M & M: Modifiers and their Effect on Memory in Younger and Older Adults

Alyssa Thompson (alyssa-thompson@uiowa.edu)
Department of Communication Sciences and Disorders, 250 Hawkins Drive
Iowa city, IA 52242 USA

Raheleh Saryazdi (raheleh.saryazdi@uhn.ca)
KITE-Toronto Rehabilitation Institute, University Health Network, 550 University Avenue
Toronto, ON M5G 2A2 Canada

Si On Yoon (sion-yoon@uiowa.edu)
Department of Communication Sciences and Disorders, 250 Hawkins Drive
Iowa city, IA 52242 USA

Abstract

Modification is often required to differentiate potential referents in discourse context and enhances future memory for those referents. Not yet known is whether the type of modifier produced by younger and older adults differentially affects their object memory. We investigated the use of modifiers and whether it affects memory in younger and older adults. Further, we examined whether the effects vary depending on the type of modifiers produced, namely color versus state. Participants were asked to describe an object that was accompanied by a same-category object of different color or different state, or an unrelated object. A follow-up memory task then assessed their recognition memory. Older adults overspecified more than younger adults. Although modifiers improved memory for both age groups, older adults showed better memory performance. The current finding suggests a link between language production and memory, but we did not observe evidence that specific types of modifiers affected memory.

Keywords: referential production; overspecification; aging; memory

Introduction

Modification with Respect to the Discourse Context

Imagine that you are running late for work, and you ask your partner to help you get ready by passing you the shirt that is in the pile of clothes on your bed. There are many different ways to refer to this item with respect to the discourse context. For example, you can use a typical basic-level noun (e.g., the shirt) with or without a modifier (e.g., the green shirt), a subordinate noun (e.g., dress shirt), or even a pronoun (e.g., it). Speakers are required to provide enough information – neither too much nor too little – for their listeners to identify the referent according to Gricean Maxim (Grice, 1975). When there are more than two items that are similar or from the same category, modification is warranted to differentiate between the items in the discourse context.

The type of modification can vary based on the features of the referent and its competitor in the context (i.e., the other item not going to be mentioned), such as their color, state, material, size, or even their typicality in a category. Speakers encode the salient features of the referent and produce referring expressions with respect to those features that can easily differentiate from others. For example, when there are two shirts, one green and the other blue, a color modification would be efficient to differentiate between them, whereas if there are two green shirts, one clean and the other dirty, a state modification would be necessary rather than the color modification. Likewise, depending on the discourse context, the required modification type varies even when referring to the same object.

Overspecification across the Adult Lifespan

Interestingly, speakers do not always follow Gricean Maxim and often violate this expectation. One of the most frequent overspecification types is color modification (Sedivy, 2005). Color is an absolute and salient feature of the referent that can be easily coded compared to other types of features that might require comparison between critical objects and thus more relative, such as size. In fact, speakers rarely overspecify using scalar adjectives (e.g., small, large) (Sedivy, 2005).

There have been many attempts to explain why speakers overspecify by providing more information than required in the discourse context (Heller, 2020). The consensus among recent studies is that speakers overspecify because they are cooperative and try to help the listeners with their visual search. Thus, they are more likely to use properties of the object that are most salient and easy to discriminate (Degen et al., 2020; Jara-Ettinger & Rubio-Fernandez, 2022; Rubio-Fernandez, 2016, 2019). Recall the earlier example of asking for your shirt, you may use a redundant adjective *blue* to describe the shirt even if that is the only shirt in the pile because you want your partner to find the shirt faster. Thus, the redundancy can be a rational behavior intended to help the listener (your partner) with visual search of the intended object.

It has been observed that this rational behavior of overspecification can change across adulthood. Some evidence suggests that older adults are more likely than younger adults to overspecify objects during referential communication tasks (Healey & Grossman, 2016; Saryazdi, Bannon, & Chambers, 2019; Shekleton, Heller, & Yoon, 2022). There is also greater variability in the types of modifiers used by older adults than by younger adults (Saryazdi et al., 2019). One possible explanation is that older adults are providing more information because they want

In M. Goldwater, F. K. Anggoro, B. K. Hayes, & D. C. Ong (Eds.), *Proceedings of the 45th Annual Conference of the Cognitive Science Society.*

communicative efficiency, ensuring that their partner is successful in correctly identifying the intended referent (Long, Rhode, & Rubio-Fernandez, 2020)

Interplay between Language and Memory

Previous studies have shown that the way speakers describe the referent shapes the memory representation of that particular referent and its related context. In Yoon, Benjamin, and Brown-Schmidt (2016, 2021), speakers had better memory than listeners for the things that were discussed during the conversation, consistent with the *generation effect* in the memory literature (Slamecka & Graf, 1978). Further, it was tested whether the form of referential expressions affected their memory in the future. The results have shown that when the referent was described with a modifier (e.g., the green shirt), the memory of that referent was enhanced compared to when the referent was described without a modifier (e.g., the shirt). This suggests interaction between language and memory, that language is closely connected with memory and the referential form affects how the memory representation is encoded and updated while communicating. The act of speaking puts the speaker's attentional focus on the referent, and the selected features are encoded and retrieved later. Less clear is whether and how the type of modification used to describe an object in the referring expression affects the memory representation of that object across the lifespan.

Color versus State Modifiers

The aim of the present study is to explore whether the type of modifier produced during a referential communication task differentially affects memory performance in younger and older adults. We are particularly interested in color and state adjectives and their effect on recognition memory. Color adjectives reflect the salient static feature of the referent whereas state adjectives reflect dynamic (changing) features of the referent (e.g., open/closed, dirty/clean). An extensive amount of work has examined overspecification and referential processing regarding color adjectives (e.g., Degen et al., 2020; Rubio-Fernandez, 2016; Tarenskeen et al., 2015), while only a few studies have asked the use of state adjectives in discourse (Parker & Heller, 2019; Saryazdi, Nuque, & Chambers, 2021).

Previous studies reported that speakers are less likely to overspecify state information compared to color information (Parker & Heller, 2019). However, interestingly, younger adults often remember more state properties than color properties during memory tasks even with a delay (Brady et al., 2012), suggesting color and state information of the objects are encoded differently. The feature of object color is less likely to be bound to the object representation compared to the feature of state.

A recent language comprehension study compared the effect of linguistic redundancy on real-time language processing and memory in younger and older adults. The study revealed that relative to a bare noun, redundant color adjectives facilitated real-time comprehension when they helped to narrow attention to a single object. In contrast, redundant state adjectives always impaired comprehension. Interestingly, however, participants were faster at recognizing the target object that was earlier described using a state adjective than a bare noun. The pattern of results was similar in both younger and older adults, thus highlighting that state modifiers could have potential benefits for memory (Saryazdi, Nuque, & Chambers, 2022).

Taken together, different types of modifiers are processed differently in both production and comprehension and affect memory representations. However, how each type of modifier affects memory representation across the lifespan has not been explored especially from the perspective of language production. Thus, in the current study, we aim to understand how speakers describe the same referents across different discourse contexts and how the use of modification and its type affect speakers' future memory across the lifespan.

The Present Research

Method

Participants

Participants included 24 younger (M_{age}= 25.17, SD = 2.96, 13 females) and 24 older adults (M_{age}= 68.88, SD = 3.15, 12 females). All participants were recruited through Prolific in return for cash payment ($8). Participants were all native English speakers and were located in the USA. They reported typical hearing, normal or corrected-to-normal vision, and no colorblindness.

Materials and Procedure

Participants took part in a picture description task designed on the online experiment platform Gorilla (https://gorilla.sc/). After completing a demographic questionnaire and a microphone check, participants were asked to complete the picture description task. Participants in this task were presented with two images on each trial and asked to verbally describe the target image in the grey box so that it can be easily differentiated from the image next to it. We asked them to imagine that someone is listening to their descriptions and that they should be able to identify the image that the participant is describing. They could use any descriptive expressions that they saw fit but locative phrases (e.g., the left or right object) were not allowed.

We manipulated whether the target object was unique in its category on the screen or if it was accompanied by another same-category competitor object (Competitor Absent vs. Competitor Present). Further, we manipulated the property of the competitor in the Competitor Present condition: 1) Color Competitor condition included the competitor image that varied in color alone (e.g., blue balloon for the competitor vs. yellow balloon for the target, Figure 1a), 2) State Competitor

condition included the competitor image that varied in their state (e.g., popped balloon vs. inflated balloon, Figure 1b). The object in the Competitor Absent condition was a semantically and phonologically non-relevant object (e.g., yoga mat vs. balloon, Figure 1c). In the Color and State conditions, the two objects differed only in one property (either color or state), but never both. For example, in the Color condition, the state of the objects remained the same (e.g., blue inflated balloon vs. yellow inflated balloon), and in the State condition, the two objects were of the same color (e.g., yellow popped balloon vs. yellow inflated balloon). There were four different critical objects (i.e., 2 colors and 2 states: yellow/blue inflated/popped balloon) in each target type. The critical items were counterbalanced across the three conditions through the use of 12 experimental lists. Each participant was randomly assigned to a particular list.

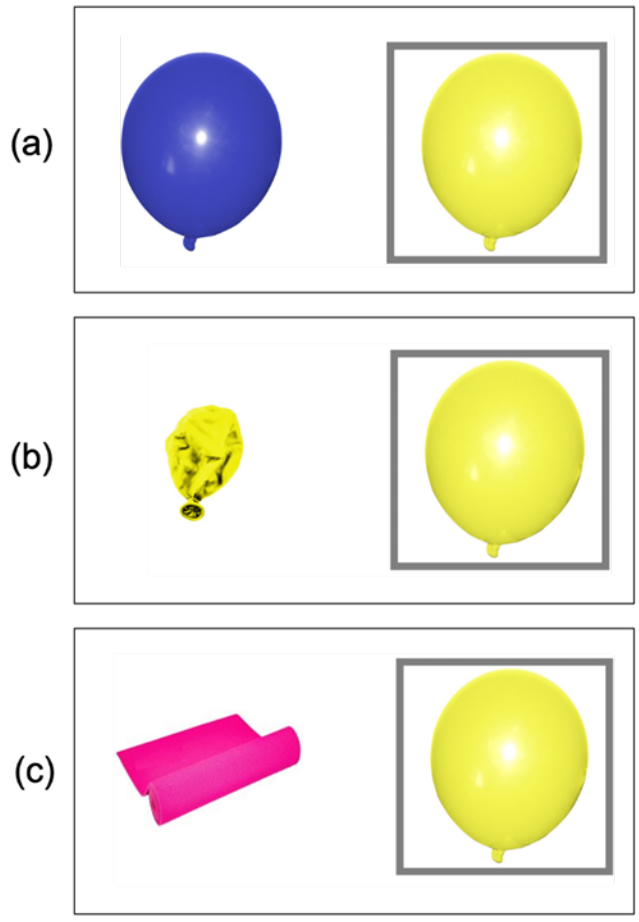

Figure 1: Example stimuli in the picture description task. (a) Color Competitor condition, (b) State Competitor condition, and (c) Competitor Absent condition.

There was a total of 96 trials, including 36 critical trials and 60 filler trials. Of 36 critical trials, we expect modified expressions in 24 trials from the Competitor Present conditions (12 color and 12 state trials) and bare noun expressions in 12 trials from the Competitor Absent condition. To equally balance modified expressions and bare noun phrases, we had 24 filler trials with two different objects (e.g., laptop and bottle) and 36 filler trials with size-contrasting competitor images (e.g., big/small).

After participants completed the picture description task, they completed a series of cognitive measure tasks that examined their processing speed (e.g., sustained attention test), inhibitory control (e.g., flanker task), and working memory span (e.g., digit span task). These tasks were included to have an average 20-minute break between the picture description task and the memory test as an unrelated distractor test. These measures were not of our primary interest and thus, the results will not be discussed.

Following the cognitive measure tasks, the participants performed an unexpected recognition memory test. On each trial, participants were presented with one image and were asked to respond whether they had seen the picture on the screen earlier or not. They pressed the "Y" key if they thought they had seen the image before during the picture description task and pressed the "N" key if they thought the image was new. There was a total of 216 trials, including 36 critical old items, 36 new lure items for the corresponding old items (e.g., a new balloon of a different color and state compared to the target), 72 old filler items, and 72 new items. The lure items were the same across the conditions. The trials were presented in random order. The entire study took approximately 40-45 minutes.

Results

All analyses were conducted in R version 4.1.1 (R Core Team, 2021). The mixed effect models were performed with the lme4 package version 1.1-27.1 (Bates, Mächler,Bolker, & Walker, 2015) and statistical significance was assessed with lmerTest package version 3.1-3 (Kuznetsova, Brockhoff, & Christensen, 2017). All initial models included maximal random effect structure including intercept terms for participants and items, as well as relevant by-item and by-participant slope terms. Models that did not converge or had singular fit warning were further simplified.

Picture Description Task

We transcribed each participant's descriptions verbatim and then coded the expressions for its 1) expression length: the number of words produced to describe each target image; 2) modifier use: whether or not the expression was modified (Yes=1, No=0), 3) modifier count: the number of modifications, 4) modification position (i.e., prenominal, postnominal, or both), and 5) the type of modifier used (i.e., color, state, and others). Options 3 to 5 were analyzed only when the expressions were modified. The trials that did not include a recording due to technical difficulties or trials that did not contain a critical noun (usually just adjectives) were dropped from the analyses. This included 73 trials (31 trials

in younger adults and 42 trials in older adults) and the final data set included a total of 1655 trials.

Expression Length First, we analyzed the length of a description produced by each age group, namely the number of words they produced in each condition (Table 1). Expression length was examined in a mixed-effects model with Age (Older Adults=-1 vs. Younger Adults=1), Competitor condition (Competitor Absent=-1 vs. Competitor Present=1), and their interaction as fixed effects. Older adults (OA) overall produced longer expressions than younger adults (YA) (t=-3.61, p=.001; OA: M=6.02 words SD=5.93 vs. YA: M=3.18 words, SD=2.01). Both age groups produced longer expressions in the Competitor Present condition than in the Competitor Absent condition (t=2.19, p=.036), and the interaction between Age and Competitor was not significant (t=-0.09, p=.925).

Table 1: Average number of words (standard deviation) used to describe each image.

Competitor Condition	Younger Adults	Older Adults
Absent	2.82 (2.06)	5.62 (5.09)
Present	3.36 (1.96)	6.22 (6.30)

Modifier Use We explored the use of modification in the Competitor Present (e.g., competitors differ in their color or state) and Competitor Absent conditions across age groups (Figure 2). The results revealed that both older and younger adults produced modified expressions when modification was required in the Competitor Present condition. Their modification rate was almost at ceiling (OA: 99% vs. YA: 96%). In contrast, in the Competitor Absent condition, older adults produced more modification than younger adults even though it was unnecessary in the discourse context (OA: 87% vs. YA: 72%). The binary measure of modification (i.e., Modified Expression=1, Unmodified Expression=0) was analyzed using a mixed-effects logistic regression model that includes Age (OA=-1 vs. YA=1) and Competitor condition (Competitor Absent=-1 vs. Competitor Present=1), and their interaction as fixed effects. The model revealed significant main effects of Age (z=-2.76, p=.006) and Competitor condition (z=5.02, p<.001). The interaction between Age and Competitor was not significant (z=0.46, p=.642).

Modifier Count We further analyzed the number of modifications used in each expression. Results revealed that older adults produced more modification than younger adults (t=-3.37, p=.001; OA: M=1.61, SD=0.71 vs. YA: M=1.32, SD =0.53). There was a significant main effect of Competitor (t=2.45, p=.02) but not a significant interaction between Age and Competitor condition (t=-0.20, p=.84). This finding was consistent with the results in expression length, suggesting more modifiers used in the referring expressions lead to overall longer expressions.

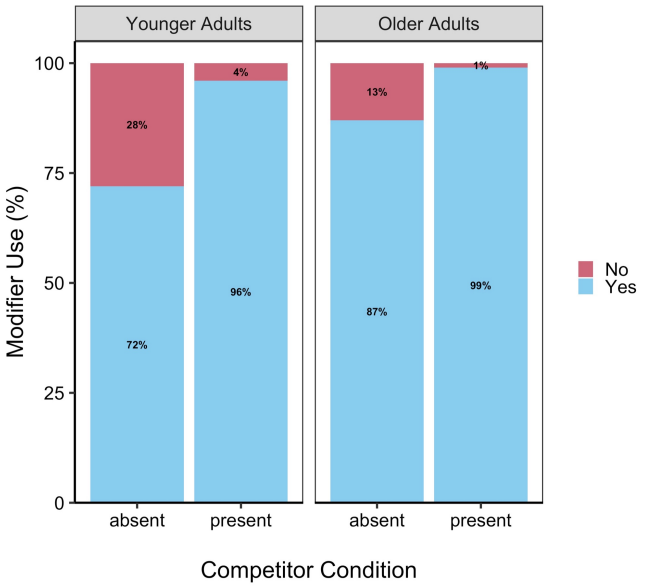

Figure 2: Proportion of modified expressions.

Modifier Position and Type We also explored the characteristics of the modifier in terms of its position and type. As shown in Figure 3, older adults, compared to younger adults, produced more postnominal modifiers (OA: 13% vs. YA: 6%) but fewer prenominal modifiers (OA: 58% vs. YA: 81%). Older adults were also more likely to use both prenominal and postnominal modifiers together (OA: 29% vs. YA:12%).

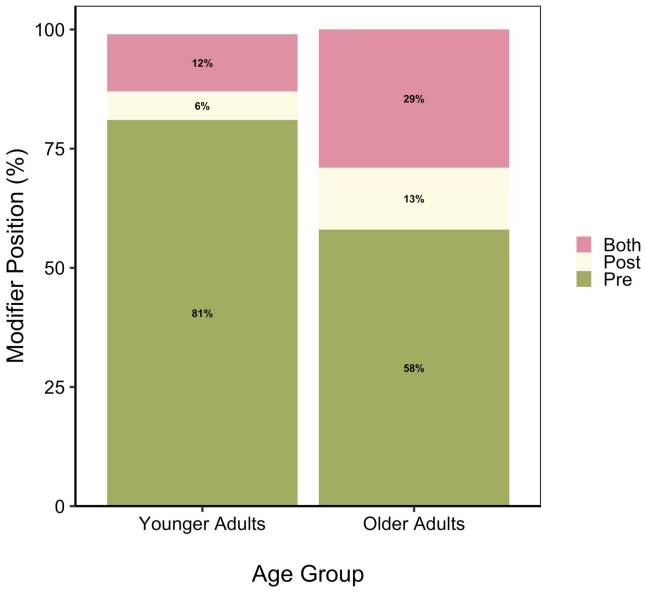

Figure 3: Proportion of modifier position.

Regardless of the conditions we manipulated, we examined modification types that were produced across groups (Figure 4). We examined the first adjectives produced (if there were more than one) because this would reflect the most salient feature that speakers encoded for production. As shown in

Figure 4, both younger and older adults showed similar patterns of using the first modifiers. They used color adjectives most often, followed by state adjectives, and finally other types of adjectives.

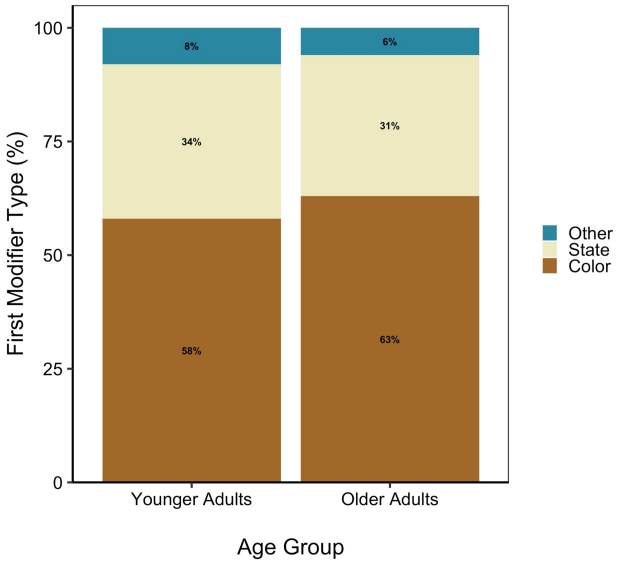

Figure 4: Proportion of the first modifier type.

We then explored each type of modifier type produced to examine whether speakers produced the appropriate type of modifier according to the discourse context (Table 2). All modifiers (not necessarily the first adjective) were included in these analyses. The dependent measure was binary (modifier type used=1, modifier type not used=0). First, we explored whether participants appropriately produced a color adjective. Both older adults and younger adults produced at least one color adjective to differentiate between the target and the competitor for most of the time in the Color Competitor condition (OA: 97% vs. YA: 94%). A mixed-effects logistic regression model examined the effect of Age and Type of Competitor condition manipulation (color vs. state vs. absent). We used competitor type absent as the reference level (Color Modifier Contrast: Absent=-1, Color=1; and State Modifier Contrast: Absent=-1, State=1). As expected, relative to the absent condition, speakers produced more color adjectives in the Color Contrast condition (z=10.87, p<.001) and fewer color adjectives in the State Contrast condition (z=-10.63, p<.001). There was a significant interaction between Age and Color Contrast condition (z=3.61, p<.001) and between Age and State Contrast condition (z=-2.37, p=.018). As seen on Table 2, these results suggest that although both younger and older adults produced appropriate types of modifiers according to the discourse context, younger adults did to a greater extent.

Next, we explored whether or not participants produced state adjectives. The results revealed that speakers across groups produced appropriate state adjectives in the State Competitor condition (OA: 80% vs. YA: 80%), but the overall proportion was lower than the proportion of color adjectives produced in the previous Color use analyses. The mixed-effects model revealed that relative to the absent condition, speakers produced more state adjectives in the State Contrast condition (z=14.67, p<.001) and fewer state adjectives in the Color Contrast condition (z=-9.08, p<.001). There was also a significant interaction between Age and State Contrast condition which seemed to be driven by a higher proportion of State adjectives produced by younger adults than older adults (z=2.69, p=.007).

We also analyzed the trials where both color and state adjectives were produced together. There was a significant Age effect (z=-3.95, p<.001) whereby older adults were more likely to produce both adjectives than younger adults. Further, speakers across groups were more likely to produce both adjectives in the State Contrast condition (z=6.01, p<.001). There were no further interaction effects.

Table 2: Proportion of modifiers produced in each type across conditions.

Competitor Type	Age Group	Color produced	State produced	Both produced
Competitor Absent	YA	0.44	0.11	0.07
	OA	0.46	0.13	0.24
Color Competitor	YA	0.79	0.02	0.15
	OA	0.64	0.03	0.33
State Competitor	YA	0.12	0.52	0.28
	OA	0.17	0.34	0.46

Note. The columns indicate the types of modifiers produced by speakers and the rows indicate the Type of Competitor condition we manipulated. We do not report the proportion of other types of adjectives and thus, the sum of color, state, and both adjectives produced may not equal to 1.

Unexpected Recognition Memory Test

Next, we analyzed the accuracy of target and lure items in the recognition memory test. The accuracy was overall high in both groups, especially for the lure items (OA: 96% vs. YA: 94%). The accuracy of lure items reached ceiling and thus, we only focused on analyzing target items (OA: 94% vs. YA: 85%), which showed more variability.

The target accuracy data were analyzed using a mixed-effects logistic regression model that includes Age (OA=-1 vs. YA=1) and Competitor condition (Competitor Absent=-1 vs. Competitor Present=1), and their interaction as fixed effects. The model revealed a significant main effect of Age (z=-4.15, p<.001), suggesting older adults remembered the target images better than younger adults. The main effect of Competitor condition was marginal (z=1.76, p=.078) and the interaction between Age and Competitor condition was not significant (z=0.12, p=.902).

Language-Memory Interaction

Finally, the interplay between language and memory was explored by testing the effect of the referential form (i.e.,

whether it was modified or not) on memory. In a mixed-effects logistic regression model, Age (OA=-1 vs. YA=1) and Referential Form (Unmodified=-1 vs. Modified=1) during the picture description task and their interaction were included as fixed effects. The dependent measure was binary –whether the response on the memory test was correct or not. The model revealed significant main effects of Age (z=-2.76, p=.006) and Referential Form (z=2.31, p=.021). The interaction between Age and Referential Form was not significant (z=-0.37, p=.709). Older adults had better memory than younger adults and the items described with modifiers were remembered better than the items described with bare noun phrases. This finding suggests that the referential form shapes the mental representation of the referent and affects future memory.

We also examined whether the Modifier Types produced (Color=1, State=-1) during the picture description task influenced younger and older adults' performance in the memory test. However, the mixed-effects model revealed only a significant main effect of Age (z=-2.56, p=.01), suggesting that older adults remembered past referents better than younger adults. The effect of modifier type (z=-0.18, p=0.861) and the interaction between Age and Modifier Type (z=-0.801, p=.423) were not significant.

General Discussion

The present study investigated how speakers described the same referents with respect to the discourse context and the impact of modifier use during object description on later memory across the lifespan. We examined the expression length of referential expressions, modifier use, modifier position and types, recognition memory of the past referents, and the interaction between language and memory. The current findings report a higher proportion of modifier use and longer utterances in older adults than younger adults. These results were in combination with data that indicated older adults used more postnominal modifiers in comparison to younger adults. Surprisingly, older adults displayed greater memory for past referents (despite their potential cognitive aging and memory decline compared to younger adults). Although both groups demonstrated a link between language and memory, showing enhanced memory for objects that had been described by modified expressions versus bare noun phrases during the production task, we did not observe evidence that specific modifier types modulate their future memory.

First of all, participants in our study produced a high modification rate even in the Competitor Absent condition where modification is not necessary for a simple discourse context including only two objects on the screen. One possible explanation for participants producing modifiers during the Competitor Absent condition could be attributed to the online modality of the experiment. Without feedback from a live listener, participants ensured that their utterances were sufficient for their (not-existing) partner to meet their needs, thereby producing longer than expected utterances. This explanation is consistent with previous findings in Van der Wege (2009) that demonstrated speakers' tendency to overspecify more when they imagined an addressee compared to when they interacted with an addressee during a referential communication task.

We also observed that older adults produced more modifiers and thus, had longer expressions than younger adults. This is consistent with previous studies showing a greater rate of overspecification in older adults including prenominal and postnominal modifiers (Healey & Grossman, 2016; Saryazdi et al., 2019; Shekleton, Heller, & Yoon, 2022). The greater incidence of redundancy in older adults could be attributed to their greater motivation to communicate efficiently. Thus, it can be simply a communicative strategy to ensure referential success (Long, et al., 2020).

Lastly, older adults showed better memory performance than younger adults. This was surprising given the cognitive declines across aging that often accompany declines in explicit memory performance (Light & Singh, 1987). Previous studies also reveal that older adults showed declined, or at least comparable, memory performance for past referents and their context compared to the performance of younger adults (Yoon & Stine-Morrow, 2019). The data from this study, showing better memory for older adults, could be due to the encoding time of the participants. Because older adults produced longer expressions and took more time, they could have experienced better encoding of each referent in comparison to younger adults. However, in a previous comprehension study, no relationship was found between longer encoding time during the processing of modified descriptions and the speed of recognition in a memory task (Saryazdi et al., 2022). Thus, it is possible that the enhanced memory is in fact influenced by producing redundant features (consistent with generation and production effect in memory literature) and the extent to which these features highlight more object attributes in memory compared to when modifiers are not produced.

Together, the present study reveals that older adults overspecify more than younger adults and that this has potential benefits for their object memory. We provided evidence of a link between language production and memory. However, further investigation on when and how memory representations are modulated by language is warranted to develop a more unified theoretical framework of cognitive processes that support interdependence between memory and language.

Acknowledgments

This work was supported by National Institutes of Health/National Institute on Aging Grant RO3 AG072236 to Si On Yoon. We thank Adrian Bradley, Saloni Upadhyay, and Abigayle Shekleton for data coding.

References

Bates, D., Mächler, M., Bolker, B. M., & Walker, S. C. (2015). Fitting linear mixed-effects models using lme4. Journal of Statistical Software, 67(1).

https://doi.org/10.18637/jss.v067.i01

Brady, T. F., Konkle, T., Alvarez, G. A., & Oliva, A. (2012). Real-world objects are not represented as bound units: Independent forgetting of different object details from visual memory. *American Psychological Association*. https://doi.org/10.1037/a0029649

Degen, J., Hawkins, R. D., Graf, C., Kreiss, E., & Goodman, N. D. (2020). When redundancy is useful: A Bayesian approach to "overinformative" referring expressions. Psychological Review, 127(4), 591–621. https://doi.org/10.1037/rev0000186

Grice, H. P. (1975). Logic and conversation. In P. Core & J. L. Morgan (Eds.), *Syntax and semantics 3: Speech arts* (pp. 41–58). New York: Academic Press.

Healey, M. L., & Grossman, M. (2016). Social coordination in older adulthood: A dual-process model. Experimental Aging Research, 42(1), 145–164. https://doi.org/10.1080/0361073X.2015.1108691

Heller, D. (2020). The production and comprehension of referring expressions: Definite descriptions. *Language and Linguistic Compass,* 14.

Jara-Ettinger, J., & Rubio-Fernandez, P. (2022). The social basis of referential communication: Speakers construct physical reference based on listeners' expected visual search. *Psychological Review, 129(6), 1394–1413. https://doi.org/10.1037/rev0000345*

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. Journal of Statistical Software, 82(13), 1–26. https://doi.org/10.18637/jss.v082.i13

Light, L. L., & Singh, A. (1987). Implicit and explicit memory in young and older adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13*(4), 531–541.

Long, M., Rohde, H., & Rubio-Fernandez, P. (2020). The pressure to communicate efficiently continues to shape language use later in life. Scientific Reports, 10(1), 1–13. https://doi.org/10.1038/s41598-020-64475-6

Parker, M., & Heller, D. (2019). Overspecifying state information in the production of referring 126 expressions. CUNY Conference on Human Sentence Processing.

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL: https://www.R-project.org/.

Rubio-Fernandez, P. (2016). How redundant are redundant color adjectives? An efficiency-based analysis of color overspecification. Frontiers in Psychology, 7, 1–15. https://doi.org/10.3389/fpsyg.2016.00153

Rubio-Fernandez, P. (2019). Overinformative speakers are cooperative: Revisiting the Gricean Maxim of Quantity. *Cognitive Science, 43(11)*. https://doi.org/10.1111/cogs.12797

Saryazdi, R.**,** Bannon, J., & Chambers, C. G. (2019). Age-related differences in referential production: A multiple-measures study, *Psychology and Aging, 34*(6). 790. https://doi.org/10.1037/pag0000372

Saryazdi, R., & Nuque, J., & Chambers, C. G. (2021). Younger and older speakers' use of linguistic redundancy with a social robot. Proceedings of the Cognitive Science Society, 46(4).

Saryazdi, R., Nuque, J., & Chambers, C. G. (2022). Linguistic redundancy and its effects on younger and older adults' real-time comprehension and memory. *Cognitive Science*, *46*(4). https://doi.org/10.1111/cogs.13123

Sedivy, J.C. (2005). Evaluating explanations for referential context effects: Evidence for Gricean mechanisms in online language interpretation. In J.C. Trueswell & M.K. Tanenhaus (Eds.), *Approaches to Studying World-situated Language Use: Bridging the Language as product and Language as action Traditions* (153-171). Cambridge: MIT Press.

Shekleton, S., Heller, D., & Yoon, S. O. (2022). Sensitivity to prior context in referring expressions across the lifespan. The 35th Annual Conference on Human Sentence Processing, Santa Cruz, CA.

Slamecka, N. J., & Graf, P. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning & Memory, 4,* 592–604.

Tarenskeen, S., Broersma, M., & Geurts, B. (2015). Overspecification of color, pattern, and size: Salience, absoluteness, and consistency. *Frontiers in Psychology*, 6, 1703. https://doi.org/10.3389/fpsyg.2015.01703

Van der Wege, M. M. (2009). Lexical entrainment and lexical differentiation in reference phrase choice. *Journal of Memory and Language, 60,* 448–463.

Yoon, S. O., Benjamin, A. S., & Brown-Schmidt, S. (2016). The historical context in conversation: Lexical differentiation and memory for the discourse history. *Cognition, 154,* 102–117. https://doi.org/10.1016/j.cognition.2016.05.011

Yoon, S. O., Benjamin, A. S., Brown-Schmidt, S. (2021). Referential form and memory for the discourse history. Cognitive Science, 45, e12964. https://doi.org/10.1111/cogs.12964.

Yoon, S. O., & Stine-Morrow, E. A. L. (2019). Evidence of preserved audience design with aging in interactive conversation. *Psychology and Aging, 34(4),* 613–623. https://doi.org/10.1037/pag0000341