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The contribution of discursive and cognitive factors in referential choices made by elderly people during a narrative task

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ABSTRACT

The present study focuses on referential choices made by healthy aged adults during narrative discourse, and their relationship with cognitive and socio-cognitive abilities. Previously, some studies have shown that, compared to young adults, older adults produce more pronouns when referring to various entities during discourse, regardless of the accessibility level of the referent for the addressee. This referential behavior has been interpreted in relation to the decrease of cognitive abilities, such as working memory abilities. There is, as of yet, little empirical evidence highlighting which cognitive competences preferentially support referential choices during discourse production. Here, we focus on three categories of referential markers (indefinite, definite markers and pronouns) produced by 78 participants from 60 to 91 years old. We used a storytelling task enabling us to examine the referential choices made at three discourse stages (introduction, maintaining or shift of the referent in focus) and in increasing levels of referential complexity (one vs two characters, and different vs same gender). In addition to specifically assessing how increasing age influences referential choices, we also examine the contribution of various cognitive and socio-cognitive skills that are presumed to play a specific role in referential choices. We found that both age and specific cognitive abilities (planification, inhibition, and verbal episodic memory) had an effect on referential choices, but that these effects depended on when (at which discourse stage) the referential markers were produced. Overall, our study highlights the complex interplay between discursive and cognitive factors in referential choices made by healthy older speakers.

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1. Introduction

Numerous studies have characterized cognitive changes associated with advancing age. It is currently well documented that healthy elderly people show a decline in episodic memory (Korkki et al., 2020), attention (Zanto & Gazzaley, 2019) and executive functions (Sweeney et al., 2001). While age-related changes in some language functions, such as

word retrieval or complex sentence comprehension, are well known and frequently reported (Payne et al., 2014; Shafto et al., 2007), the effect of cognitive aging on discourse production is still a matter for debate. Over the past 20 years, most of these studies have analyzed discourse in healthy elderly people through various measures assessing the global quality of the narratives (for instance, Beaudreau et al., 2006; Juncos-Rabadán et al., 2005; Marini et al., 2005). Some studies showed that, compared to young adults, healthy elderly participants present difficulties in maintaining global coherence (see Ellis et al., 2016, for a systematic review) and produce less informational content (Capilouto et al., 2005; Marini et al., 2005) and/or lexical diversity (Capilouto et al., 2016). However, other studies reported more positive outcomes. Notably, some studies showed that the discourse measures are not all affected to the same extent by cognitive aging, with an important interindividual variability in the participant performance (Fergadiotis et al., 2011; Kavé & Goral, 2017; Nippold et al., 2014; Pereira et al., 2019; Pistono et al., 2017; Wright & Capilouto, 2009; Wright et al., 2011; Yoon & Stine-Morrow, 2019). In this line of research, recent studies aimed to extract discursive markers enabling a distinction between normal aging and underlying neurodegenerative processes (Faroqi-Sah et al., 2020; Kim et al., 2017; Pistono et al., 2017; Roberts et al., 2021) and therefore, discourse analysis in aging is of growing interest. Surprisingly, studies assessing the relationships between cognitive abilities and discourse profiles are quite rare in elderly individuals, although cognitive changes are pointed out to explain the decrease in discourse abilities. It is therefore of importance to better understand how various cognitive profiles interact with discourse abilities, both for the development of sensitive tools and for clinical practice.

1.1. Referential choices in aging during discourse production

Beyond the analysis of the quality of narratives through various discourse measures, some studies focused more specifically on how elderly people refer to entities during discourse production (Horton & Spieler, 2007; Lysander & Horton, 2012; Saryazdi et al., 2019; Yoon & Stine-Morrow, 2019), which is a major discursive competence enabling successful communication between individuals. Indeed, according to the cognitive models of reference (Ariel, 1990, 2001; Gundel et al., 1993), the speaker's choice of referential marker is expected to be closely connected to the referent accessibility level (low, intermediate and high accessibility) at a given moment in the addressee's discourse representation. Thus, speakers tend to use a full noun-phrase (NP) with an indefinite determiner ("a child") to mention a new referent, whereas pronouns ("he/she") are preferentially used to indicate highly accessible referents (i.e., referents that the addressee can easily retrieve). In the context of a referent with intermediate accessibility, that is to say, when the referent has been previously mentioned but is not currently in the discourse focus, speakers will reintroduce these referents using a wide variety of markers, including definite NPs ("the child"), demonstrative NPs ("this child"), possessive NPs ("his/her child"), and accented pronouns. In accordance with the referent's accessibility level, as assumed by the speaker, this pattern of referential expressions has been observed in many different studies that used a variety of narrative tasks with both children and adults (Achim et al., 2017; Arnold, 2001; Colle et al., 2008; Contemori & Dussias, 2016; Experiment 1; Hendriks et al., 2008, 2014).

Within this framework, two studies by Hendriks et al. (2008, 2014) specifically investigated referential choices by older adults during narrative discourse. Based on a picture storytelling task depicting two characters, the authors focused on the referential markers produced by young and older participants at a specific moment in the discourse, when a previously mentioned referent has to be reintroduced in the discourse focus. The authors expected that participants would produce preferentially definite markers in relation to the intermediate accessibility level of the referent (i.e., a referent already known by the addressee but no longer in the focus of the discourse). They observed that older participants frequently produced pronouns to reintroduce the referent in focus, compared to young adults who produced essentially definite markers. Hendriks et al. (2008, 2014) interpreted this referential behavior in line with a difficulty, for elderly participants, in considering the addressee's perspective and adjust their referential choices accordingly.

1.2. Cognitive and socio-cognitive skills related to referential choices

In a recent theoretical model, Hendriks (2016) proposed which cognitive skills are underlying referential choices and especially, those involved when reintroducing a referent in focus. The author determined three steps by which speakers choose a referential expression in accordance with the accessibility level of the intended referent.

Firstly, speakers select a referent in their discourse representation and, based on its activation in working memory, determine its accessibility level. At the second step, Hendriks argued that speakers select short and efficient referential expressions preferentially, such as pronouns, regardless of the activation level of the referent in the speaker's working memory. It is only at the third and final step that speakers consider the addressee perspective and assess whether the referential expression selected enables the addressee to identify the intended referent. Hendriks (2016) argued that Theory of Mind (ToM) abilities allow the speaker to consider the addressee's perspective and adjust the referential expression accordingly (e.g., by selecting a definite marker rather than a pronoun when the referent is not highly accessible for the addressee). While other studies have already linked ToM abilities with speaker referential choices that are adjusted to the addressee's knowledge of a referent (Achim et al., 2015; Champagne-Lavau et al., 2009; Moreau et al., 2016), Hendriks's model is the first to theorize this relationship within a narrative structure.

To sum up, according to Hendrik's model (Hendriks, 2016), two major cognitive abilities are involved in referential choices: working memory abilities allowing the speaker to keep the referent active in the discourse representation, and ToM abilities that are more specifically involved when the speaker must guide his/her addressee in the selection of the targeted referents, typically when a shift of the character who is in focus occurs. These assumptions, however, are not fully supported by the studies of Hendriks et al. (2008, 2014), as the authors did not find significant relationships between the proportion of pronouns used by elderly participants at the reintroduction of the character and their performance in a working memory task. Moreover, it could be argued that other cognitive abilities might be necessary for the selection of referential expressions during discourse production. For instance, we can expect that some executive competencies related to ToM abilities could also be involved in referential choices. Notably, inhibitory control has

been shown to play a role when individuals have to coordinate different perspectives and suppress their own perspective in order to resolve classic ToM tasks (for instance, Qureshi et al., 2010; Rakoczy et al., 2011).

Sandoz et al. (2020) investigated referential choices made by older adults with and without Alzheimer's disease (AD). Following Fossard et al.'s study (Fossard et al., 2018), they used a storytelling-in-sequence task enabling the assessment of referential choices based on two parameters: the level of referential complexity between the stories (variations in the number of characters depicted, one vs two and, when there are two characters, variations in their gender ambiguity, different vs same gender) and the discourse stages within the stories (introduction, maintaining and shift of the character who is in focus). In addition to the narrative task, Sandoz et al. (2020)'s study considered several cognitive skills in order to assess their relationships with referential choices. The authors showed that various cognitive abilities are linked to referential choices depending on the discourse stages and the participant group, including verbal episodic and working memory, flexibility, planning, and ToM abilities. Regarding more particularly the referential expressions chosen by participants, the authors found that at the shift stage for the levels 2 and 3, pronouns (instead of definite markers) are frequently used by both groups to refer to the character in focus, although in a lesser extent in the control group compared to the AD group.

In sum, studies investigating referential choices made by older adults during discourse production suggest that some changes occur with cognitive aging, characterized by a tendency to produce less informative expressions, such as pronouns, regardless of the referent accessibility level (Hendriks et al., 2008, 2014; Sandoz et al., 2020). These changes have been explained mainly by the decline of cognitive abilities during aging. There are, however, still few evidences highlighting the involvement of specific cognitive processes on referential choices during discourse production in aging, and little is known about how discursive abilities, more particularly referential choices, evolve with increasing age. Indeed, in most studies, older adults were compared to young adults and the studies that have focused specifically on discursive abilities in increasing age showed a decrease in discursive abilities for the oldest aged participants, compared to the youngest of them (Juncos-Rabadán et al., 2005; Mackenzie, 2000; Marini et al., 2005; Pistono et al., 2017). Furthermore, in previous studies assessing referential choices during narrative discourse, the main research focus was on the choices made when a shift of a character occurred within the narrative, yet little is known about referential choices when older speakers introduce or maintain a referent in the discourse focus. Given that linguistic and cognitive constraints change within the dynamic of narratives, it could be expected that various cognitive competences might interact with referential choices, depending on the stage of discourse, as suggested by Sandoz et al. (2020).

To conclude, the present study aims to specifically address how increasing age influence the choices of referential markers in a narrative discourse where the referents have different accessibility levels (low, intermediate, and high accessibility), and to relate these referential choices with cognitive abilities.

2. Objectives of the present study

The objectives of the present study are twofold. Firstly, it aims to provide a better overview of referential abilities in healthy aging participants during a narrative task that allows

to assess referential choices made at specific discourse stages (introduction, maintaining and shift of the character who is in focus), and in increasing level of referential complexity (one vs. two characters and of different vs. same gender).

More precisely, the present study includes a group of elderly participants with a large range of age (from 60 to 91 years old) to explore if increasing age leads to a change in referential choices. In accordance with studies that assessed discursive abilities within a group of elderly participants (Juncos-Rabadán et al., 2005; Mackenzie, 2000; Marini et al., 2005; Pistono et al., 2017), it can be expected that increasing age will influence the specificity of referential markers produced, for instance by a decrease in the production of full NP and a concurrent increase of pronouns. However, the extent of these changes has yet to be determined. Notably, this study aims to identify if increasing age leads to a decrease in the specificity of referential markers irrespectively of the discourse stages, or if these changes occur at a specific discourse stage, for instance, at the reintroduction of a character in the discourse focus (Hendriks et al., 2008, 2014). Furthermore, the effects of age and the discourse stages on referential choices will be assessed according to different levels of referential complexity. To our knowledge, only the study of Sandoz et al. (2020) investigated the referential choices made by elderly participants with and without AD based on stories with different levels of referential complexity (one vs two characters and of different vs same gender). The present study aims therefore to investigate how referential complexity influences referential choices in participants with increasing age.

The second objective of the present study is to better understand which cognitive and/or socio-cognitive abilities support referential choices during discourse production. Recent studies (Kuijper et al., 2015; Sandoz et al., 2020) suggest that, depending on the discourse stages, the production of a privileged marker (e.g., indefinite marker, definite marker, or pronoun) is related to specific cognitive abilities. For instance, and according to Hendriks' theoretical model (Hendriks, 2016), executive abilities (e.g., inhibition and flexibility), as well as Theory of Mind abilities, can be related to the production of definite markers when reintroducing a referent into the discourse focus. However, there is still little evidence of the cognitive skills related to referential choices at other discourse stages in aging. The present study also intends to address this gap.

3. Method

3.1. Participants

Seventy-eight participants (40 women and 38 men) from the French-speaking part of Switzerland, aged from 60 to 91 years old were included in the study (Table 1). The following inclusion criteria were applied: a) being a native French speaker or having French as the language of use; b) having no reported history of cerebral or neurological disorders; c) presenting no uncorrected visual or auditory deficits that could impede the completion of the tasks; d) having no reported history of severe psychiatric disorder and e) presenting a preserved general cognitive profile, assessed with the MoCA (score equal or greater than 26; Nasreddine et al., 2005), to ensure that participants did not demonstrate signs of cognitive decline beyond the normal variability due to age.

The study and participant recruitment were approved by the local ethics committee (Commission cantonale (VD) d'éthique de la recherche sur l'être humain; CER-VD). To

Table 1. Demographic data for all participants (n = 78).

		Mean	Standard Deviation	Min - Max
Age		75.03	7.11	60-91
Education level ^a	Level 1 to 3	2.04	0.76	1-3
General cognitive functioning	MoCA (max 30)	27.60	1.47	26-30

^aEducation level: 1 = 9 years; 2 = 9–12 years; 3 = > 12 years. MoCA = Montreal Cognitive Assessment.

ensure informed consent, participants received written information and had enough time before accepting to participate to the study.

3.2. Materials and procedure

3.2.1. General procedure

Each session followed the same general procedure: participants underwent a cognitive and socio-cognitive assessment before completing the narrative task. About 2 h were required to complete all the tasks. Frequent pauses were included so that participants could rest if they needed. The tasks used and their specific procedure are presented in details below.

3.2.2. The storytelling-in-sequence task (Fossard et al., 2018)

The storytelling-in-sequence task was used to assess referential choices during verbal interaction. The task comprises nine narrative sequences. Each sequence is presented to the participant in size A3 and is composed of six colored images (10 × 11.5 cm) displaying one or two characters performing everyday activities (for instance, going shopping or going camping). The task was designed to assess the effects of two main parameters: the levels of referential complexity of the stories, and the discourse stages.

The levels of referential complexity correspond to the manipulation of the number (one or two) and gender (different or same) of the characters depicted in the sequences (see Figure 1). This manipulation makes it possible to distinguish between three levels of increasing referential complexity, equally distributed across the task (three stories for each level of complexity). The lowest complexity level (level 1) corresponds to sequences displaying a single character (Figure 1A); the intermediate level (level 2), to sequences displaying two characters of different genders (Figure 1B); and the most referentially complex level (level 3), to sequences displaying two characters of the same gender that are therefore ambiguous for reference (for instance, “she” could refer to any of the two female characters in the example of Figure 1C).

The discourse stages refer to the manipulation of the relative visual salience of the characters, combined with their active/passive roles in the sequence of six images. Within each story, the task allows for the distinction between the introduction of a character (image 1 for all levels of referential complexity), the maintaining of the character in focus, which is the second consecutive time the character is active and in the foreground of the picture (images 2 to 6 for the first level of referential complexity and images 2, 4, and 6 for the second and third levels), and the shift of the character who is in focus, where the character moves to the foreground of the picture and becomes active (images 3 and 5 for the second and third levels of referential complexity).

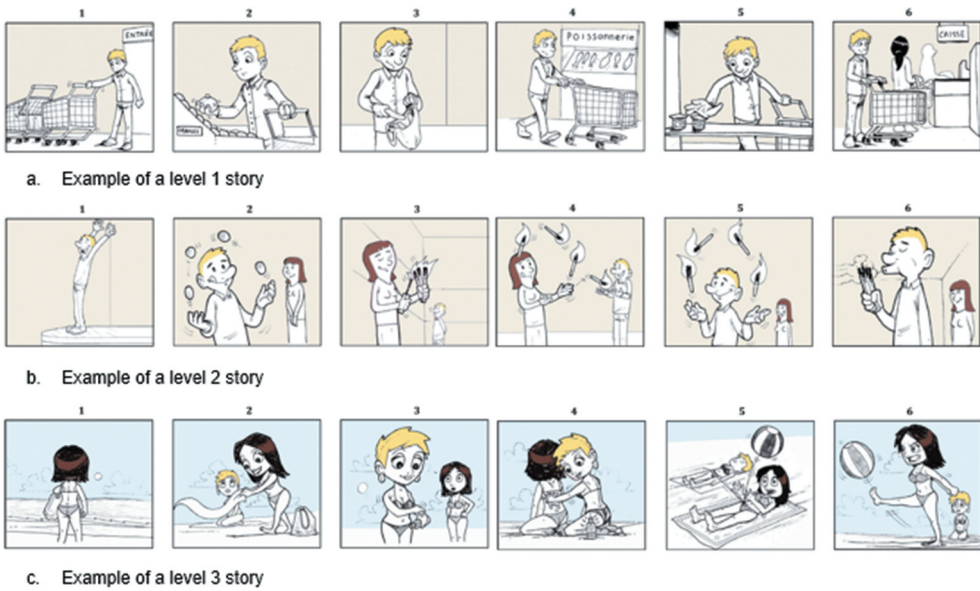


Figure 1. Examples of stories used for the three levels of referential complexity.

The task procedure follows a referential communication paradigm enabling verbal interaction between two partners (see Fossard et al., 2018 for more details). An opaque screen was placed between the two partners to avoid nonverbal communication. The nine sequences were presented in a random order, but each participant started with a level 1 story in order to get familiar with the task. The participants played the role of the speaker narrator whose task was to tell successively each of the stories depicted in the nine sequences to his/her addressee (i.e., the first author of the present study). The addressee had the same set of images but in a random order and had to recreate the story told by the participant by placing each set of six images in the same predetermined order. Feedbacks have been standardized so that the addressee could signal understanding (e.g., “ok”) or to ask for clarification when she could not identify the correct image (e.g., “can you give me more details?”).

3.2.3. Extraction and coding of referential markers

Each story was recorded and then transcribed verbatim. In order to extract referential markers depending on the three discourse stages, all stories were divided into six fragments, corresponding to the six images of the sequences. Within each fragment, we focused on the clause that referred to the character in focus (the character visually in the foreground and performing an action in the image) and we extracted the first marker produced to refer to that character.

One verbatim transcription for the second level of referential complexity is reported below. The referential markers extracted and coded for each fragment (separated by double slashes) are underlined (see Figure 1B for corresponding images). The English translation of the verbatim is in brackets.

« Un homme lève les bras au ciel il a l'air de saluer la foule (a man raises his arms he seems to be greeting the crowd)//dans la deuxième séquence il jongle avec quatre boules ou quatre œufs devant les yeux ébahis d'une collaboratrice d'une compagne (in the second image he is juggling four balls or four eggs in front of an amazed teammate or companion)//ensuite la compagne prend trois torches elle les allume (then the companion takes three torches and she lights them)//et elle les lance au prestidigitateur elle les lance une à une au prestidigitateur (and she throws them to the illusionist she throws them one by one to the illusionist)//les torches sont allumées le prestidigitateur jongle avec ces quatre torches devant le sourire de la compagne (the torches are lit the illusionist is juggling these four torches in front of his smiling companion)//et dans la dernière séquence il éteint les torches en soufflant dessus (and in the last image he is blowing the torches out) »

Three categories of referential markers were created to analyze participant's verbal production. First, indefinite markers (IN) comprised all full NPs that began with an indefinite determiner as in "a young woman." Second, definite markers (D+) included full NPs beginning with a definite ("the young woman"), a demonstrative ("this young woman") and a possessive ("his young woman") determiners. Following Fossard et al. (2018), this category also included demonstrative ("this/that woman") and accented ("and thus, SHE") pronouns. Finally, the category of pronouns (PR) comprised clitic ("she") and zero ("and_lights them") pronouns.

Reliability of the coding (transcription, identification of the critical clause, selection and attribution of the referential marker to one of the three categories) was assessed by a second rater who coded 10% of the verbatim, equally distributed between the three levels of referential complexity. Cohen's Kappa statistic was $k = 0.76$ ($p < .001$), showing a strong agreement between the two raters.

3.2.4. Cognitive and socio cognitive tasks

Given the second objective of the present study, various tasks assessing different cognitive domains were selected in order to have an overview of the participant's cognitive profile.¹ All tasks of the present study were chosen because they are frequently used in clinical practice and research due to their good psychometric properties. More specifically, we focused on tasks that have been validated among an elderly population with good sensitivity in detecting cognitive difficulties.

More specifically, two memory tasks were used: 1) the French adaptation of the Free and Cued Selective Reminding Test (Van der Linden et al., 2004), with the free delayed recall scores as a verbal episodic memory indexes and 2) the Digit Span task from the Wechsler Memory Scale (WMS-IV; Wechsler, 2009), with the span forward as a short-term memory index and the span backward as a working memory index.

Participants also underwent different tasks assessing executive functions: i) the Stroop Victoria (Bayard et al., 2009), with interference scores as inhibition indexes; ii) the Zoo map task from the BADS (Behavioral Assessment of the Dysexecutive Syndrome;

Wilson et al., 1996; see Allain et al., 2005, for a study with elderly participants), with part 1 scores as a planning index; iii) the Category Switching condition of the Verbal Fluency test from the D-KEFS (Delis-Kaplan Executive Function System; Delis et al., 2001; see Wecker et al., 2005, for a study with elderly participants) and the phonemic and semantic fluency tasks (Godefroy, 2008), with the number of words produced as flexibility scores.

When available, we compared participant's scores to normative data, ensuring that all participants were within the normal range of performance.

Theory of Mind (ToM) and perspective taking abilities were also assessed. Perspective taking was assessed using the "perspective taking" subscale from the French adaptation of the Interpersonal Reactivity Index (Gilet et al., 2013). ToM was assessed with a shortened version of the Combined Stories task (COST; Achim et al., 2012; Thibaudeau et al., 2018), from which we retained a subset of 10 ToM stories.

3.3. Statistical analysis

For both of the study's objectives, we conducted separate generalized linear mixed models for each category of referential markers (IN, D+ and PR as dichotomic dependent variables; referential expression present "yes/no") with participants as random effect

(Baayen et al., 2008), using R (R Development Core Team, 2008) and the "lme4" package (Bates et al., 2015). Items were not included as random effects because the task did not contain enough sequences of images. Likelihood ratio tests were systematically used to compare the different models performed (Pinheiro & Bates, 2000). Betas, standard errors and odds ratios (OR) are presented in the results section. Effect size was computed using McFadden pseudo R^2 from deviance (McFadden, 1974) (1 minus the deviance of the model with the fixed effects divided by the deviance of the model without the fixed effects).

For the first objective, two steps were performed to assess the effect of age, the discourse stages and the level of referential complexity on the choices of referential markers. First, we performed one model which included the following independent variables: 1) the discourse stages (introduction, maintaining, and shift); 2) the level of referential complexity (levels 1, 2 and 3); 3) age (continuous variable); and 4) the interaction between the discourse stages and age. Secondly, to assess the interactions between the levels of referential complexity and the discourse stages, we conducted two separate models: in the first model, we compared the presence of one vs two characters (level 1 vs levels 2 and 3) at the introduction and maintaining stages as there was no shift stage for level 1; in the second model, the effect of the different versus same gender of the characters (level 2 vs 3) at the three discourse stages. The following independent variables were included in both models: 1) the discourse stages; 2) age, 3) the level of referential complexity (level 1 vs 2–3 or level 2 vs 3); and 4) the interactions between the level of referential complexity, the discourse stage and age. Note that only the introduction and maintaining stages were included in the model assessing the effect of the number of characters (level 1 vs 2–3), as there is no shift stage in the level 1 stories.

Significant interactions were decomposed using post hoc tests performing Tukey correction for multiple comparisons with the "lsmeans" package (Lenth, 2016). For each model performed, we also assessed random slopes for the discourse stages with likelihood ratio tests.

For the second objective, we performed separate models for each discourse stage (introduction, maintaining, and shift) to assess the involvement of cognitive or socio-cognitive competences on referential choices (IN, D+, and PR; referential expression present "yes/no"). More specifically, a model was conducted for each discourse stage with the referential marker expected as dependent variable (IN at the introduction, PR at

the maintaining, and D+ at the shift stage). Then, for each model, cognitive scores were added as independent variables and were assessed with a likelihood ratio test following a forward stepwise selection. Age was also inserted as independent variable but as it did not change the result of the models assessing the effect of cognitive abilities on referential choices, it was removed from the final models.

4. Results

Descriptive statistics of the participants' scores at the cognitive and socio-cognitive tasks are presented below in Table 2. Exploratory analyses did not show any statistical outlier and all observations were treated in the subsequent analyses.

4.1. Storytelling-in-sequence task

Figure 2 shows the proportion of each referential marker (indefinite (IN); definite (D+) and pronouns (PR) produced at each discourse stages (introduction, maintaining, and shift) according to the three levels of referential complexity.

4.1.1. Indefinite markers (IN)

Table 3 shows the proportion of indefinite markers produced by all participants at each discourse stage and for the three levels of referential complexity.

Results of the likelihood ratio tests are presented in Table 4. They revealed a significant effect of the discourse stages and of the level of complexity but no significant effect of age. None of the interaction tested was significant.

The significant effect of the discourse stages showed that the probability of producing an indefinite marker was higher at the introduction stage than it was at the maintaining ($b = 6.66$ (0.33), $z = 20.23$, $OR = 780.55$, $p < .001$) and the shift stages ($b = 4.04$ (0.20), $z = 20.24$, $OR = 56.83$, $p < .001$). A higher probability of producing an indefinite marker was also observed at the shift stage, compared to the maintaining stage ($b = 2.62$ (0.34), $z = 7.65$, $OR = 13.73$, $p < .001$).

Table 2. Neuropsychological data for all participants ($n = 78$).

		Mean	Standard Deviation	Min - Max
Age		75.03	7.11	60-91
Education level ^a	Level 1 to 3	2.04	0.76	1-3
General cognitive functioning	MoCA (max 30)	27.60	1.47	26-30
Verbal episodic memory	FCSRT Delayed Free Recall (max 16)	11.46	2.71	3-16
Short-term memory	Digit span forward (max 9)	6.02	1.00	4-8
Working memory	Digit span backward (max 8)	4.21	1.19	3-7
Flexibility	Category switching*	13.18	3.33	4-19
	Phonemic fluency	24.70	7.38	11-47
	Semantic fluency	30.88	6.87	17-50
Inhibition	Stroop interference score	2.33	0.79	0.83-6.33
Planning	Zoo map task part A* (max 8)	4.68	2.72	0-8
Perspective taking	Subscale from the IRI* (max 35)	24.43	4.24	15-34
Theory of Mind	Short version of the COST*: (max 20)	16.98	2.83	8-20

Note: ^aNormative data not available. FCSRT= Free and Cued Selective Reminding test; IRI= Interpersonal Reactivity Index; COST= Combined Stories Task.

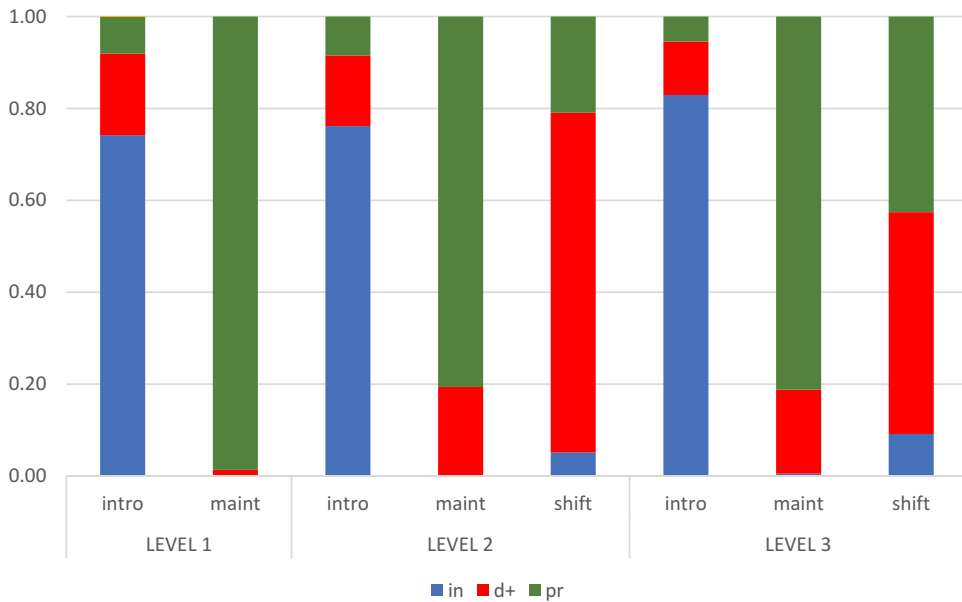


Figure 2. Proportions of referential markers produced (%) at each discourse stage (introduction, maintaining and shift) for the three levels of referential complexity. Intro= introduction; maint = maintaining; in= indefinite; d+= definite, possessive and demonstrative; pr= pronouns.

Table 3. Proportion of indefinite markers produced by all participants at the three discourse stages (introduction, maintaining, and shift) and for the three levels of referential complexity.

	Level 1	Level 2	Level 3
Introduction	0.74	0.76	0.83
Maintaining	0.00	0.00	0.01
Shift	-	0.05	0.09

Table 4. Results of the likelihood ratio tests assessing the effects of the discourse stages and the level of referential complexity on the production of indefinite markers (IN).

Model IN	LRT	p-value
Discourse stages	$\chi^2(2) = 1784.60$	< .001
Level of referential complexity	$\chi^2(2) = 11.11$.003
Effect size Model IN: pseudo R^2	57%	

Note: LRT: likelihood ratio test.

The significant effect of the level of referential complexity indicated, for all discourse stages, a higher probability of producing an indefinite marker at the level 3, compared to level 2 ($b = 0.55$ (0.18), $z = 3.05$, $OR = 1.73$, $p = .006$) and level 1 ($b = 0.53$ (0.21), $z = 2.56$, $OR = 1.7$, $p = .03$). There was no significant difference between the levels 1 and 2 ($b = 0.02$ (0.19), $z = 0.08$, $OR = 1.02$, $p = .99$).

Table 5. Proportion of definite markers produced by all participants at the three discourse stages (introduction, maintaining, and shift) and for the three levels of referential complexity.

	Level 1	Level 2	Level 3
Introduction	0.18	0.15	0.12
Maintaining	0.01	0.19	0.18
Shift	-	0.74	0.48

4.1.2. Definite markers (D+)

Table 5 shows the proportion of definite markers (definite, possessive, and demonstrative markers) produced by all participants at each discourse stage and for the three levels of referential complexity.

Results of the likelihood ratio tests are presented in Table 6. They revealed a significant effect of the discourse stages, the level of referential complexity, and a significant effect of age.

As presented in Table 6, the interaction between age and the discourse stages was significant. Decomposition revealed that increasing age was related to a decrease in the probability of producing a definite marker at the shift stage, compared to the maintaining (b = -0.03 (0.01), $z = -2.06$, $OR = 0.97$, $p = .004$) and the introduction stages (b = -0.07

(0.02), $z = -3.55$, $OR = 0.93$, $p < .001$). As age increased, a decrease in the probability of producing definite markers was also observed at the introduction stage, compared to the maintaining stage (b = -0.06 (0.03), $z = -1.99$, $OR = 0.94$, $p = .002$).

A significant interaction between the level of referential complexity and the discourse stages was observed as an effect of the presence of one vs two characters (level 1 vs levels 2 and 3). It revealed that there was a higher probability of producing definite markers at the maintaining stage for the levels 2 and 3, than at the level 1 (respectively, b = 3.22 (0.40), $z = 7.96$, $OR = 25.03$, $p < .001$; b = 3.06 (0.40), $z = 7.53$; $OR = 21.33$, $p < .001$). No significant interaction was observed for the effect of gender (different vs same gender; level 2 vs level 3).

Table 6. Results of the likelihood ratio tests assessing the effects of age, the discourse stages, the level of referential complexity, and the interactions between these variables on the production of definite markers (DP).

Model DP	LRT	p-value
Discourse stages	$\chi^2(2) = 359.04$	< .001
Level of referential complexity	$\chi^2(2) = 15.21$	< .001
Age	$\chi^2(2) = 10.85$	< .001
Effect size Model DP: pseudo R^2	11%	
Model DP-a : Model DP + interaction	LRT	p-value
Age * Discourse stages	$\chi^2(1) = 9.59$	< .001
Effect size Model DP-a: pseudo R^2	46%	
Model DP-b: Model DP (-shift stage) + interaction	LRT	p-value
Discourse stages* Level of referential complexity (level 1vs levels 2-3)	$\chi^2(2) = 75.67$	< .001
Effect size Model DP-b: pseudo R^2	48%	

Note: LRT: likelihood ratio test.

Table 7. Proportion of pronouns produced by all participants at the three discourse stages (introduction, maintaining, and shift) for the three levels of referential complexity.

	Level 1	Level 2	Level 3
Introduction	0.08	0.08	0.05
Maintaining	0.99	0.81	0.81
Shift	-	0.21	0.43

4.1.3. Pronouns (PR)

Table 7 shows the proportion of pronouns produced by all participants at each discourse stage and for the three levels of referential complexity.

Results of the likelihood ratio tests are presented in Table 8. They revealed a significant effect of the discourse stages, the level of referential complexity, and a significant effect of age.

As for the definite markers, the interaction between age and the discourse stages was significant, reflecting that when age increases, there is a decrease in the probability of producing preferentially pronouns at the maintaining stage, compared to the shift stage ($b = -0.04$ (0.01), $z = -2.98$, $OR = 0.96$, $p = .002$).

An effect of the number of the characters (one vs two characters; level 1 vs levels 2 and 3) on the discourse stages was also observed. The decomposition of the interaction indicated that there was a higher probability of producing pronouns at the maintaining stage for the level 1 than for the levels 2 and 3 (respectively, $b = 1.48$ (0.32), $z = 4.57$, $OR = 4.39$, $p < .001$; $b = 1.30$ (0.32), $z = 3.99$, $OR = 3.67$, $p < .001$).

Finally, a significant interaction between the level of referential complexity and the discourse stages was observed as an effect of the gender of the characters (different vs same gender; level 2 vs 3). It showed an increase in the probability of producing pronouns at the shift stage for level 3 than for level 2 ($b = 1.13$ (0.30), $z = 3.71$, $OR = 3.09$, $p < .001$).

Table 8. Results of the likelihood ratio tests assessing the effects of age, the discourse stages, the level of referential complexity, and the interactions between these variables on the production of pronouns (PR).

Model PR	LRT	p-value
Discourse stages	$X^2(2) = 165$	$p < .001$
Level of referential complexity	$X^2(2) = 14.51$	$p < .001$
Age	$X^2(1) = 6.34$	$p < .001$
Effect size Model PR: pseudo R^2	32%	
Model PR-a : Model PR + interaction	LRT	p-value
Age * Discourse stages	$X^2(2) = 10.30$	$p = .005$
Effect size Model PR-a: pseudo R^2	34%	
Model PR-b: Model PR (-shift stage) + interaction		
Discourse stages* Level of referential complexity (level 1 vs levels 2-3)	$X^2(2) = 13.76$	$p = .001$
Effect size Model PR-b: pseudo R^2	38%	
Model PR-c : Model PR (- level 1) + interaction		
Discourse stages* Level of referential complexity (level 2 vs level 3)	$X^2(2) = 29.11$	$p < .001$
Effect size Model PR-c: pseudo R^2	25%	

Note: LRT: likelihood ratio test.

4.1.4. Cognitive and socio cognitive skills related to referential choices

At the introduction stage, only an effect of the level of education was observed on the probability of producing an indefinite marker ($X^2(1) = 7.12, p = .007, \text{pseudo } R^2 = .01$). This result indicated that there was a higher probability of producing an indefinite when the level of education increased ($b = 0.70 (0.27), z = 2.57, OR = 2.01, p = .001$).

At the maintaining stage, the performance at the planification task contributed significantly to the model ($X^2(1) = 6.43, p = .001, \text{pseudo } R^2 = .003$), with higher scores at this task related to a higher probability of producing pronouns ($b = 0.09 (0.03), z = 2.52, OR = 1.09, p = .012$).

Finally, at the shift stage, the likelihood ratio tests indicated an effect of two cognitive competences on the probability of producing definite markers. Results showed that a decrease in inhibition scores² ($X^2(1) = 12.59, p < .001, \text{pseudo } R^2 = .013$) and an increase in verbal episodic memory scores ($X^2(1) = 15.75, p < .001, \text{pseudo } R^2 = .005$) were both significantly related to a higher probability of producing definite markers at this stage (respectively, $b = -0.25 (0.12), z = -1.96, OR = 0.77, p = .05$; $b = 0.23 (0.09), z = 2.35, OR = 0.79, p = .02$).

Given that participants used frequently pronouns at the shift stage (about 30% for the two levels of referential complexity), we performed a supplementary analysis that revealed similar, although inverse results. Indeed, we observed a higher probability of producing pronouns that was significantly related to an increase of inhibition scores ($X^2(1) = 13.57, p < .001, \text{pseudo } R^2 = .016$; $b = 0.31 (0.12), z = 2.55, OR = 1.36, p < .001$) and a decrease in episodic verbal memory scores ($X^2(1) = 11.58 (1), p < .001, \text{pseudo } R^2 = .013$; $b = -0.04 (0.02), z = -2.08, OR = 0.96, p < .001$).

5. Discussion

5.1. The effects of age, discourse stages and levels of referential complexity on referential choices

The present study aimed to examine referential choices made by healthy elderly participants using a storytelling task enabling verbal interaction between two partners. The first objective of the study was to assess the variation of referential markers produced according to three discourse stages (introduction, maintaining, and shift of the referent who is in focus) and in increasing levels of referential complexity (level 1: one character; level 2: two characters of different genders; and level 3: two characters of the same gender). Analyses were performed on three categories of referential markers that were expected at the three discourse stages (indefinite at the introduction; pronouns at the maintaining; definite at the shift stage) (Fossard et al., 2018; Sandoz et al., 2020).

First of all, results showed a significant effect of the discourse stages, which replicated what was previously observed in younger adults (Fossard et al., 2018) and adults with AD (Sandoz et al., 2020). Indeed, production of indefinite markers was favored when introducing a new character, while pronouns were mainly used to maintain a character in focus. For the shift of the character who is in focus, participants produced preferentially definite markers, in line with the intermediate accessibility level of the referent at that stage. However, regarding the production of definite markers and pronouns, we also found that

the effect of the discourse stage was modulated by age, suggesting that increasing age has an effect on referential choices. More particularly, older participants tended to produce less definite markers and more pronouns at the shift stage, compared to the other stages. Our study thus showed that age lead to a decrease in the specificity of the use of referential markers, in relation to the discourse stages. Our results complete those of Hendriks et al. (2008, 2014) which focused solely on the comparison of referential choices between young and older participants at each discourse stage separately. In the present study, the comparisons of the referential choices made between the discourse stages refined our understanding of the effect of aging: although elderly participants adjusted their referential choices according to the discourse stages, they tended to decrease this adjustment with increasing age, and especially at the shift stage.

The first objective of the study also aimed to assess the effect of the referential complexity of the stories on referential choices. Results showed that the number of characters influenced referential choices at the maintaining stage. Indeed, compared to the stories with one character, participants produced less pronouns and more definite markers at this stage when the stories involved two characters. This observation, also in line with those of Sandoz et al. (2020), has been explained by a competitive effect between the characters (Arnold & Griffin, 2007; Contemori & Dussias, 2016; Fukumura et al., 2010): The presence of a second character in the background may decrease the accessibility of the active referent in the speaker's model of discourse and consequently, participants tended to use referential markers typically used for less accessible referents. Finally, another effect of referential complexity was observed by an increase of pronouns at the shift stage for the complexity level 3, compared to the level 2. As mentioned above, there is a significant effect of age on the markers produced at the shift stage, indicating that when age increases, a decrease in the probability of producing a definite marker at the shift stage is observed, compared to the other stages. However, as the interaction between age, the discourse stages and the levels of referential complexity did not reach significance, we cannot conclude that the increase of pronouns observed at the shift stage for the complexity level 3 is led by the oldest participants.

5.2. Cognitive and socio-cognitive skills related to referential choices

The second objective of the present study was to investigate the cognitive and socio-cognitive skills related to referential choices. In general terms, we observed that each discourse stage involved specific cognitive competences for the production of the expected marker (indefinite at the introduction, pronoun at the maintaining, and definite at the shift stage), suggesting that different mechanisms are involved during the selection of referential markers during discourse. Notably, at the shift stage, we found that two cognitive abilities are related to referential choices. The involvement of inhibition abilities with the production of definite markers and pronouns could be understood within the theoretical framework of Hendriks (2016; see also Kuijper et al., 2015). As exposed in the introduction, the author argues that executive competences are required to produce a referential marker that corresponds to the intermediate level of the referent's accessibility in the addressee's memory (such as definite markers for instance). In our study, the involvement of inhibition could therefore indicate that participants had to suppress their own point of view in order to consider the addressee's perspective. We did not find,

however, a significant involvement of ToM and/or perspective taking abilities, as it has been suggested by Hendriks (2016). A possible explanation lies in the different settings of the storytelling task, compared to the tasks used to assess ToM and perspective taking abilities. In both the latter, the participant is put in a hypothetical situation in which he/she has to project himself/herself and/or infer the mental state of fictitious protagonists, whereas in the storytelling task, the participant is involved in a real interaction. According to some authors, ToM abilities during real interpersonal exchange does not necessary require inferential abilities about the mental state of the partner (see for instance, Galati & Brennan, 2010; Moreau et al., 2016), abilities that are typically assessed by “classical” ToM tasks. These differences could therefore be responsible for the lack of significant relationships between the three tasks in the present study.

Furthermore, regarding the shift stage, we observed an effect of episodic verbal memory on the production of definite markers, as well as on the production of pronouns but with an inverse effect (a good performance in the episodic verbal memory task increases the probability of producing definite markers, whereas it decreases the probability of producing pronouns at this stage). Although most research has preferentially linked referential abilities with working memory capacity (for instance, Vogels et al., 2015), there is a growing interest in the study of the relationships between declarative memory and language processing, and especially its role in flexible use of language (for a review, see for instance Duff & Brown-Schmidt, 2017). Within this framework of research, two functions of the declarative memory system are crucial for language use. Firstly, declarative memory supports construction and integration of various representations, as a result of a verbal interaction for instance (spatial and temporal context, as well as information about a specific partner and previous verbal exchanges). Secondly, it also supports flexible uses of these representations during discourse and/or interactional language use, allowing the speaker to tailor various aspects of language to his/her addressee (Duff & Brown-Schmidt, 2012; Rubin et al., 2014). In this context, it has been shown that referential choices are related to the efficiency of declarative memory processes (Duff et al., 2011; Horton & Spieler, 2007). Moreover, in Sandoz et al.’s study (Sandoz et al., 2020), the involvement of episodic verbal memory in referential choices at the maintaining stage was also observed for all participants (healthy elderly and AD adults), suggesting that episodic verbal memory might have an important role in referential choices in the elderly population.

Concerning the maintenance of the character in focus, we found a significant effect of planning abilities on pronoun production, a result that was also found in the Sandoz et al.’s study (Sandoz et al., 2020). In the Hendrik’s model (Hendriks, 2016), because at this stage the referent is highly accessible for both the speaker and the addressee, there is no specific prediction about the cognitive abilities related to referential choice. However, it could be argued that at this stage, there is a need to indicate that a specific referent has to be maintained in the discourse focus and therefore, pronoun use can also be driven by cognitive ability. In the present study, its association with planning abilities could reflect the participants’ capacity to guide their addressee to maintain his focus on the intended referent. Finally, at the introduction stage, only the education level showed a significant effect on the production of indefinite markers, suggesting that beginning a story with an indefinite marker seems to be more related to individual experiences than to cognitive abilities. In addition, we observed that indefinite markers are almost exclusively produced

at the introduction stage, contrary to definite markers and pronouns that are used in a more flexible manner all along the narratives. Indefinite markers could be less supported by cognitive abilities, as their use is essentially limited to introducing a new referent.

6. Limitations

A main limitation of our study includes the sample size that did not allow us to perform finer analyses on the interactions between the parameters of the narrative task and the cognitive and socio-cognitive competences related to referential choices. As we performed separated analysis for each discourse stage to assess the effect of cognitive and socio-cognitive skills on the choice of referential markers, we could not include in our models the levels of referential complexity, nor the interaction between the referential complexity and the score at a cognitive task due to the reduced number of observations. It would be interesting however to investigate if, depending on the referential complexity of the stories, there is a greater involvement of some specific cognitive abilities (e.g., inhibition) on the choice of a referential marker at a given discourse stage. Further research is needed to refine our understanding of the interplay between discursive and cognitive factors on the choice of referential markers during discourse.

Another limitation concerns the characteristic of our sample that comprises mainly participants between 70 and 85 years old. Indeed, due to the difficulty of recruiting adults with advanced age who meet the inclusion criteria, the group includes about 7% of participants over 85 years old. A larger sample of oldest old participants would have allowed us to strengthen our results regarding the effect of increasing age on referential choices.

7. Conclusion

Overall, the present study contributes to a better understanding of referential choices in aging. Firstly, our results highlight the importance of assessing referential choices during real verbal interactions and according to different discourse stages. As was also claimed by Hendriks et al. (2008, 2014), the modulation of referential choices, according to the accessibility of the referent, is a discursive competence that is sensitive to cognitive aging. The results obtained in this study show that the effects of cognitive aging are subtle. Indeed, advancing age seems to reduce the specificity of referential markers produced when we compare the choices made at the maintaining and the shift stages. However, we also observed that globally, the expected marker is mainly produced at each discourse stage (indefinite at introduction, pronouns at maintaining, and definite at shift stage). These two main results provide a better overview of referential abilities in cognitive aging. Moreover, this study is the first to point out that referential choices in aging are also influenced by the referential complexity of the stories, suggesting a complex interaction between different discursive factors. Future research could use a similar strategy that combines the referential complexity of the stories with the discourse stages, for instance, to identify different referential profiles associated with particular cognitive states (e.g., neurodegenerative diseases or acquired neurological disorders).

The present study also highlights the diversity of the cognitive processes related to referential choices during narratives, allowing the refinement of current theoretical

assumptions. Notably, few studies have focused on the discursive function of pronouns and our results suggest that their selection for maintaining a referent in focus could be a marker of discourse planning. Furthermore, besides executive abilities, the present study also showed that episodic verbal memory may have an important role in the flexible use of referential markers during discourse. Narrative discourse analysis could therefore provide additional information for clinical purposes as it would enable us to shed light on the integrity of cognitive competences during an ecological task (Kim et al., 2017; Pistono et al., 2017; Roberts et al., 2021).

Notes

1. The cognitive and socio-cognitive tasks were presented in a pseudo random order between participants. Indeed, there were few possible orders to present the cognitive and socio-cognitive tasks to our participants as we had to be careful that some tasks (for instance, verbal tasks) did not interfere with other tasks (for instance, the verbal episodic memory task).
2. To note, a low score in the inhibition task indicates good inhibition skills.

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