

The role of cognitive control and referential complexity on referential choice over the adult lifespan

Madeleine Long (MPI), Hannah Rohde (Edinburgh), Paula Rubio-Fernández (MPI)

This study aims to advance our understanding of the nature and source(s) of individual differences in pragmatic behaviour over the adult lifespan. Here we probed adults' choice of referential forms (i.e., names vs pronouns to refer to the main character) across four story continuation experiments (N=496 English speakers). Our manipulations were based on Fossard et al.'s scale of referential complexity: level 1 (1 character in the scene), level 2 (2 characters of different genders in the scene) and level 3 (2 characters of the same gender in the scene) [1]. According to Fossard et al., pronouns should decrease as referential complexity increases, since pronouns are used to signal topic continuity [2]. As such, the choice of names vs. pronouns provides insight into participants' perception of the topicality of a referent, and whether that varies by age and cognitive capacity. Throughout adulthood, participants demonstrated sensitivity to manipulations of referential complexity, with evidence linking attention switching to optimal referential choice in older adults alongside an increase in pronoun use.

EXP 1: To test how referential choice varies with scene complexity and speaker age/executive function, 200 English speakers (aged 19-82, $m=49$) underwent a cognitive assessment and completed a story continuation task [3] (materials/data/code on [OSF](#)). Two scene types were shown: 1-character and 2-character (Fig. 1), (i.e., levels 1 and 2 on the complexity scale). For each trial, participants heard a sentence about panel 1 and repeated it, then saw panel 2 (with the subject from panel 1 depicted as the main character) and constructed a story continuation. Based on prior work [1-3] we predicted adults of all ages would respond to complexity manipulations through reduced pronominal use for 2-character scenes, but that older adults' general referential patterns would be linked to attention switching, given a positive association between older adults' planning abilities and pronominal use [4] and evidence that switching predicts pragmatic success in old age [5-6]. **Results:** Our LMER model of Pronominal Use (pronoun=1, name=0) with Age and Complexity as predictors revealed more reduced forms (pronouns) for less complex scenes ($p<0.001$), with no age effects ($p's>.05$). Our second LMER model of Pronominal Use (with Age, Switching, Inhibition, and Working Memory as predictors) revealed higher rates of pronominal use with advanced age ($p=.005$), a common finding in the literature [7]. As hypothesised, better switching was associated with more pronouns ($p=.005$), driven by an increased reliance on switching in later life to guide referential choice (Fig 2.).

EXP 2: During the pandemic, we moved to online testing and did not collect cognitive measures. Here we tested whether increased complexity (1- vs 2- vs 3-character scenes) yields more explicit referential forms (N=96 English speakers aged 18-73, $m=45$). For items with a third character, it was always the same sex/gender as the secondary character, which differed from the main character, ensuring a pronoun would distinguish the main character. **Results:** Our LMER model of Pronominal Use with Complexity and Age as predictors revealed pronominal use was greater for 1-character than 2-character scenes ($p<.001$) with no difference between 2- and 3-characters, suggesting a second competitor of a different sex/gender does not increase referential complexity. As in Experiment 1, no age effects were found across conditions ($p's>.05$), however, general pronoun use increased with age ($p<.002$).

EXP 3: We tested sensitivity to the TIMING of competitors' presence in the scene (N=100 English speakers aged 19-77, $m=45$). We created a hybrid manipulation

between levels 1 and 2 to test whether referential choice varies with the presence of the competitor in panel 1 or 2 (i.e., 1>2/ different vs. 2>1/ different). In addition, we tested complexity level 3 through 2>2/ same gender trials. The comparison of 1>2/ different vs. 2>1/ different allows us to test the role of TIMING; the comparison of 2>2/ same with either of the other two conditions allows us to test the role of gender ambiguity. **Results:** Our LMER model of Pronominal Use with Age and Complexity as predictors revealed a difference between 2>1/ and 1>2/ different gender trials ($p < .001$), such that more pronouns were used in the latter condition, which suggests adults make complexity decisions early on. No difference was found between 2>1/ different gender and 2>2/ same gender trials ($p = .178$) perhaps because pronouns are perceived as less ambiguous in these contexts. Again, no age differences were found across conditions (p 's $> .05$), but general pronoun use increased with age ($p < .002$).

EXP 4: We tested whether decreasing EMPHASIS on competitors (through re-mentioning of the main character) would impact referential complexity and lead to age-related differences (N=100 English speakers aged 18-73, $m=45$). We assessed four trial types: 1>2/ different gender, 2>1/ different gender, 2>2/ different gender and 2>2/ same gender. For the first two trial types, we added a sentence to each prompt using an additional pronoun to refer back to that referent. For the latter two, we repeated the main character's name. The pronoun manipulation was expected to increase the main character's prominence as pronouns are reserved for topical characters [7]. **Results:** Our LMER model of Pronominal Use with Age and Complexity as predictors revealed pronominal use for 1>2 and 2>1/ different gender trials was greater than for 2>2/ different gender trials, suggesting the additional pronoun in the prompt lowered the likelihood of the competitor as a topic, decreasing referential complexity. Notably, here the effect of age on general pronominal use went in the opposite direction than in Experiments 1-3: Younger adults used more pronouns ($p < .001$). Older adults may be less sensitive to linguistic-only cues when calculating a referent's status.

Our results provide insight into the relationship between pragmatics and ageing by identifying a link between older adults' switching skills and the use of pronouns as a marker of topic continuity. Likewise, our results reveal what type of contextual information is prioritised at different ages, highlighting older adults' preserved sensitivity to (visual) scene complexity but reduced sensitivity to linguistic prominence cues, compared to younger adults. These findings contribute to our understanding of individual differences in pragmatic behaviour and can be used to refine current computational models of reference [8].

Key words: *reference, ageing, attention switching*

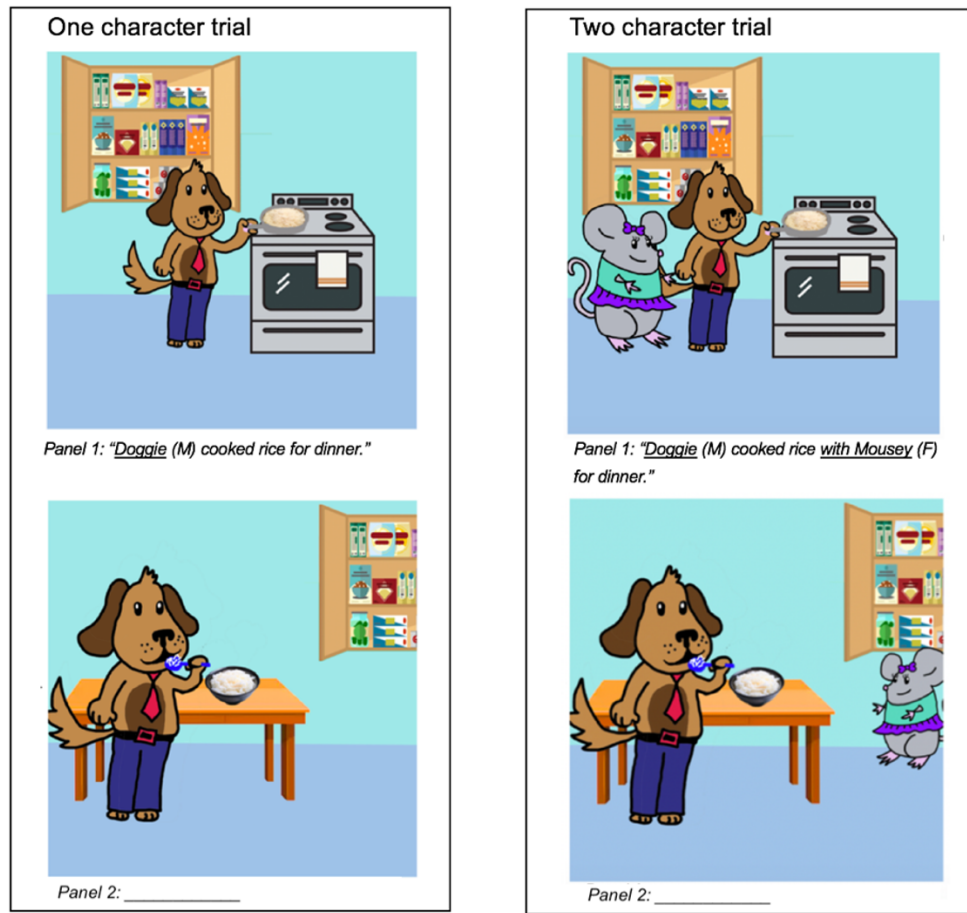


Figure 1. Sample 1-character and 2-character (different gender) trials from Exp 1.

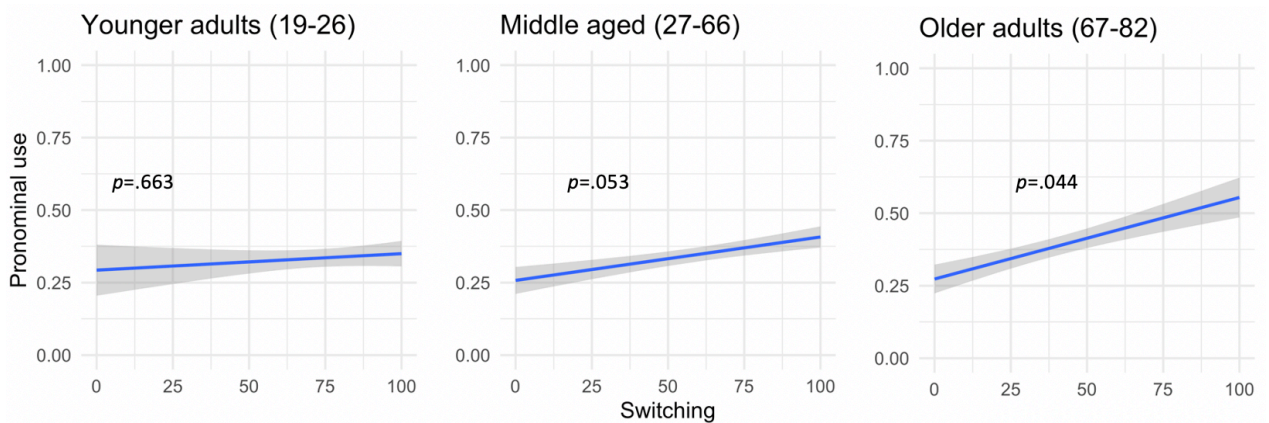


Figure 4. Plots of Exp 1 data showing the relationship between attention switching (a measure of executive function) and pronoun use for each developmental stage of adulthood. Note: the age ranges were determined by a tertile age split (with N=67 younger adults, N=67 middle aged, and N=66 older adults).

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