4 shows the mean RTs for each participant group in response to the different AoA groupings. Inspection of the means suggested that there might be some differential effect of AoA on the RTs of the three age groups, with the linear AoA effect being most pronounced in the 60-year-old group. The mean differences are displayed in Table 4. There was a smaller processing advantage for 1960s relative to 1970s celebrities in the 40- (mean difference = 21 ms) and 50-year-old participants (mean difference = 29 ms). However, the participant group x AoA interaction did not prove to be statistically significant, $F(4, 3840.579) < 1$, $p = .528$.

TABLE 4 ABOUT HERE

4.3 Accuracy

4.3.1. Distractor items

The mean overall percent accuracy of response to distractor stimuli was 94% (SEM = 0.57). There was no significant participant age group difference in accuracy of response to the unfamiliar names, $F(2, 69) = 1.092$, $MSE = 23.214$, $p = .341$, partial $\eta^2 = .031$.

4.3.2. Target items

There was no significant effect of participant group on accuracy of response, $F(2, 3832.097) = 1.243$, $p = .289$, with participants aged in their 40s, 50s, and 60s performing at similar, and high, levels of accuracy. There was, however, a significant effect of AoA, F(2, 3855.524) = 10.32, $p < .001$. The participants were significantly more accurate in response to 1960s than 1980s stimuli ($p < .001$) and also more accurate to 1970s than 1980s famous names ($p = .003$). There was no significant difference in accuracy between 1960s and 1970s stimuli ($p = .821$). The participant group x AoA interaction was not significant, F (4, 3832.097) < 1, $p = .447$. Table 5 shows the mean proportion correct.

TABLE 5 ABOUT HERE

5. Discussion

We investigated long-term AoA effects for naturally occurring famous names acquired gradually over the course of three decades. Three groups of mature adults were asked to make familiarity decisions to celebrity stimuli, which had been carefully matched a priori. Our stimulus selection was confirmed by the post hoc ratings that we collected. These demonstrated that the celebrities in each AoA grouping held equivalent levels of familiarity (or frequency of encounter) and distinctiveness for our experimental participants, thereby ruling out any potential confounds from these two variables. They also confirmed that the celebrities making up the three AoA groupings were acquired at different points in our participants lives.

A main effect of participant age was found in the RT data, with older adults responding more slowly than their younger counterparts. There was no group difference in accuracy, however. The age-related difference in RT was unsurprising given the literature on cognitive ageing and information processing (e.g., Salthouse, 1991, 1992) and will not be commented on further.

The findings relating to AoA, being the focus of the experiment, were of considerably more theoretical interest. We found main effects of AoA on both RT and accuracy. All three participant groups evinced faster RTs to the early-acquired names. Indeed, the effect of AoA was manifested in a linear increase in RT to the names of celebrities from the 1960s, 1970s, and 1980s. Our participants were significantly faster and more accurate to make familiarity decisions to the names of celebrities acquired in the 1960s than those acquired in the 1970s. Names from the 1970s were, in turn, recognised significantly faster than celebrities from the 1980s. The significant AoA effect found in the accuracy data demonstrated that no speed-accuracy trade-off had occurred. Participants were more accurate in responding to both the 1960s and 1970s celebrities than those from the 1980s, but there was no difference in accuracy between responses to the 1960s and 1970s stimuli. This may have been due to the high levels of accuracy on the task. There were no participant group x AoA interaction effects, with a similar pattern to the RTs for participants in their 40s, 50s, and 60s being found. While non-significant, the RT data are, however, generally consistent with previous work suggesting that the processing advantage for early-acquired items is somewhat greater in older people (e.g., Barry et al., 2006).

Therefore, we have found long-term effects of AoA on RT that persist over very long periods of time (thirty to forty years). This is an important point and, with the exception of Gilhooly (1984), has not previously been addressed experimentally. Some research (e.g., Izura et al., 2011; Stewart & Ellis, 2008; Tamminen & Gaskell, 2008) has investigated the influence of OoA over the course of days or several weeks. The strength of such an approach is that frequency can be fully controlled (although Izura et al., 2011, did have to request that their participants refrained from thinking about the words they were learning between training sessions) in a way that it simply cannot be when using naturally occurring stimuli acquired over decades. However, the a priori and post hoc controls that we have set in place show that neither familiarity (frequency of encounter) nor facial distinctiveness can explain the effects we have uncovered. There was no confounding effect of either variable. Our data indicate that the AoA effect is more subtle than simply delineating between the earliest acquired items and all later items, but rather would seem to reflect a gradual reduction in the efficiency of knowledge acquisition and processing items over an extended period of time (c.f. Lambon Ralph & Ehsan, 2006).

So, can these data be explained successfully by current theories of AoA? As previously argued, robust effects of AoA on people processing have been reported consistently, meaning that theoretical accounts couched in terms of a single, phonological, locus or a unique critical period of language acquisition (e.g., Brown & Watson, 1987) are clearly insufficient in explaining data in the people processing domain. This is because the names of such people are acquired years after language development. While the literature has moved away from such accounts, our results do add to a growing corpus of empirical evidence against such explanations as a unique or sole account of the effects of AoA. But are the semantic hypothesis (e.g., Brysbaert et al., 2000; Ghyselinck et al., 2004a), the neural plasticity account (e.g., Ellis & Lambon Ralph, 2000; Lambon Ralph & Ehsan, 2006), and the SSPS hypothesis (Moore, 2003; Moore & Valentine, 1999) able to explain our data?

It would appear that the neural plasticity account (e.g., Ellis & Lambon Ralph, 2000) is able to explain the AoA effects that we report in this paper. Indeed, the linear increase in RT over the three AoA groupings in our experiment is similar to Ellis and Lambon Ralph's Simulation 5 results. There would appear to be a gradual reduction in the efficiency with which celebrities can be processed as they are acquired over decades. The results of Ellis and Lambon Ralph's simulation argue that order is more important than age in influencing processing speed. Thus, the model is able to explain the absence of an interaction effect in our data, with age not being found to mediate the AoA effects uncovered. As we have noted in Section 1.1, the neural plasticity model has been limited mainly to explaining AoA effects in the lexical processing domain, but it would appear that its predictions generalize to the famous name processing domain. Likewise, a long-term AoA effect for famous names was predicted by the SSPS (Moore, 2003; Moore & Valentine, 1999) and this hypothesis can also readily explain our data.

Long-term AoA effects were also predicted by the semantic hypothesis (e.g., Brysbaert et al., 2000; Ghyselinck et al., 2004a), reflecting the greater semantic connectedness of names learnt earlier in life (Steyvers & Tenenbaum, 2005). The linear nature of our results can thus also be accounted for by the semantic hypothesis. As we have already noted, however, AoA effects are subsumed by semantic effects in the Steyvers and Tenenbaum semantic hub network model and this model is frequently appealed to in semantic accounts of AoA (e.g., Ghyselinck et al., 2004a,b). It does, indeed, seem obvious that, over the course of decades, celebrities will be involved in making more feature films, getting caught up in scandals, fighting law suits through the courts, etcetera. Therefore, a greater wealth of information surrounding a celebrity should build up over time. Is there any way that our experiment can differentiate an effect based on point-of-entry from one based on semantic connectedness?

Whilst the participant age group x AoA interaction was statistically non-significant, the most profound AoA effects were found in the oldest age group. The 60-year-old participants demonstrated a clear linear increase in RT across the three AoA conditions. Over a number of decades, there was a very clear AoA effect with RTs to each AoA grouping differing significantly from the next. Similar AoA effects were found in the 40-year-old and 50-year-old groups. However, the mean differences in RTs between celebrities from the 1960s and 1970s were roughly half the magnitude of that found in the 60-year-old group. As a reviewer pointed out, it is possible that the two younger age groups' representations of the 1960s celebrities were initially more semantically sparse, due to a more limited range of media being available to children and teenagers. As a result, a greater number of details about the 1960s celebrities may have been filled in later by the younger two age groups, and this could have made the RT difference between them and the 1970s celebrities less clear-cut. Alternatively, given that the oldest group were slowest to respond overall, there may have been more chance for a semantic influence on processing speed to occur than in the two younger groups. However, we feel that these explanations of the findings are unable to account for our data. First and foremost, the interaction was not statistically significant and speculating on null results is fraught with peril. Secondly, the mean RTs for all three participant groups (around 900-1100ms) are what would be expected in response to a perceptual familiarity decision task involving celebrities. People processing tasks involving semantic processing would yield mean RTs of around 1500ms, considerably longer than those reported for even the slowest group of participants in our experiment. Therefore, it would seem unlikely that the semantic system was engaged by the task. Our data would, therefore, argue against a wholly semantic locus of AoA effects in the people processing domain.

It was beyond the scope of the paper to explore the role of semantics fully. While we controlled for familiarity (cumulative frequency) and facial distinctiveness, controlling for semantic variables would have made stimulus selection and matching very difficult to achieve. Matching celebrities on semantic attributions is no simple matter, as many celebrities stubbornly refuse to remain in one specific category; for example, film stars become politicians, sports players become commentators or actors, and models become United Nations envoys. Even ‘living’ or ‘deceased’ is a variable that can be subject to change during the experiment, with the possibility of a celebrity, whose name or face is used as an experimental stimulus, inconveniently dying halfway through data collection. For these reasons, it is difficult to control fully for semantic variables in testing AoA effects on people processing tasks. However, the results of a study conducted by Smith-Spark, Moore, and Valentine (2007) may be informative here. They used a perceptual familiarity decision to test mature adults' responses to celebrity stimuli. Employing mature adults as participants led to a much wider separation between early- and late-acquired items. Age of acquisition and the quantity of semantic information known about the celebrities were manipulated orthogonally, with our stimulus groupings being validated with post hoc ratings by the participants. The results did not support the Steyvers and Tenenbaum (2005) semantic hub network model, with the amount of semantic information only facilitating responses to late-acquired, and not early-acquired, celebrities. Taken together with the non-significant participant age x AoA interaction and RTs reflecting a task that is perceptual rather than semantic in nature, the Smith-Spark et al. findings would appear to rule out an overall mediating semantic influence on AoA effects in response to celebrity names. However, more research needs to be done in this area, perhaps using a similar factorial design to ours but controlling for the amount of information known about the celebrities or using a task (such as semantic categorization) that makes greater demands on the semantic processing system. In the meantime, we feel that the neural plasticity account (Ellis & Lambon Ralph, 2000) and the SSPS hypothesis (Valentine & Moore, 1999; Moore, 2003) provide a more parsimonious account of the long-term, persistent AoA effects that we have uncovered.

Our experimental design and the linear nature of our RT findings broaden the scope of AoA towards the consideration of OoA as being at the root of the processing advantage conferred on earlier-acquired items, although not conclusively, given that our stimuli were learnt by participants at different ages. At the least, our data suggest that OoA may exert an influence in the people processing domain. Further research is also required to determine whether the OoA effects suggested by our data extend to other types of task and different domains. It may be the case that AoA, and not OoA, effects exist, for instance, in the lexical processing domain (as suggested by Gilhooly, 1984). However, the importance of the order in which items have been introduced during learning has been demonstrated experimentally (e.g., Izura & Ellis, 2002; Izura et al., 2011; Stewart & Ellis, 2008; Tamminen & Gaskell, 2008) and computationally (e.g., Ellis & Lambon Ralph, 2000; Monaghan & Ellis, 2010).

In conclusion, our results indicate that it is not just the earliest stimuli to be encountered that receive a processing advantage, but that items learnt progressively later also gain an advantage over their successors, at least for the people processing domain. Our data suggest that AoA effects can appear throughout life, across different processing domains, and persist across decades. A clear linear increase in processing speed occurred in response to items across the three decades. Our findings are even more cogent given the tight control of AoA, familiarity, and distinctiveness exerted on our stimulus groups. The AoA phenomenon would appear to go beyond simply differentiating between responses to the earliest- and all later-acquired items. Instead, it would seem to have a pervasive influence on processing, with a gradual slowing of RT and diminishing accuracy over time, even when frequency of encounter (or familiarity) is controlled across stimulus groups. As well as highlighting the persistence of AoA effects over the long-term, in a processing domain different to that generally explored by AoA researchers, the results suggest that the processes involved in acquiring skills and knowledge in new domains throughout the lifespan may be much more flexible than suggested by current accounts of AoA.

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Table 1

Showing the participant age x AoA manipulation.

	Participant age by decade		
Decade	40s	50s	60s
1960s	0 –10 years old	10-20 years old	20-30 years old
1970s	10-20 years old	20-30 years old	30-40 years old
1980s	20-30 years old	30-40 years old	40-50 years old

Table 2

Item means (with SEMs in parentheses) for the three groups of celebrity names.

Measure	1960s	1970s	1980s	Partial η^2	p
Number of syllables in name	3.85	3.60	4.05	.044	.278
	(0.93)	(0.68)	(1.00)		
Number of times generated *	51.65	41.30	52.00	.018	.600
	(45.11)	(29.43)	(37.43)		
A priori familiarity rating	4.67	4.37	4.44	.047	.257
	(0.38)	(0.71)	(0.61)		
A priori distinctiveness rating	4.60	4.41	4.47	.016	.626
	(0.40)	(0.75)	(0.74)		
A priori AoA rating	4.23	5.17	5.97	.939	< .001
	(0.25)	(0.12)	(0.16)		
Post hoc familiarity rating	4.76	4.60	4.56	.029	.431
	(0.44)	(0.57)	(0.48)		
Post hoc distinctiveness rating	4.31	4.14	4.11	.020	.562
	(0.44)	(0.78)	(0.63)		
Post hoc AoA rating	3.59	4.30	5.14	.793	< .001
	(0.34)	(0.28)	(0.37)		

*Smith-Spark et al. (2006) asked 182 participants to write down the names of famous people whose faces they would recognise. Participants were requested to do this spontaneously and without recourse to reference books. Number of times generated represents the number of participants who generated a particular famous person.

Table 3

Mean post hoc ratings for each participant age group. Standard deviations are shown in parentheses.

Post hoc rating	40-year-olds	50-year-olds	60-year-olds
Familiarity	4.61 (.97)	4.71 (.98)	4.69 (.73)
Distinctiveness	4.01 (.82)	4.29 (.83)	4.37 (.77)
AoA	3.41 (.58)	4.35 (.51)	5.21 (.45)

Table 4

Mean participant group RTs (ms; with SDs in parentheses) for target items.

Participant group	AoA grouping			Mean difference in RT		
	1960s	1970s	1980s	1960s vs. 1970s	1960s vs. 1980s	1970s vs. 1980s
40-year-olds	957 (199)	977 (240)	1040 (240)	20	83	63
50-year-olds	980 (251)	1009 (237)	1081 (286)	29	101	72
60-year-olds	1005 (233)	1057 (287)	1130 (320)	52	125	73

Table 5

Mean proportion correct (with SDs).

Participant group	AoA grouping			Mean
	1960s	1970s	1980s	
40-year-olds	.97	.96	.95	.96
50-year-olds	.97	.97	.93	.95
60-year-olds	.98	.97	.95	.97
Mean	.97	.97	.94	

Figure 1

Mean RTs (and SEMs) for each participant age grouping.

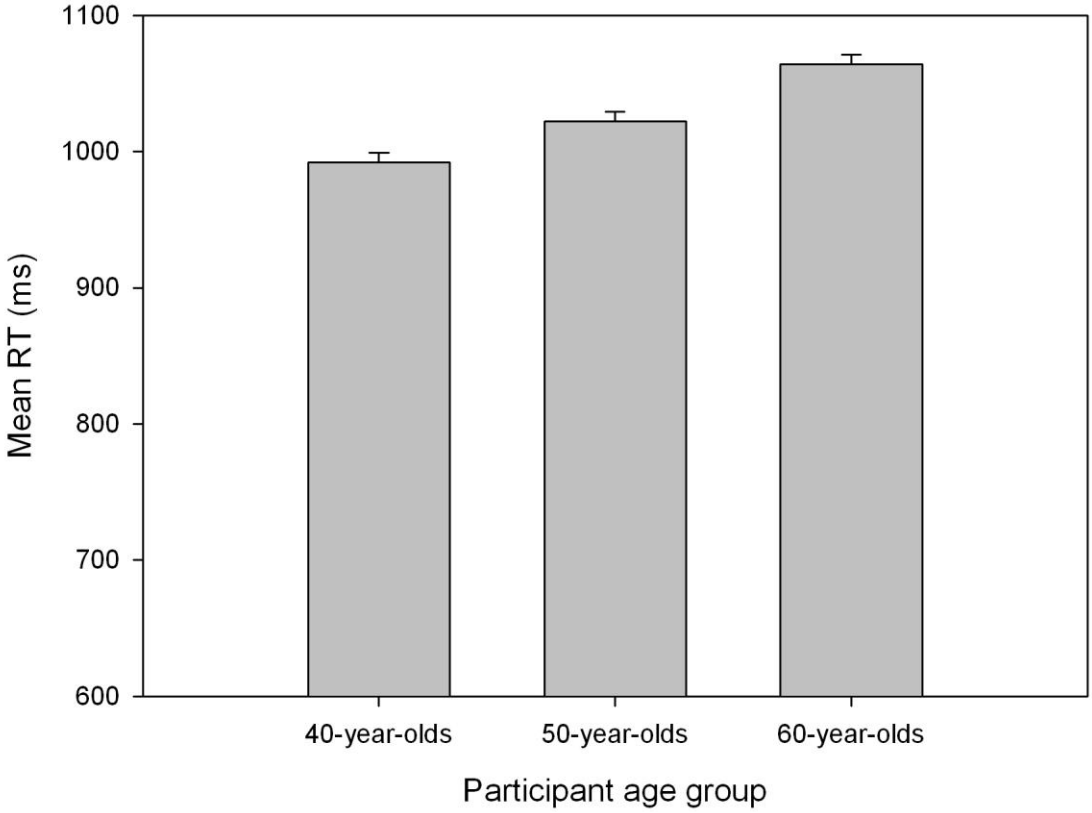
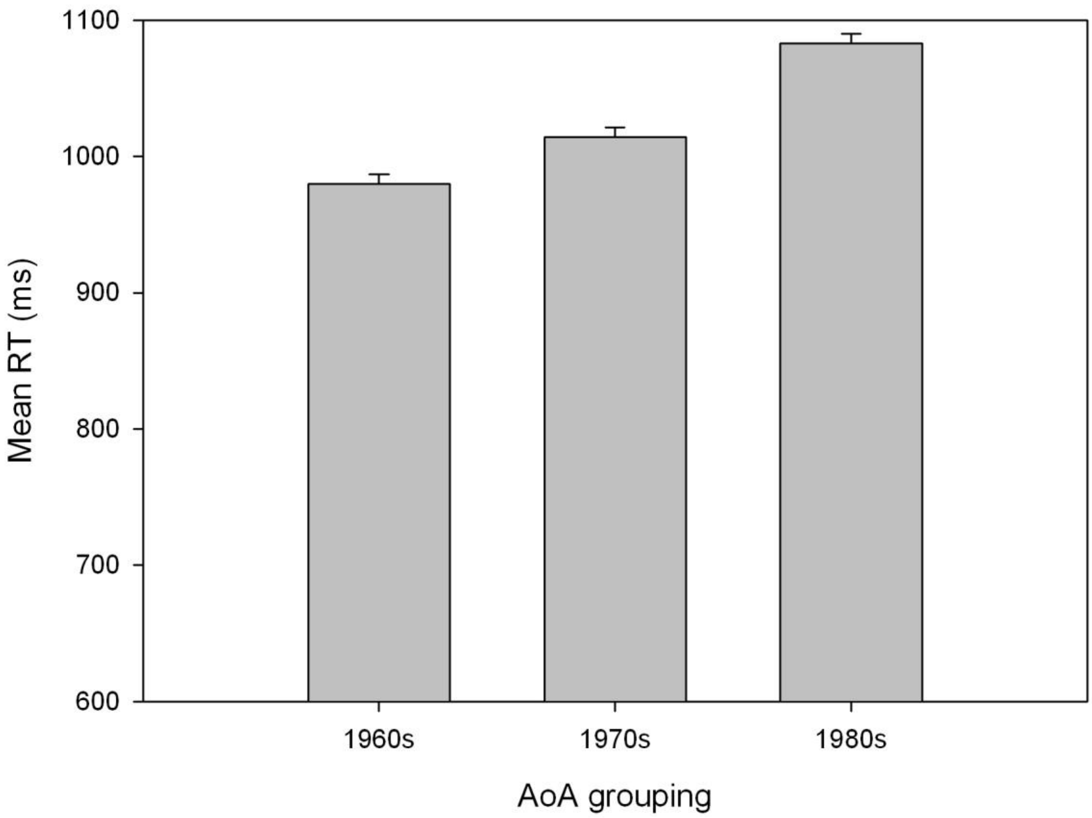


Figure 2

Mean RTs (and SEMs) for each AoA grouping.



Appendix

Experimental stimuli

1960s	1970s	1980s
Bobby Charlton	Angela Rippon	Anna Ford
Bobby Moore	Barbra Streisand	Arnold Schwarzenegger
Clint Eastwood	Bjorn Borg	Boris Becker
David Attenborough	Chris Evert	Chris Tarrant
Edward Heath	Denis Healey	Diana Spencer
Enoch Powell	Dustin Hoffman	Geoffrey Howe
Ernie Wise	Esther Rantzen	Ian Botham
Fidel Castro	Gerald Ford	Jilly Cooper
George Harrison	Glenda Jackson	John McEnroe
Harold Wilson	Goldie Hawn	Michael Aspel
Harry Secombe	Idi Amin	Mikhail Gorbachev
John F. Kennedy	James Callaghan	Neil Kinnock
Kenneth Williams	James Hunt	Norman Tebbit
Marlon Brando	Jane Fonda	Peter Sutcliffe
Nikita Kruschev	Jimmy Saville	Sarah Ferguson
Paul Newman	Michael Caine	Steve Cram
Robert Mitchum	Richard Nixon	Steve Davis
Sophia Loren	Robert Redford	Sylvester Stallone
Steve McQueen	Robin Day	Trevor McDonald
Tommy Steele	Terry Wogan	Yasser Arafat

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