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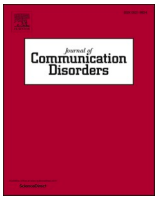

Pragmatic and narrative decline in healthy aging: a multilevel assessment of their interplay

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ABSTRACT

Introduction: Effective communication in aging is supported by both narrative and pragmatic abilities, which are known to undergo declines in healthy older adults. Traditional language assessments may overlook these changes, especially in multimodal and ecologically valid communicative contexts. This study investigates the structure and interplay of narrative and pragmatic abilities in aging by integrating multilevel discourse analysis and the Assessment Battery for Communication (ABaCo).

Methods: Forty-four healthy Italian-speaking old adults aged 65 to 86 years took part in the study. Participants completed a narrative production task based on visual stimuli, analyzed through multilevel discourse analysis to extract measures of productivity, informativeness, and coherence. Pragmatic production was assessed using the ABaCo battery. Two separate Principal Component Analyses (PCAs) identified latent components in narrative and pragmatic domains. Pearson correlations assessed interrelations between these components.

Results: Narrative analysis revealed two components: "*Narrative Information Organization Difficulties*" (coherence errors, lexical informativeness) and "*Narrative Productivity*" (word fluency, word count). ABaCo subscales loaded onto a single component, "*Communicative-pragmatic efficiency in production*". A significant negative correlation was found between narrative organization difficulties and pragmatic efficiency ($r = -.469$, $p = .001$), while no significant correlation emerged between narrative productivity and pragmatic efficiency.

Discussion: Findings support a partially overlapping structure between narrative and pragmatic competence in aging. Pragmatic efficiency relates specifically to lexical informativeness and coherence, rather than raw verbal productivity. This distinction highlights the clinical relevance of multimodal and integrative assessments, such as ABaCo, in identifying early communicative decline. Joint assessment of narrative and pragmatic dimensions offers a comprehensive approach to profiling communicative functioning in aging.

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1. Introduction

Human communication is a complex social activity that involves the integration of linguistic, pragmatic, and narrative abilities. It is a cooperative process (Grice, 1989) in which individuals construct meaning together through language, context, and inference (Bara, 2010; Bara & Tirassa, 2010). Through pragmatic competence, speakers can appropriately use language (Levinson, 1983) and other expressive means (Bara, 2010; Holler & Levinson, 2019) to convey information within a given social context. Their narrative production abilities, by contrast, allow them to construct and convey coherent and structured accounts of events. This includes organizing information in a temporally and causally logical sequence and maintaining topic coherence.

Growing evidence suggests that both pragmatic and narrative discourse production skills are significantly affected by healthy aging (e.g., Bambini et al., 2021; Baraldi & Domaneschi, 2024; Hilviu et al., 2022; Marini et al., 2025; Gabbatore et al., 2025a). For example, Baraldi and Domaneschi (2024) demonstrated that aging is associated with a general decline in pragmatic ability, with impairments more evident in comprehension than in production. Their findings revealed that elderly individuals performed significantly worse than younger adults on both the Assessment of Pragmatic Abilities and Cognitive Substrates total score (APACS; Arcara & Bambini, 2016) and the pragmatic comprehension composite score, suggesting that age-related pragmatic difficulties can be particularly salient in tasks requiring discourse interpretation, inference of non-literal meanings, and understanding of verbal humor. Research has shown that healthy aging affects language production rather than comprehension (Marini & Andreetta, 2016; Thornton & Light, 2006). Recent evidence suggests that narrative discourse production skills are affected by healthy aging, with significant negative effects on the ability to produce coherent and informative narratives (Hilviu et al., 2025; Juncos-Rabadán et al., 2005; Marini et al., 2025; Pistono et al., 2017; Sherratt & Bryan, 2019). Furthermore, healthy older individuals may have also weakened grammatical production skills (D'Ortenzio et al., 2025), reduced lexical diversity (Petriglia et al., 2025), and even diminished abilities to express subjectivity and describe emotions while producing samples of narrative discourse (Gallo et al., 2025).

Given the rapidly increasing rate of population aging worldwide, it is necessary to investigate the nature and progression of age-related changes induced by advanced age. Understanding such variations can inform clinical practices, interventions, and social policies aimed at supporting older adults. However, traditional neuropsychological assessments of language skills (e.g., the Token Test [De Renzi & Vignolo, 1962] or the Aachener Aphasie Test [AAT; Huber et al., 1984]) may not be able to detect the subtle declines in pragmatic and narrative functioning associated with aging. Therefore, it is crucial to explore the advantages of using ecologically valid assessment tools that may better reflect the complexity of real-life communication (see Angeleri et al., 2012; Bosco et al., 2012; Holland et al., 1999).

Considering the assessment of pragmatic skills, pragmatics has traditionally been defined with a primary focus on linguistic content, often overlooking additional expressive means that have more recently been recognized as integral to communicative competence. Recent research has emphasized a multimodal perspective, involving a comprehensive assessment of extralinguistic and paralinguistic resources (Bara, 2010; Bosco & Gabbatore, 2025; Hilviu et al., 2022; Holler & Levinson, 2019; McNamara & Durso, 2003). Extralinguistic means refer to non-verbal elements such as gestures, facial expressions, and body posture, which play a crucial role in modulating and supporting verbal communication (Anolli, 2005). Paralinguistic aspects include prosodic features such as intonation, rhythm, and stress patterns, which significantly contribute to the interpretation of speaker intentions and emotional states. As highlighted by Bara and Tirassa (2010), the integration of these modalities is essential for successful social interactions, as pragmatic competence relies on the dynamic interplay between verbal and non-verbal channels. This was demonstrated by Hilviu et al. (2022) who showed that younger adults outperformed older participants on overall pragmatic performance, including extralinguistic and paralinguistic skills, as well as in social appropriateness. Unfortunately, for Italian language the available batteries of tests usually focus on verbal-linguistic aspects and only partially address other key domains of pragmatic functioning, such as extralinguistic cues, prosodic modulation, contextual appropriateness, and conversational management; few exceptions that include also some items regarding nonverbal communication are BLED Santa Lucia (Rinaldi et al., 2006) and the Italian adaptation of the Montréal Communication Evaluation Protocol (MEC; Joanette et al., 2004; Tavano et al., 2013). To overcome these limitations, the present study adopts the Assessment Battery for Communication (ABaCo; Angeleri et al., 2012), which systematically evaluates different expressive means (linguistic, extralinguistic, paralinguistic) in addition to contextual sensitivity, across both comprehension and production. This battery is widely used and empirically validated in both clinical and research settings, especially with adult clinical populations such as individuals with acquired brain injury (Angeleri et al., 2008; Bosco et al., 2017; Bosco et al., 2018a; Parola et al., 2016), schizophrenia (Colle et al., 2013; Parola et al., 2021), and Autism Spectrum Disorders (Loukusa et al., 2023; Angeleri et al., 2016), including telehealth applications (Traetta et al., 2025). Some ABaCo scales have also been adapted to English (Davis et al., 2016), Finnish (Gabbatore et al., 2019), Serbian (Đorđević et al., 2016), and Portuguese (Agrela et al., 2020) cultural contexts.

Regarding narrative production skills, allowing for the simultaneous assessment of both micro- and macro-linguistic dimensions of linguistic production (Kintsch & Van Dijk, 1978; Marini et al., 2011; Marini & Carlomagno, 2004) multilevel procedures of discourse production analysis are effective in capturing the subtle effects determined by healthy aging on narrative production abilities (e.g., Marini et al., 2011). Micro-linguistic aspects include intra-sentential features such as lexical access, morphosyntactic processing, and grammatical accuracy. Macro-linguistic aspects refer to the organization and coherence of discourse at a higher level, including the pragmatic and thematic structuring of narrative content across multiple utterances (Marini, 2023). Such integrated procedure of discourse analysis offers higher ecological validity than traditional tests that assess specific linguistic functions without considering their cooperation in the context of linguistic production. In a recent investigation on a large cohort of adults, Marini et al. (2025) used this procedure of discourse analysis to explore linear and non-linear changes induced by healthy aging on discourse production abilities. Among other things, this study revealed that three measures particularly critical for efficient discourse production (i.e., the ability to produce informative words or *lexical informativeness*, and the production of coherence errors at both local and global levels)

are significantly affected by healthy aging. Furthermore, the authors also found that measures of linguistic productivity (i.e., words and speech rate) were explained by a single component (i.e., Productivity skills) whereas measures of lexical informativeness, semantic errors production, and narrative disorganization (in terms of percentages of errors of local and global coherence) were explained by another component (i.e., Semantic-Coherence breakdown).

Theoretically, ABaCo and the procedure of multilevel discourse analysis approach the same domain (i.e., communicative-pragmatic competence) from distinct perspectives that, in our opinion, should be assessed in an integrated way to have a clear understanding of how healthy aging affects linguistic, extralinguistic, and paralinguistic skills when producing narrative discourse. Specifically, this study was designed to explicitly assess whether the information obtained by administering ABaCo and performing discourse analysis allows to obtain coherent information about the impact of aging on communicative production abilities. To do so, we first aimed to confirm the presence of different components for productivity skills and narrative disorganization (Research Question 1, RQ1). In line with this, we expected that the narrative measures included in this study would confirm the existence of distinct components reflecting productivity skills and coherence breakdown. We also aimed to investigate if the ABaCo production subscales can be explained by one or more components potentially reflecting multimodal pragmatic abilities (RQ2). Finally, we explored to what extent the components whose existence we aimed to confirm for narrative production (RQ1) and identify for ABaCo pragmatic production (RQ2) are associated with each other, suggesting shared or modality-specific contributions to communicative competence (RQ3). Namely, we hypothesized that pragmatic skills would be related to narrative efficiency in terms of narrative organization and informativeness rather than to mere productivity skills. By addressing these questions, we aimed to refine the ecological and clinical relevance of communication assessment in aging, and to better characterize the shared and unique contributions of narrative and pragmatic dimensions in detecting early communicative decline.

2. Materials and methods

2.1. Participants

Forty-four Italian-speaking older healthy adults aged 65 to 86 years were included in this study (see Table 1). Inclusion criteria were the absence of neurological or neuropsychiatric diseases, as well as above the cutoff performance on the Italian version of the Montreal Cognitive Assessment (MoCA; Conti et al., 2015) and on the short version of the Token test (De Renzi & Vignolo, 1962). They were also required to produce at least 100 words during narrative task.

All participants were thoroughly informed about the purpose and procedures of the study and provided written consent to participate in accordance with ethical guidelines. The study was approved by the Bio-Ethical Committee of the University of Turin (Protocol 202174).

2.2. Multilevel discourse analysis

Narrative samples were collected through presentation of three picture stimuli: a single-picture scenes, the “Picnic” from the Western Aphasia Battery (Kertesz, 1982) as well as two cartoon-picture sequences, the “Flowerpot” by Huber and Gleber (1982) and the “Nest Story” by Paradis (1987). Pictures were always visible to the subject and were not shared with the examiner as indicated by the criteria outlined in Marini et al. (2011). The narratives were audio-recorded and then later transcribed by using a semi-automatic procedure developed by one of the authors (F.P.), which formatted the transcripts for automatic data transfer into our database. Every transcript corresponds to a single story told by a subject. A Python script was designed to extract text from audio through Whisper large-v3 model and then to annotate automatically every word with its Part Of Speech (POS) through the spaCy Python library. The transcripts were reviewed and amended by experienced reviewers after listening to the audio files. Final transcripts files were coded in a CHAT-like format (MacWhinney, 2000) and included meta-data (e.g. duration in seconds of the story), a Universal POS Tag labeling and a personalized labeling for the multilevel discourse analysis. In addition to the usual POS tagging (e.g. nouns, verbs, pronouns), the personalized labeling includes potential phonological fillers, pauses, false starts, phonological errors, and neologisms. Every line of the file represented a different utterance, segmented according to four major criteria described by Marini et al. (2011). In this study, we mainly focused on five specific measures derived by the multilevel discourse analysis. These provided information about the participants’ production levels (in terms of words and speech rate), narrative organization (calculating percentages of local coherence and global coherence errors), and informativeness (deriving a percentage of lexical informativeness). The word count included all

Table 1
General information about the participants. Data are presented as means with standard deviations in parentheses. For sex, the number of females is reported along with the corresponding percentage in parentheses.

	Participants (N= 44)
Age	74.89 (6.59)
Years of formal education	11.18 (4.29)
Sex	F= 9 (42.86 %)
MoCA score	23.19 (2.15)
Token Test score (short version)	4.96 (0.15)

phonologically well-formed lexical items, excluding phonological paraphasias, false starts, or neologisms. In our cohort no phonological paraphasias or neologisms were produced. The word count was used to compute speech rate, calculated dividing the number of words by total production time. To assess narrative organization, percentages of local coherence and global coherence errors were calculated. Errors of local coherence included the abrupt interruptions of the ongoing utterance and the shift to a different topic in the following utterance. They also included instances of words with no clear referents. The percentage of local coherence errors was calculated by dividing the number of such errors by the number of utterances and multiplying by 100. Errors of global coherence include the production of tangential, semantically unrelated, filler or repeated utterances. The *percentage of global coherence errors* was calculated by dividing the number of these errors by the total number of utterances and multiplying by 100. Finally, *lexical informativeness* was calculated by dividing the number of informative words (i.e., error-free words) by the total number of words multiplied by 100. Lexical informativeness reflects the speakers' ability to convey meaningful information during narrative production (Marini & Urgesi, 2012).

Narrative measures were calculated across the three narrative stories for every participant. Successively an average score for every measure was calculated. The scoring procedures were performed by two expert raters. An interrater reliability analysis using the Kappa statistic was performed to determine consistency among raters. The two expert raters reached a high inter-rater reliability.

2.3. Assessment battery for communication

The Assessment Battery for Communication (ABaCo; Angeleri et al., 2012, 2015) is a validated assessment tool of 172 items, consisting of vis-à-vis interactions and short videoclips on various communicative phenomena. The items composing ABaCo are organized in five evaluation scales, i.e., Linguistic, Extralinguistic, Paralinguistic, Contextual, and Conversational, focusing on a wide range of communicative acts e.g., direct and indirect communicative act, irony and deceit. Each scale assesses both comprehension and production abilities, with the only exception of the conversation scale where, for the nature of the ability investigated, these two processes can't be strictly distinguished. Administration and scoring procedures are detailed in the ABaCo's manual (Angeleri et al., 2015): each administration is video recorded, with the participant's authorization, to enable offline scoring. The responses at each ABaCo's item may be coded 0 (wrong) or 1 (correct answer), resulting in a global pragmatic performance (ABaCo total score), a composite score for comprehension and production abilities, respectively, and a performance score for each of the five scales (Linguistic, Extralinguistic, Paralinguistic, Contextual and Conversational). ABaCo has good psychometric properties (Angeleri et al., 2012) and has proven effective and sensitive in assessing pragmatic ability in a number of clinical conditions (e.g., Bosco et al., 2017, 2019; Gabbatore et al., 2014; Parola et al., 2016). More details on the scales composing ABaCo as well as examples of items are provided in Hilviu et al. (2022) and in Gabbatore et al. (2025b).

As the multilevel discourse analysis focuses exclusively on productive aspects, in this study we limited our analysis to the production subscales of ABaCo. This alignment ensures conceptual and methodological coherence between the two sets of measures.

2.4. Data analysis

Descriptive statistics were computed for all measures of narrative and pragmatic performance. To address RQ1, two separate Principal Component Analyses (PCAs) were carried out: one on multilevel narrative indicators, and one on the ABaCo production subscales (RQ2), in order to identify latent components underlying performance in each domain. To address RQ3, Pearson correlations were computed between the extracted components from the two PCA models, exploring potential associations between narrative and pragmatic dimensions of communicative functioning. All analyses were conducted using JASP (version 0.19; JASP Team, 2025), and results were interpreted using a significance threshold of $p < .05$.

3. Results

3.1. PCA – narrative variables (RQ1)

The means and standard deviations of the narrative scores obtained by the participants are shown in Table 2. To explore the relationships among narrative-level linguistic measures, the narrative variables were subjected to PCA. The Kaiser-Meyer-Olkin (KMO) measure was 0.586. Bartlett's Test of Sphericity was statistically significant ($\chi^2_{(10)} = 111.603$, $p < .001$), supporting the factorability of the correlation matrix. The PCA yielded two components with eigenvalues greater than 1. Parallel analysis confirmed the retention of

Table 2
Participants' narrative scores. Data are presented as means with standard deviations in parentheses.

Narrative variables	Performance scores
Words	95.19 (42.63)
Speech rate	132.20 (21.82)
% Local coherence errors	25.32 (14.09)
% Global coherence errors	14.23 (9.27)
% Lexical informativeness	78.10 (10.87)

these two components, as their eigenvalues exceeded those derived from randomly generated data. Together, these two components accounted for 75.70 % of the total variance.

The first component accounted for 49.80 % of the total variance and was defined by positive loadings from *% Global coherence errors* (0.935), *% Local coherence errors* (0.804), and a strong negative loading from *% Lexical informativeness* (–.957). This pattern suggests a breakdown in information organization, with higher coherence errors and lower informativeness marking reduced narrative efficiency. The second component accounted for 26 % of the total variance and loaded positively on Speech rate (0.647) and negatively on Total Words (–.816). This component reflects narrative productivity, capturing aspects related to the quantity of verbal output.

These two dimensions were labelled "*Narrative Information Organization Difficulties"* and "*Narrative Productivity*" and were subsequently used in correlational analyses to investigate their relationship with components extracted from ABaCo in the second PCA.

3.2. PCA – ABaCo production subscales (RQ2)

The means and standard deviations of the ABaCo scores obtained by the participants are shown in Table 3. To explore the underlying structure of ABaCo production subscales, a second PCA was performed. The KMO measure of sampling adequacy was 0.615 and Bartlett's Test of Sphericity was statistically significant ($\chi^2_{(6)} = 13.800$, $p = .032$), supporting the factorability of the data.

The PCA revealed one component with an eigenvalue greater than 1. Parallel analysis confirmed the retention of a single factor. This component accounted for 42.8 % of the total variance in the rotated solution. All four subscales loaded moderately to strongly on this component, suggesting a unified latent construct. Linguistic scale registered a loading of 0.657, Extralinguistic 0.778, Paralinguistic 0.641 and Contextual 0.511. This component likely reflects an integrated multimodal production factor, encompassing both verbal and nonverbal dimensions of pragmatic communication. Uniqueness values ranged from 0.394 (Extralinguistic) to 0.738 (Contextual), indicating varying but meaningful contributions of each subscale to the overall structure. This single component was named "*Communicative-pragmatic efficiency*".

3.3. Components correlation (RQ3)

To examine the relationship between latent dimensions of pragmatic production and narrative performance, Pearson correlations were calculated between the component obtained from the two PCAs (see Fig. 1). Specifically, the association between the "*Communicative-pragmatic efficiency*" component and the two narrative components, "*Narrative Information Organization Difficulties"* and "*Narrative Productivity*", were examined.

Results showed a significant negative correlation between the ABaCo pragmatic efficiency component and the narrative disorganization component ($r = –.469$, $p = .001$). No significant correlation emerged between the ABaCo pragmatic production component and narrative productivity ($r = –.214$, $p = .162$), indicating that the amount of verbal output is not closely linked to pragmatic communicative competence as assessed by ABaCo.

4. Discussion

The present study aimed to explore the latent structure of two complementary domains of communicative functioning in healthy aging - multimodal pragmatic ability and narrative production skills - and to examine the extent to which they are interrelated. Overall, the findings support a multidimensional yet partially overlapping organization of narrative and pragmatic performance in late adulthood.

Considering the first research question, the PCA on indicators extracted from the multilevel discourse analysis framework confirmed the existence of two components: *Narrative Information Organization Difficulties* (represented by coherence errors and lexical informativeness), and *Narrative Productivity* (Speech rate and Total Words). This aligns with what reported in Marini et al. (2025) as these two components accounted for over 75 % of the total variance, indicating that they represent a meaningful decomposition of narrative functioning. Notably, the first component reflects not only coherence errors but also a marked reduction in the ability to convey relevant information. This aligns with previous literature highlighting age-related impairments in discourse macrostructure and informativeness (Marini et al., 2025).

Regarding the second research question, the PCA on ABaCo production subscales yielded a single latent component, i.e., pragmatic ability, which captured shared variance across linguistic, extralinguistic, paralinguistic, and contextual subdomains. The identification of this component, labelled *Communicative-pragmatic efficiency*, aligns with theoretical models that emphasize the integrative and multimodal nature of pragmatics, independently from the expressive means used to realize it. These results provide new insight on the

Table 3
Participants' scores at ABaCo's production subscales. Data are presented as means with standard deviations in parentheses.

ABaCo subscales	Performance scores
Linguistic production	.75 (0.13)
Extralinguistic production	.66 (0.18)
Paralinguistic production	.77 (0.15)
Contextual production	.81 (0.26)

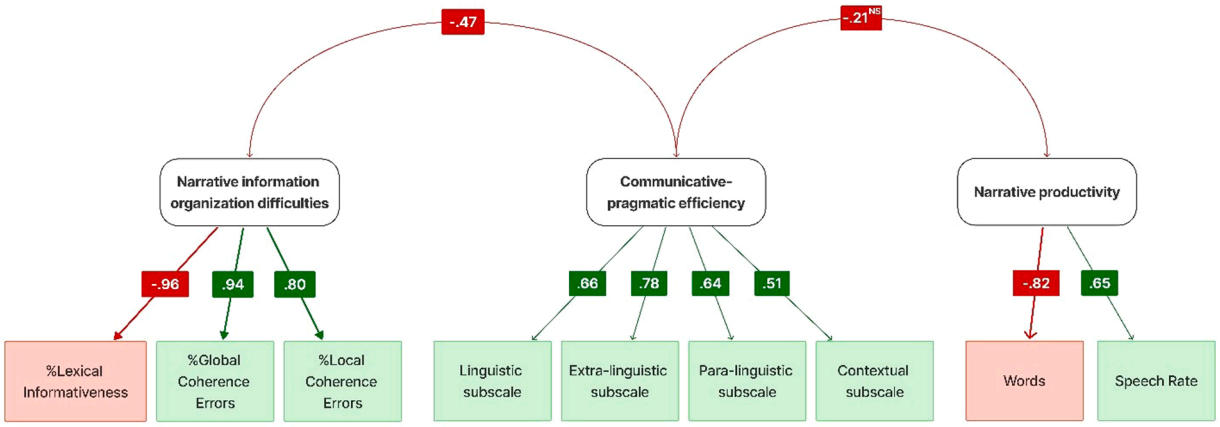

Fig. 1. Correlations between the three components identified using PCA and the loadings of each narrative or pragmatic measure on each component. Positive correlations are shown in green and negative correlations in red. Arrows represent the direction and magnitude of the relationships among components and between components and measures.

effectiveness of ABaCo in detecting strengths and weaknesses in healthy aging, with a particular attention to linguistic production. It is noteworthy that the ABaCo has already highlighted the need for a multimodal approach when assessing pragmatic ability in various clinical populations, such as individuals with traumatic brain injury (Angeleri et al., 2008), schizophrenia (Colle et al., 2013), and right (Parola et al., 2016) or left (Gabbatore et al., 2014) hemisphere brain damage. In these studies, the assessment of the different expressive means composing pragmatic ability made it possible to identify specific strengths and difficulties for each clinical profile, with important clinical implications for planning treatments and intervention programs. At the same time, the present data align with previous studies showing that ABaCo has good internal consistency when administered to healthy adults (Angeleri et al., 2012), as well as to individuals with traumatic brain injury (Angeleri et al., 2008; Bosco et al., 2017) and even to children, in its adapted version (Bosco et al., 2013).

Addressing the third research question, we tested whether the pragmatic component extracted from ABaCo would be more strongly associated with narrative measures reflecting communicative effectiveness (i.e., informativeness and coherence errors) than with mere productivity (i.e., number of words or fluency rate). This hypothesis was supported by the results: the pragmatic component showed a moderate negative correlation with the *Narrative Information Organization Difficulties* component, indicating that higher pragmatic productive efficiency is associated with fewer coherence errors and greater lexical informativeness in narrative production. In contrast, no significant association was found between pragmatic efficiency and the *Narrative Productivity* component. This dissociation supports the validity of ABaCo, which was designed to assess communicative-pragmatic effectiveness rather than mere verbal productivity, underscoring its specificity in capturing functionally and ecologically relevant aspects of communication.

These results may have both theoretical and clinical implications. Theoretically, they provide empirical support for the view that narrative and pragmatic ability in aging, while distinct, converge on shared inferential and coherence-based components. Clinically, this study offers a novel contribution by directly comparing pragmatic and narrative indicators extracted from the same cohort of participants, showing how distinct tools capture complementary dimensions of communicative competence.

The correlational pattern observed between Communicative-pragmatic efficiency and Narrative Information Organization Difficulties provides an insight into the relationship between pragmatic and narrative functioning in aging. The moderate negative association between the two components indicates that participants showing lower pragmatic efficiency tend also to produce narratives characterized by a higher proportion of global and local coherence errors and lower lexical informativeness. In other words, poorer multimodal pragmatic competence parallels reduced ability to organize and convey information coherently at the discourse level. This convergence suggests that the two domains, although assessed through different tasks and modalities, rely on shared mechanisms.

Importantly, the absence of a significant correlation between Communicative-pragmatic efficiency and Narrative Productivity confirms that these relationships are not driven by general verbal output or fluency, but by qualitative aspects of discourse organization and informativeness.

This pattern outlines a functional coupling between pragmatic integration and narrative macrostructure: difficulties in managing communicative intent and contextual adaptation (as captured by ABaCo) correspond to reduced capacity to sustain topic coherence across the narrative task. The data therefore support the view that age-related changes in discourse are rooted not in language form, but in higher-order cognitive-pragmatic integration processes.

These findings further reinforce the potential utility of tools like ABaCo not only as diagnostic instruments but also as sensitive outcome measures in the context of interventions targeting communicative-pragmatic functioning. When used alongside structured narrative analysis, ABaCo can contribute to a more granular understanding of which components of communication are selectively affected by aging. This dual-level assessment approach may support the identification of specific targets for intervention, such as difficulties in maintaining coherence or using paralinguistic cues, while also providing a reliable framework for monitoring changes over time. In this sense, ABaCo may serve as a valuable reference in the design and evaluation of evidence-based programs aimed at

supporting pragmatic functioning. Such programs should aim to address pragmatic ability from a multimodal perspective, encompassing all aspects of communicative competence. Ideal activities in this direction should address the appropriate, coherent, and organized use of language, as well as the integration of other expressive means – namely, paralinguistic cues and communicative gestures – together with specific training to improve adherence to the context in which the communicative interaction occurs, that is, social appropriateness.

A successful attempt in this direction has been made in recent years by the training programs grounded in the Cognitive Pragmatics framework like Cognitive Pragmatic Training (CPT; Gabbatore et al., 2015; Bosco et al., 2016, 2022). The multimodal and comprehensive structure of the CPT enables improvement at both pragmatic and narrative levels in a number of clinical populations, such as adolescents with autism specturm disorders (Hilviu et al., 2023), and individuals with brain injury (Parola et al., 2019), also supporting their improvement in functional aspects of communication (Bosco et al., 2018b). Recently, in light of new evidence based on the value of joint assessment of narrative and pragmatic dimensions, the same approach is being developed for healthy aging; a newly adapted, advanced, version of the CPT has been specifically designed for older adults (see Gabbatore et al., 2025c), thus filling a gap in research and clinical practice regarding multimodal communicative training programs. The ultimate aim of such interventions is to improve and strengthen participants' ability to navigate social interactions in daily life, thus contributing to reduced isolation, increased emotional well-being and social integration, and overall quality of life.

While further research is needed, these preliminary results suggest that the instruments discussed in the present study, i.e., multimodal pragmatic and narrative production assessments, may help delineate which aspects of communication are most responsive to training and which may benefit from preventive strategies to sustain functional interaction in aging populations.

5. Conclusions and future directions

This study provided clear answers to our research questions. Addressing RQ1, the Principal Component Analysis on narrative variables confirmed the presence of two distinct yet complementary dimensions of narrative performance: Narrative Information Organization Difficulties, reflecting coherence breakdown and reduced informativeness, and Narrative Productivity, reflecting quantitative fluency and word output. Concerning RQ2, the PCA of ABaCo production subscales revealed a single component of Communicative-pragmatic efficiency, encompassing linguistic, extralinguistic, paralinguistic, and contextual dimensions. This supports the notion of pragmatics as an integrated multimodal construct, consistent with the Cognitive Pragmatic framework (Bara et al., 2010). The observed dissociation between narrative productivity and pragmatic efficiency (RQ3), highlights the clinical value of assessing coherence and informativeness in discourse, especially as early markers of decline. Future research could explore the joint application of this dual approach in clinical populations. Such integration holds promise for enhancing diagnostic accuracy and rehabilitation practices, particularly in contexts where traditional linguistic assessments may be insufficient. For individuals with neurodegenerative or acquired brain conditions this combined methodology may offer a more detailed profile of communicative functioning. Furthermore, it could support the development of personalized interventions targeting not only language form but also the functional and interactive dimensions of communication.

In conclusion, these findings support the hypothesis that pragmatic and narrative skills, although distinct aspects of language production, share some critical features that are necessary to produce efficient and communicatively adequate samples of narrative discourse. Furthermore, they confirm the usefulness of ABaCo in capturing critical aspects of communicative efficacy. Future research should explore the combined application of this dual approach in clinical populations. In our view, such integration represents an important asset for enhancing diagnostic accuracy and the effectiveness of rehabilitation programs, particularly in contexts where traditional linguistic assessments fail to detect subtle communicative difficulties. For individuals with neurodegenerative or acquired brain conditions, this combined methodology may offer a more detailed profile of communicative functioning. As a direct consequence, it could support the development of personalized rehabilitative and enhancement interventions targeting not only language form, but also the functional, multimodal, and interactive dimensions of communication.

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Ethics approval and consent to participate

Ethics approval and consent to participate The Bio-Ethical Committee of the University of Turin approved the study (Protocol N. 202174). All participants signed the informed consent form and gave their written permission.

Availability of data and materials

The datasets generated during and/or analyzed during the current study are not publicly available for privacy or ethical restrictions; however, they will be available from the corresponding author on reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used InstaText in order to improve the readability and language of the manuscript. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

CRediT authorship contribution statement

F. Petriglia: Writing – original draft, Formal analysis. **A. Marini:** Writing – original draft, Supervision, Funding acquisition, Formal analysis, Conceptualization. **I. Gabbatore:** Writing – original draft, Methodology, Funding acquisition, Data curation. **F.M. Bosco:** Writing – original draft, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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