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CIU and main event analyses of the structured discourse of older and younger adults

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Abstract

Correct information unit (CIU) and main event analyses are quantitative measures for analyzing discourse of individuals with aphasia. Comparative data from healthy younger (YG) and older (OD) adults and an investigation of the influence of stimuli type would considerably extend the usefulness of such analyses. The objectives were (a) to compare discourse ability of younger and older healthy adults, and (b) to investigate influence of stimuli type on performance. Seventeen younger and 17 older healthy adults participated. Language samples obtained were analyzed for CIU and proportion of main events. Results indicated the YG group produced more accurate, relevant, and informative content than the OD group, and participants expressed more main events in response to sequential picture stimuli, regardless of age. We conclude that clinicians should consider stimuli type when measuring discourse ability. Age should also be considered when comparing performance of adults with brain damage to that of healthy adults.
Learning outcomes: The reader will be able to: (a) recognize the importance of obtaining information about discourse performance in both older and younger healthy adults; (b) identify the purposes of CIU analysis and main event analysis for examining discourse; and (c) appreciate the potential influences of different language elicitation procedures on the discourse obtained from a task.
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1. Introduction

Structured discourse analyses serve as a potential tool for monitoring changes in the connected speech of individuals with aphasia (Craig et al., 1993; Nicholas & Brookshire, 1993; Yorkston & Beukelman, 1980). Several quantitative measures are available for monitoring these changes, including Yorkston and Beukelman's (1980) content unit analysis, Nicholas and Brookshire's (1993) correct information unit (CIU) analysis and Nicholas and Brookshire's (1995) rule-based system for scoring main concepts in connected speech.

Nicholas and Brookshire (1993) developed the CIU analysis; defining a correct information unit as being relevant to the stimulus and informative. CIU analysis includes words per minute (WPM), correct information units per minute (CIUpm), and percentage of CIUs (%CIUs; total CIUs/total words × 100). Nicholas and Brookshire described %CIUs as an indicator of the informativeness of structured discourse. They reported that CIUpm was the most sensitive measure for discriminating adults with and without aphasia; however, the three measures could be used collectively to provide information about the informativeness and efficiency of a person's discourse.

Nicholas and Brookshire (1995) expanded their approach to discourse analysis by developing a rule-based system for scoring *main* concepts in discourse. They conceded that a limitation of CIU analysis was that it did not allow investigation of the relative importance of participants' CIUs to a story as a whole. That is, CIU analysis alone did not take into account that some events and relationships between events are more critical to a story than others. In addition, they noted that CIU analysis did not provide information about main ideas omitted from participants' versions of the stories. Their results suggested that adults with aphasia were less able to tell the complete story portrayed in the pictures. They also reported that accuracy of main concepts in the connected speech of adults with aphasia could be reliably scored and performance was reasonably stable across sessions.

1.1. Normative data on discourse measures

Other authors have employed these measures, emphasizing their clinical usefulness (Craig et al., 1993; Ross & Wertz, 2001). They have been applied repeatedly to clinical populations; yet normative data for the measures are limited. Consequently, analyses of structured discourse are usually interpreted descriptively, rather than with reference to groups of adults with normal language. Arguably, without information about the performance of adults with normal language, clinical application of these discourse measures is considerably restricted.

Moreover, prior investigations have demonstrated that narrative discourse skill changes with age, and although the direction of findings has generally favored younger adults (Benjamin, 1988; Kemper, 1987; Kemper, Kynette, Rash, O'Brien, & Sprott, 1989; Kynette & Kemper, 1986; North, Ulatowska, Macaluso-Haynes, & Bell, 1986; Ulatowska, Hayashi, Cannito, & Fleming, 1986), some studies report an advantage of advanced age (James, Burke, Austin, & Hulme, 1998; Kemper, Rash, Kynette, & Norman, 1990). If discourse skill changes with age, then identifying ways in which performance changes relative to CIU and main event analyses is critical for clinical use. Though stroke is more

prevalent in older adults, young adults are susceptible to brain damage, as well. As such, normative reference data are needed for both younger and older adults.

1.2. Influence of stimulus type

The impact of various language elicitation stimuli has also been of interest in the study of the structured discourse of individuals with aphasia. The stimuli used to elicit language have been shown to impact performance (e.g., Coelho, 2002; Cooper, 1990; Liles, Coelho, Duffy, & Zalagens, 1989). For example, Coelho (2002) found that individuals with and without closed head injury (CHI) produced fewer episodes during a story generation task with a single picture stimulus, compared to a story retelling task with sequential pictures; the task with the single picture was more challenging for participants. In contrast, Potechin, Nicholas, and Brookshire (1987) compared two types of story productions produced by individuals with aphasia: a single picture stimulus (Cookie Theft) and a picture sequence (wordless book). The authors found no difference in efficiency and informativeness of productions across stimulus types. They did, however, find that participants produced significantly longer language samples for the picture sequence. The participants with aphasia were similar across stimulus type in their accuracy in identifying the characters and actions in the pictures.

Van Dijk and Kintsch (1983) have suggested that one way speakers establish main ideas in conversation is by communicating the relations and causal links among units of information. An important aspect that has not been addressed in previous studies of the discourse abilities of individuals with aphasia is these individuals' abilities to convey these relationships and causal connections between ideas.

The purpose of this study, then, was twofold: (a) to compare the discourse ability of younger and older healthy adults as measured by CIU analysis and main event analysis, and (b) to investigate the influence of stimuli type on the CIU and main event production of younger and older healthy adults. Moreover, the study was intended to extend previous findings by examining the extent to which *relations* between main events (as opposed to just a listing of discrete events) were expressed in adults' discourse.

2. Methods

2.1. Participants

Thirty-four neurologically intact adults participated in the study. Participants were separated into two groups, younger (YG) and older (OD), with 17 participants in each group. The YG group included eight women and nine men and the OD group included 12 woman and five men. The mean ages for the YG and OD groups were 22.4 (S.D. = 2.2) and 71.4 (S.D. = 8.2), respectively. Mean years of education completed for the YG and OD groups were 14.7 (S.D. = 1.7) and 15.0 (S.D. = 2.4), respectively. Groups differed significantly in age, $t(16) = 23.57$, $p < .001$, but not in years of education completed, $t(16) = 43$, $p = .67$. Additionally, all participants passed a hearing screening and reported no previous neurological episodes or conditions.

2.2. Language elicitation and transcription

Participants' language samples consisted of four story-tellings using the procedures and stimuli described by Nicholas and Brookshire (1993). Two *single* pictures "depicted a story-like situation with a central focus and interactions among pictured elements" (Nicholas & Brookshire, 1993, p. 339). Two picture *sequences* each consisted of six frames that also conveyed a story. For the purpose of this study the pictures are referred to as follows: Birthday Cake (single picture), Cat in Tree (single picture), Fight (picture sequence), and Directions (picture sequence). The samples were audio recorded, then orthographically transcribed. A trained graduate research assistant transcribed a random selection of samples a second time to establish transcription agreement; in each case, word-by-word agreement was greater than 95%.

2.3. Experimental procedures

Participants performed the experimental tasks in a single session. Participants provided examiners with their demographic and medical history information and then completed each of the story-telling tasks from which the language samples were collected. Order of picture presentation was randomized across participants. Each picture or picture sequence was placed on a table in front of the participant. The examiner instructed the participant to talk about what was going on in the picture(s). If a participant stopped after 15 s or less, he or she was prompted with "Can you tell me more?" No other instructions were given. These procedures were repeated for each stimulus item.

2.4. Language analyses

2.4.1. CIU analyses

Participants' language samples were subjected to the three analyses developed by Nicholas and Brookshire (1993): WPM, CIUpm, and percent of CIUs produced (%CIUs). Nicholas and Brookshire's rules for scoring words and CIUs, as well as the formulas for determining WPM, CIUpm, and %CIUs produced, were followed. For each of these analyses, the four narratives were combined resulting in a single score for WPM, CIUpm, and %CIUs for each participant.

2.4.2. Proportion of main events

As a measure of the content of participants' story telling, each sample was evaluated for the proportion of main events included. However, our definition of a main event differed from that of Nicholas and Brookshire (1995). Their main concept definition stipulated the inclusion of only a single main verb. Because of this restriction, the main concepts identified in their study generally did not convey relationships between characters and events. That is, participants could be given credit for producing accurate main concepts even when they were unable to convey an understanding of the relationships between concepts. Consequently, we chose to broaden this definition, in keeping with the Van Dijk and Kintsch's (1983) idea of a main event, which acknowledges the importance of expressing relationships between ideas.

Prior to this analysis, the three investigators independently reviewed each set of picture stimuli and provided a list of the main events for each story. Lists were then compared, and a final list of main events was compiled. An event was included in the final list if at least two of the three investigators listed it as an independent event. A *main event*, then, was operationally defined as an event that at least two of the three judges agreed on (a) its importance to the story as a whole and (b) its independence from the other events in the story. When the wording of an event was slightly different across investigators, but the content was the same, all wordings were included in the final list. This procedure was intended to (a) retain only the *main* events of each picture set while eliminating those that were less central, and (b) allow for subtle variations in interpretation or wording of an aspect of the picture. The main events employed for each picture are listed in Appendix A. This procedure of comparing participants' events to a list of predetermined events in each story is similar to that of Nicholas and Brookshire (1995), as well as other investigations within the child language literature (e.g., Chappell, 1980).

2.5. Reliability measures

Inter- and intra-rater agreement for word and CIU counts were determined for the samples collected from the participants. A graduate student assistant rescored 30% of the OD group's samples and 53% of the YG group's samples. Inter-rater agreement for number of words and CIUs was calculated as (total agreements/[total agreements + total disagreements] $\times$ 100). Inter-rater agreement for word and CIU counts for the OD group were 91% and 91%, respectively, and for the YG group were 89% and 94%, respectively. Intra-rater agreements for word and CIU counts were 95% and 94%, respectively, for the OD group and 94% and 98%, respectively, for the YG group.

3. Results

3.1. Comparison of younger and older healthy adults

Statistical analyses were conducted to determine if the YG and OD groups differed for CIUs and proportion of main events produced. Three mixed analyses of variance (ANOVA) were performed with the CIU data. The mixed ANOVAs included group (OD, YG) by picture stimulus (Birthday Cake, Cat in Tree, Fight, Directions) for WPM, CIUpm, and %CIUs. Group main effects for the ANOVAs indicated that the YG and OD groups did not differ significantly for WPM, $F(1, 31) = .077$, $p = .78$, and CIUpm, $F(1, 31) = 2.21$, $p = .15$, but did differ significantly for %CIUs, $F(1, 32) = 5.93$, $p < .05$. The YG group's discourse resulted in significantly higher %CIUs, compared to the OD group. Group WPM, CIUpm, and %CIUs are reported in Table 1.

Main event analysis
Preliminary inspection of the main event data revealed that the mean ratio of main events produced by participants to the total number of main events was higher for the YG group ($M = .67$, S.D. = .12) than the OD group ($M = .59$, S.D. = .20). A mixed ANOVA of

Table 1
Means (S.D.s) and ranges for %CIUs, WPM, and CIUpm for the groups

	Group					
	Younger group			Older group		
	%CIUs	WPM	CIUpm	%CIUs	WPM	CIUpm
Birthday Cake						
Mean (S.D.)	.893 (043)	163.3 (37.7)	146.5 (34.3)	.794–.123	157.5 (26.6)	127.6 (30.08)
Range	.810–.98	83.3–232.3	71.7–209.7	.500–.920	116.04–195.2	72.4–181
Cat in the Tree						
Mean (S.D.)	.848 (.078)	175.55 (41.8)	148.1 (39.6)	.798–.144	167.37 (25.09)	134.3 (31.2)
Range	.700–.960	85.7–246.4	60–197.8	.380–.900	120.4–208.4	65–177.1
Fight						
Mean (S.D.)	.824 (.092)	151.2 (37.3)	124.6 (29.1)	.789 (.117)	159.3 (27.4)	126.1 (31.7)
Range	.650–1.00	69.6–213.2	54.3–195.8	.550–.960	117.7–210	72.03–190
Directions						
Mean (S.D.)	.813 (.066)	150.2 (37.06)	123.5 (30.8)	.742 (.100)	142.17 (21.06)	105.8 (21.02)
Range	.700–.900	67.7–224.5	59.7–186.00	.610–.970	80.2–174.5	61.5–155.9
Total						
Mean (S.D.)	.841 (.048)	157.7 (35.3)	132.5 (29.4)	.781 (.089)	154.9 (18.7)	119.6 (19.3)
Range	.750–.920	75.9–214.7	62.1–193.6	.630–.910	118.4–184.3	88.9–151.6

group (OD, YG) by picture stimulus (Birthday Cake, Cat in Tree, Fight, Directions) was performed. Results indicated that the group main effect was not significant, $F(1, 3) = 2.65$, $p = .05$.

3.2. Influence of stimulus type

Influence of stimulus type on the CIU measures and the proportion of main events were determined. From the mixed ANOVAs performed with the CIU data, the picture stimulus main effects were significant for WPM, $F(3, 96) = 11.19$, $p < .0001$, CIUpm, $F(3, 96) = 11.08$, $p < .0001$, and %CIUs, $F(3, 96) = 3.89$, $p < .05$. Planned comparisons controlling for a familywise error rate of .05 (.05/6 = .0083) were conducted for each CIU measure. Participants produced significantly more WPM for the Cat in Tree compared to the Directions, critical difference = 20.96, $p < .0083$. Participants produced significantly more CIUpm for the Birthday Cake and Cat in Tree compared to the Direction, critical difference = 20.81, $p < .0083$, critical difference = 20.63, $p < .0083$, respectively. All other planned comparisons were nonsignificant. Additionally, all interactions were nonsignificant.

Main event analysis

For the mixed ANOVA with the main event data, the main effect for picture stimulus was significant, $F(3, 96) = 11.67$, $p < .0001$, suggesting that certain picture stimuli were more easily described by the participants than others. Planned comparisons controlling for a familywise error rate of .05 (.05/6 = .0083) were conducted. Results indicated that subjects told significantly more main events for the Fight compared to the Birthday Cake and Cat in

Table 2

Means (standard deviations) and ranges for proportion of main events told by the groups for each picture stimuli

	Group	
	Younger group	Older group
Birthday Cake		
Mean (S.D.)	.64 (.24)	.44 (.25)
Range	.20–1.00	.00–.80
Cat in the Tree		
Mean (S.D.)	.46 (.24)	.49 (.27)
Range	.00–.75	.25–1.00
Fight		
Mean (S.D.)	.79 (.20)	.65 (.28)
Range	.43–1.00	.00–1.00
Directions		
Mean (S.D.)	.68 (.20)	.70 (.23)
Range	.25–1.00	.25–1.00
Total		
Mean (S.D.)	.67 (.11)	.59 (.20)
Range	.38–.83	.25–.88

Tree, critical difference = .16, $p < .0083$, critical difference = .16, $p < .0083$, respectively, and for the Direction picture compared to the Cat in Tree, critical difference = .16, $p < .0083$. Appendix B provides examples of participants' story telling by group and picture type. See Table 2 for group means and standard deviations of the proportion of main events.

3.3. Post hoc correlation

As indicated above, results of the CIU analysis revealed that the %CIUs, or the efficiency and informativeness of the YG group, was significantly greater than that of the OD group. Moreover, the OD group produced a comparatively smaller proportion of main events. To assist in our interpretation of these findings, post hoc Pearson correlations of CIU and main event data were conducted. If these two forms of analysis measure distinct aspects of discourse, we would expect to see a weak or perhaps inverse correlation between them. For the OD group, correlations between CIU measures and main event data were not significant. However, results for the YG group indicated a significant correlation between WPM and proportion of main events told, $r = .57$, $p < .05$, and between CIUpm and proportion of main events told, $r = .58$, $p < .05$. These findings suggest differences between groups in the extent of the relationship between the informativeness and efficiency of their structured discourse and their production of the central aspects of the stories within the picture stimuli.

4. Discussion

The main objectives of this investigation were (a) to compare the discourse ability of younger and older healthy adults as measured by CIU analysis and main event analysis, and

(b) to investigate the influence of stimuli type on the CIU and main event production of younger and older healthy adults. Our findings suggest that age does influence performance in the production of structured discourse. A significant difference in the percentage of correct information units (%CIUs) was detected between younger and older healthy adults. The narratives of younger adults resulted in a higher %CIU. In contrast, no significant difference between the two groups was found for WPM or CIUpm. Our groups did not differ significantly in the proportion of main events provided. However, upon inspection of the proportion of main events provided by participants for each picture type (i.e., single picture, sequential pictures), significant differences were detected, with more main events elicited from the sequential pictures than from the single pictures. Further, we performed post hoc analyses to investigate the relationship among the CIU measures and proportion of main events told by the YG and OD groups. The extent of the relationships between groups differed, adding support to the notion that discourse abilities change with age.

4.1. Effect of age on measures of discourse

4.1.1. CIU measures

Previous investigations of the effect of age on content informativeness have resulted in conflicting findings (see Obler et al., 1994, for a discussion). Some studies have shown an advantage of older adults in discourse production (James, Burke, Austin, & Hulme, 1998; Kemper, Rash, Kynette, & Norman, 1990; Obler, 1980). For example, Obler (1980) found that adults 70–79 years old identified more themes in a written picture description task than adults 50–59 years old. In contrast, other investigators have found that older adults produce less information or are less efficient in aspects of discourse production compared to younger adults (Benjamin, 1988; Kemper, 1987; Kemper et al., 1989; Kynette & Kemper, 1986; North et al.,1986; Ulatowska et al., 1986).

Though results in the literature are conflicting, they do suggest that older and younger adults differ in quantitative measures of discourse production. For this study, older adults' narratives contained a significantly lower %CIU, indicating reduced accuracy and informativeness in their narratives. The performance differences of the younger and older subjects provide support for the need to include age-matched individuals when investigating effects of brain damage on discourse production abilities.

Our results expand on Nicholas and Brookshire's (1993) findings by providing CIU scores for adults of different age ranges and different education levels. Additionally, in both studies there was considerable variability for measures within the groups, confirming the suggestion by others that healthy adults vary greatly in their connected speech production (e.g., Obler et al., 1994). Thus, when comparing brain-damaged individuals' performance, it is crucial to compare their performance to healthy individuals similar in age and education.

4.1.2. Main events measure

Groups did not differ in the ratio of main events produced to the total number of main events. Although somewhat surprising, these findings seem to suggest that, although the YG group produced greater information "density" (i.e., higher %CIUs), on balance, when only the most critical elements of a story were given credit, the groups performed similarly.

4.2. Impact of stimuli on CIU and main event production

Though no group differences in the proportion of main events told between the YG and the OD groups were found, we did find that picture type influenced participants' performance on the number of main events related. More main events were provided in response to the sequential picture stimuli, compared to the single picture stimuli, regardless of age. These results are not surprising; results of previous studies have also shown significant effects for single versus multiple picture stimuli, as well (Cooper, 1990). One possible explanation is that single picture stories required a greater degree of inference, because participants must infer the sequence of events, as well as their meaning. In addition, the sequential pictures may have acted as a scaffold, by providing subjects with story specifics such as setting, characters, problems and resolutions. In the absence of such a scaffold (i.e., in the case of the single pictures) subjects may be more prone to simply 'list' events without considering underlying relationships between them.

Our findings have important implications in terms of the method in which language samples of adults with aphasia are obtained. Typically, single pictures are used with these adults. It may be of theoretical interest to evaluate the extent to which individuals with aphasia can demonstrate the inferencing abilities necessary to provide a complete and accurate story from a single picture. However, from a clinical perspective, if the intent is to elicit a representative language sample, then the use of sequential picture stimuli would seem to be most appropriate.

4.3. Post hoc analyses

Post hoc correlations revealed different patterns of group performance in the extent of the relationship between informativeness and efficiency in structured discourse and the extent to which subjects delineated the central aspects of the stories conveyed in the pictures. For the younger group, WPM and CIUpm were significantly correlated with the proportion of main events told, suggesting that the CIU and main event analyses measure similar aspects of discourse for this group. However, no significant relationships were found between the CIU and main event measures for the older group, suggesting that these analyses may measure distinct aspects of discourse for the population. Although these results appear to conflict with Cooper's (1990) findings that most aspects of discourse do not change as a function of age, findings of discourse differences in older and younger adults are fairly well documented (e.g., Benjamin, 1988; James et al., 1998; Kemper, 1987; Kemper et al., 1989, 1990; Kynette & Kemper, 1986; North et al., 1986; Obler, 1980; Ulatowska et al., 1986). The differences in empirical findings with respect to this issue may be attributed to different approaches to measuring discourse as well as different types of stimuli and/or tasks used to elicit discourse. Overall, these findings suggest that assessment of structured discourse in healthy adults should go beyond measuring informativeness and efficiency and include a measure of individuals' abilities to relay main events. This appears especially critical for older adults, for whom main events analysis could uncover a skill set separate from that of CIU analyses.

Inclusion of a main events analysis with individuals with aphasia is equally important for at least two reasons. First, as with the older healthy adults, this analysis could provide

information distinct from that of CIU analyses. Second, and perhaps more importantly from a clinical perspective, main events analysis is, in some sense, a more direct measure of discourse production. It extends beyond the measurement of production quantity to the measurement of discourse quality, by assessing an individual's ability to cull critical ideas and inter-relationships from extraneous detail.

5. Conclusions

In summary, the results of the present study indicate that discourse abilities are affected by age. Though our groups did not differ significantly for proportion of main events told, they did evidence differences in correlational patterns between the various discourse measures, and they differed significantly in the percentage of CIUs produced in the samples. It should be noted that the lack of a significant result between groups on the main events analysis was, in part, due to our decision to use a significance level of $p < .05$; the p value for this analysis was $p = .05$ revealing, at a minimum, a statistical trend. With a greater sample size and less variability among participants on the tasks, an age difference on this task might have emerged. Thus, future investigations into the impact of age on CIU measures and measures of main event production are warranted.

One limitation of the present study is that the experimental procedures required only one discourse sample for each stimulus. Consequently, no intra-subject reliability data are available. Future investigations should include more than one session to assess reliability of the main event measure. Our results do, however, add to the literature regarding changes in discourse abilities with age, as well as expand the normative data available for comparing brain-damaged individuals' connected speech performance. Moreover, our results highlight the need for clinicians to consider the cognitive and linguistic demands of various language elicitation procedures. That is, our findings support the rather obvious notion that greater inferencing is needed to derive a story from a single picture than from a sequence of pictures. If the clinical objective is simply to assess narrative abilities in clients with aphasia, then a narrative task that requires less inferencing would seem preferable. The impact of different forms of stimulus on the production of narratives by individuals with aphasia should be the subject of future investigations. Finally, inclusion of a cognitive assessment should be considered to evaluate the extent to which certain cognitive abilities impact performance on different types of discourse tasks.

Appendix A. Main events for the single pictures and picture sequences

A.1. Cat in the Tree

1. *The dog chased the cat up the tree*/cat ran up tree to get away from the dog.
2. *The girl is trying to coax the cat into jumping from the tree*/into getting down from the tree.
3. *The man* (father) *tried to get* (rescue) *the cat, but his ladder fell, and now he's stuck* (too).
4. *The firemen* (firefighters) *arrive to rescue the man and the cat.*

A.2. Birthday Cake

1. *It is the boy's birthday* (birthday party).
2. *The boy is crying because the dog ate* (some of) *his cake*.
3. *The dog is hiding under the sofa*/couch.
4. *The mother is mad at the dog*/is scolding the dog (with a broom).
5. *The guests are arriving*.

A.3. Fight

1. *The husband* (man) *and wife* (woman) *are yelling at each other*/get into a huge fight.
2. *She packs a bag* (suitcase) *and leaves the husband*/heads for the door.
3. *The husband* (man) *is sad*/upset/distraught.
4. *The wife* (woman) *comes back in the house*/opens the front door/peeks in the door.
5. *She* (wife/woman) *is crying*.
6. *The husband* (man) *hugs his wife* (woman).
7. *She explains that*/He looks out the door and sees that/She is crying because . . . *she drove the car into a tree*/wrecked the car.

A.4. Directions

1. *A man and a woman are driving*/traveling *and see*/greet/say hello to *a farmer on the side of the road*.
2. *The farmer is planting a tree*.
3. *The couple*/the man *ask(s) for directions*.
4. *The farmer directs them*/gives them directions/tells them which way to go.
5. (The farmer watches as. . .) *the man and woman take off*/they continue on their way.
6. *The farmer goes back to work digging the hole*/planting the tree.
7. *A little while* (a few minutes)*later, the couple sees the farmer* (stops in front of the farmer) *on the side of the road again*.
8. *They are angry with the farmer because he misdirected them*/gave them bad directions/ did not give them good directions.

Note: The numbered statements are the main events. The essential information for each main event is underlined. Information in parentheses represents alternatives ways a component of the main event could be stated. [/] represent alternative information that could have been stated to complete the main event.

Appendix B. Sample of storytelling from one participant in OD group and one participant in YG group

B.1. Directions (YG group-sequential picture type)

This one looks like city folk coming to the country to check out the view and they've gotten lost so they stop and ask a farmer, you know, where they're going. And the guy gives

them directions. And they head off. And then, they come back really angry at the farmer because he obviously gave them the wrong directions. Or they just couldn't obey directions either way.

B.2. Cat in the Tree (YG group-single picture type)

It looks like there's a cat stuck in a tree and the man's in the tree. There's a dog barking up the tree and um it looks like the man's afraid of the dog or else he's . . . or it looks like he tried to climb the tree to rescue the cat. There's a ladder that's fallen down. So he's trying to get the cat uh and then the firemen are coming um with the ladder to probably to save the man the cat.

B.3. Directions (OD group-sequential picture type)

Uh let's see. It looks like people driving along a country road asking information from a farmer. And he's pointing out directions and they're going on. And he's digging a hole and he's planting a tree. And they're back up, they came back. Oh no, yeah, they came back. They must have made a circle. Did they? They didn't back up they just appeared again. Okay.

B.4. Cat in the Tree (OD group-single picture type)

Well lots of different things. The firemen are trying to rescue the cat in the trees and one of 'em . . . someone is in a tree tryin' to rescue a cat. And a little girl's tryin' to catch the cat. Bless her heart. She had to get off of her tricycle. And the firemen are racing to . . . a.. get to the . . . to rescue the cat. Poor dog barkin' at it . . . he's not helpin' much. And the little bird's tweetin'. They didn't use the ladder. It's layin' on the ground.

Appendix C. Study questions

1. Quantitative measures of structured discourse:
    a. Include content information unit analysis
    b. Can be used to track behavioral changes in response to treatment
    c. May include analysis of main event production
    d. All of the above
    e. A and c only
2. The main event measure used in this study:
    a. Is consistent with other main event measures
    b. Emphasizes the ability to express casual links and relationships
    c. Has been shown to be an unreliable measure
    d. Is not appropriate for use with individuals with aphasia
3. The results of this study indicate that:
    a. Younger and older healthy adults did not differ in the their ability to relate the main events observed in pictured stimuli

   b. Healthy young adults related fewer main events than did healthy older adults

   c. Young healthy adults have a significantly higher %CIU as compared to older, healthy adults

   d. None of the above were suggested by the results

4. With respect to the affect of stimulus on structured discourse, the authors found that:

   a. The stimuli used in the study had no particular affect on discourse production of healthy younger subjects

   b. The stimuli used in the study had no particular affect on discourse production of healthy older subjects

   c. The stimuli used in the study affected main event production, regardless of age

   d. Pictured stimuli of whole scenes yielded higher words per minute and correct information units per minute than did sequential pictures

5. Based on the results of the study, the authors concluded that:

   a. Discourse abilities are not affected by age

   b. Measures of informativeness and efficiency and measures of the ability to relate main events appear to tap different skills in older individuals

   c. The type of stimuli used to elicit discourse samples is irrelevant as long as the clinician knows how to score the samples

   d. Stimuli type does not impact the proportion of main events told by healthy adults, regardless of age

References

Benjamin, B. J. (1988). Changes in speech production and linguistic behavior with aging. In B. B. Shadden (Ed.), *Communication behavior and aging: A sourcebook for clinicians* (pp. 164–181). Baltimore, MD: Williams & Wilkins.

Chappell, G. E. (1980). Oral language performance of upper elementary school students obtained via story reformulaion. *Language, Speech and Hearing Services in Schools, 11*(4), 236.

Coelho, C. A. (2002). Story narratives of adults with closed head injury and non-brain-injured adults: Influence of socioeconomic status, elicitation task, and executive functioning. *Journal of Speech, Language, and Hearing Research, 45*, 1232–1248.

Cooper, P. V. (1990). Discourse production and normal aging: Performance on oral picture description tasks. *Journal of Gerontology, 45*(5), 210–214.

Craig, H., Hinckley, J. J., Winkelseth, M., Carry, L., Walley, J., Bardach, L., et al. (1993). Quantifying connected speech samples of adults with chronic aphasia. *Aphasiology, 7*(2), 155–163.

James, L. E., Burke, D. M., Austin, A., & Hulme, E. (1998). Production and perception of "verbosity" in younger and older adults. *Psychology and Aging, 13*, 355–367.

Kemper, S. (1987). Life-span changes in syntactic complexity. *Journal of Gerontology, 42*, 323–328.

Kemper, S., Kynette, D., Rash, S., & O'Brien, K. (1989). Life-span changes to adults' language: Effects of memory & genre. *Applied Psycholinguistics, 10*, 49–66.

Kemper, S., Rash, S., Kynette, D., & Norman, S. (1990). Telling stories: The structure of adults' narratives. *European Journal of Cognitive Psychology, 2*, 205–278.

Kynette, D., & Kemper, S. (1986). Aging and the loss of grammatical forms: A cross-sectional study of language performance. *Language and Communication, 6*, 43–49.

Liles, B. Z., Coelho, C. A., Duffy, R. J., & Zalagens, M. R. (1989). Effects of elicitation procedures on the narratives of normal and closed head-injured adults. *Journal of Speech and Hearing Disorders, 54*, 356–366.

Nicholas, L. E., & Brookshire, R. H. (1993). Quantifying connected speech of adults with aphasia. *Journal of Speech and Hearing Research, 36*, 338–350.

Nicholas, L. E., & Brookshire, R. H. (1995). Presence, completeness, and accuracy of main concepts in the connected speech of non-brain-damaged adults and adults with aphasia. *Journal of Speech and Hearing Research, 38*(1), 145–153.

North, A. J., Ulatowska, H. K., Macaluso-Haynes, S., & Bell, H. (1986). Discourse performance in older adults. *International Journal of Aging and Human Development, 23*, 267–283.

Obler, L. K. (1980). Narrative discourse style in elderly. In L. K. Obler, & M. L. Albert (Eds.), *Language and communication in the elderly* (pp. 75–90). Lexington, MA: D.C. Health.

Obler, L. K., Au, R., Kugler, J., Melvold, J., Tocco, M., & Albert, M. L. (1994). Intersubject variability in adult normal discourse. In R. L. Bloom, L. K. Obler, S. De Santi, & J. S. Ehrlich (Eds.), *Discourse analysis and applications: Studies in adult clinical populations* (pp. 15–27). Hillsdale, NJ: Lawrence Erlbaum Associates.

Potechin, G. C., Nicholas, L. E., & Brookshire, R. H. (1987). *Effects of picture stimuli on discourse production by aphasic patients.* Clinical aphasiology proceedings, Minneapolis: BRK Publishers. pp. 216–220.

Ross, K., & Wertz, R. (2001). Possible demographic influences on differentiating normal from aphasic performance. *Journal of Communication Disorders, 34*(1–2), 115–130.

Ulatowska, H. K., Hayashi, M. M., Cannito, M. P., & Fleming, S. G. (1986). Disruption of reference in aging. *Brain and Language, 28*, 24–41.

van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension.* New York: Academic Press.

Yorkston, K. M., & Beukelman, D. R. (1980). An analysis of connected speech samples of aphasic and normal speakers. *Journal of Speech and Hearing Disorders, 45*, 27–36.