Currently, there is increasing empirical and clinical interest in the integrity of nonlinguistic, cognitive processes (e.g., attention, working memory) in aphasia, and the relationship between these processes and aphasic symptoms and outcomes (Adrover-Roig et al., 2011; Fucetola et al., 2009; Murray, 2012). Indeed, recent findings support an emerging conceptualization of aphasia in which deficits in extra-linguistic cognitive functions may generate or intensify linguistic impairments (Hula & McNeil, 2008; Murray & Kean, 2004). The purpose of the current study was to specify further this processing or resource model of aphasia by examining interactions between spoken discourse and general cognitive skills in aphasic adults using a dual-task paradigm. Previous findings indicate that cognitive factors can negatively influence discourse in healthy, aphasic, and other patient populations (Duong et al., 2005; Plummer-D'Amato et al., 2008; Rogalski et al., 2010). For example, Murray et al. (1998) found that for aphasic adults, aspects of discourse formulation hypothesized to rely on relatively controlled as opposed to automatic processes were most vulnerable under dual-task conditions; however, only the interaction between increased attentional demands and microlinguistic processes were examined, even though aphasia can compromise macrolinguistic abilities (Chapman et al., 1998; Rousseaux et al., 2010). Further, adults with a limited range of aphasia types and severities participated in this study, and whether material-specific limitations (i.e., discourse characteristics during a non-distracting condition), general cognitive abilities (i.e., cognitive test scores), or both are important predictors of dual-task outcomes was not examined.

Accordingly, this study determined whether spoken discourse deficits in aphasia are associated, as least in part, with cognitive limitations by having adults with aphasia or no brain damage (NBD) complete a narrative task alone and in competition with a tone discrimination task. Aphasic and NBD subjects described sets of picture sequences under isolation, focused attention, and divided attention conditions. Narrative samples were quantified and qualified at both the micro- (i.e., morphosyntax, lexical retrieval) and macrolinguistic levels (i.e., informativeness, cohesion, coherence) to examine further the notion that a continuum of processing automaticity can account for language changes in the aphasic subjects' discourse across speaking conditions. That is, moving from isolation to focused and divided attention conditions should result in little or less change in those micro- (morphosyntax) and macrolinguistic (cohesion) features hypothesized to rely upon relatively automatic processes, and thus sparse cognitive resources (Alexander, 2006; Birnboim, 2003; Glosser, 1993; Ulatowska & Chapman, 1995); in contrast, micro- (lexical retrieval) and macrolinguistic (informativeness, coherence) features hypothesized to rely upon relatively controlled, and thus resource-consuming processes, should deteriorate during dual-task conditions. The following hypotheses will be tested:

(a) Because of concomitant cognitive deficits, aphasic adults will exhibit greater distraction and dual-task interference compared to NBD adults.

(b) As condition complexity increases, there will be no disproportionate decrements in morphosyntactic and cohesion measures, but significant decrements in terms of quantity and quality of lexical retrieval, informativeness, and coherence.

(c) Based on previous findings (Juncos-Rabadan et al., 2005; Murray, 2005), dual-task decrements of the aphasic adults will be related to both material-specific limitations and general cognitive abilities.

A comparison group of adults with right hemisphere brain damage (RBD) was also included to determine the distinctiveness of the relation between spoken discourse and cognitive abilities expected for the aphasic adults. Given that in RBD, spoken discourse (Marini et al., 2005; Rousseaux et al., 2010) and cognitive impairments (including significant attention and working memory impairments) are common (Barker-Collo et al., 2009; Tompkins et al., 1994), and under demanding conditions their linguistic performances correspond more closely to those of aphasic than NBD adults (Murray, 2000), it was predicted that the discourse performance patterns of RBD adults would be more similar to those of aphasic versus NBD adults.

Methods

Subjects. Participants included 23 adults with aphasia, 11 with RBD, and 26 NBD adults (Table 1). Groups were matched for age and education, and all subjects met inclusionary hearing, vision, and praxis criteria. According to the *Aphasia Diagnostic Profiles*, aphasic subjects had mild to moderate aphasia and represented a variety of aphasia types. On the *MIRBI-2*, RBD subjects varied from mild to severe levels of cognitive-communicative impairment.

Test Battery. All subjects completed: (a) *Boston Naming Test,* (c) *Ruff Figural Fluency* to assess nonverbal fluency and executive functions such as self-monitoring and flexibility, (a) forward and backward Visual Memory Span, (b) an auditory-verbal working memory protocol, and (c) *Test of Everyday Attention.*

Dual Task Procedures. Subjects completed discourse and tone tasks under three conditions: (a) *Isolation* - each task completed without distraction, (b) *Focused Attention* - secondary, competing tone stimuli were presented, but only the discourse task was completed, (c) *Divided Attention* - both tasks (two responses required) completed and instructed to give equal emphasis (50/50%) to each task.

Samples for the *Narrative Discourse Task* were elicited with sets of three sequentially ordered line drawings; these sequences were first piloted to assure equivalency (e.g., elicit samples of similar quantity and quality). Picture sequences were randomized across experimental conditions, assuring that each sequence was presented to an equal number of subjects in each group during each speaking condition. Subjects were instructed to tell a story about everything happening in the picture sequence and given 2 minutes to complete the task. Narrative samples were audiotaped, transcribed, and then coded via the CHAT system for automatic analyses by various CLAN programs (MacWhinney, 2000).

The *Tone Discrimination Task* required discriminating forty 500 ms pure tones (20 at 500 Hz, 20 at 2000 Hz) presented in a random order; during the dual-task conditions, a larger number of tone stimuli were presented so that this competing task was completed over the entire duration of the discourse task.

Data Analyses. Discourse samples will be analyzed in terms of: (a) quantity: number of utterances and words; (b) microlinguistic features: proportion of grammatical utterances and syntactically complex sentences (Thompson et al., 1995), morphological complexity of verb phrases (Saffran et al., 1989), frequency of word-finding problems; (c) macrolinguistic features: informativeness (CIUs and informative utterances; Murray, 2000; Nicholas & Brookshire, 1993), cohesion (proportion of complete cohesive ties to spoken words) and coherence (ratings of global and local coherence) (Ellis et al., 2005; Glosser & Deser, 1992; Rogalski et al., 2010).

Narrative and tone task data will be analyzed via group X condition ANOVAs. Bivariate correlations of dependent measures with continuous variables (e.g., cognitive test results) will be calculated separately for each group to investigate factors associated with experimental task performances.

Preliminary Results and Summary

Consistent with prior research (Kemper et al., 2006; Murray et al., 1998), preliminary analyses indicate that distraction (focused attention condition) negatively affected the spoken discourse of only the patient groups (Figure 1). The divided attention condition, while difficult for all groups, was also associated with larger decrements for the patient groups on both the discourse (Figures 1-2) and secondary tone tasks (Table 2). Completion of discourse and statistical analyses will determine whether across groups: (a) there are differential condition effects on micro- and macrolinguistic skills that rely on relatively automatic versus controlled processes, and (b) material specific limitations, cognitive impairments, or both predict dual-task decrements. Regardless of final outcomes, our findings will inform resource models of aphasia and language processing by further delineating interactions between specific discourse production and general cognitive abilities in both patient and normal populations.

Selected References

Alexander, M. P. (2006). Impairments of procedures for implementing complex language are due to disruption of frontal attention processes. *Journal of the International Neuropsychological Society, 12,* 236-247.

Birnboim, S. (2003). The automatic and controlled information-processing dissociation: Is it still relevant? *Neuropsychology Review, 13*(1), 19-31.

Duong, A., Giroux, F., Tardif, A., & Ska, B. (2005). The heterogeneity of picture-supported narratives in Alzheimer's disease. *Brain and Language, 93,* 173-184.

Juncos-Rabadan, O., Pereiro, A., & Rodriguez, M. (2005). Narrative speech in aging: Quantity, information content, and cohesion. *Brain and Language, 95,* 423-434.

Marini, A., Carlomagno, S., Caltagirone, C., & Nocentini, U. (2005). The role played by the right hemisphere in the organization of complex textual structures. *Brain and Language, 93,* 46-54.

Plummer-D'Amato, P., Altmann, L., Saracino, D., Fox, E., Behrman, A., & Marsiske, M. (2008). Interactions between cognitive tasks and gait after stroke: A dual task study. *Gait and Posture, 27*(4), 683-688.

Rogalski, Y., Altmann, L., Plummer-D'Amato, P., Behrman, A., & Marsiske, M. (2010). Discourse coherence and cognition after stroke: A dual task study. *Journal of Communication Disorders, 43,* 212-224.

Rousseaux, M., Daveluy, W., & Koslowski, O. (2010). Communication in conversation in stroke patients. *Journal of Neurology, 257,* 1099-1107.

Table 1. Preliminary Group Characteristics and Select Test Data

Variable		Aphasic (n = 23)	RBD (n = 11)	NBD (n = 26)
Age (years)	M	58.5	57.8	60.1
	SD	13.0	16.8	15.7
	Range	32-83	31-85	30-84
Education (years)	M	14.7	14.8	14.7
	SD	1.8	1.5	2.6
	Range	12-16	12-16	8-21
Time Post Stroke* (months)	M	54.0	27.2	
	SD	52.7	30.8	
	Range	6-204	6-103	
Gender (Male: Female)		15:8	7:4	13:13
Aphasia Diagnostic Profiles (Standard Scores)				
Lexical Ret.	M	13.6	14.3	
	SD	2.8	1.1	
	Range	7-17	12-16	
Aphasia Severity	M	118.6	129.5	
	SD	14.5	6.3	
	Range	93-135	118-135	
Boston Naming Test	M	45.2	55.1	57.5
	SD	14.9	2.1	2.3
	Range	18-60	51-58	52-60
Auditory-Verbal Working Memory (# recall errors)	M	20.2	12.3	6.3
	SD	10.4	4.9	4.8
	Range	6-40	6-20	0-15
WMS-R Visual Memory Span (%iles)				
Forwards	M	51.9	39.6	63.5
	SD	31.2	29.9	22.9
	Range	2-98	6-96	30-98
Backwards	M	53.9	44.8	63.3
	SD	26.1	30.8	23.7
	Range	2-96	2-78	28-99

Test of Everyday Attention (standard scores)				
Elevator Counting With Distraction	M	7.7	9.2	11.4
	SD	3.1	2.2	1.8
	Range	3-13	6-13	6-13
Telephone Search With Counting	M	6.5	7.5	11.5
	SD	3.9	4.0	3.5
	Range	0-1	2-12	6-19
Ruff Figural Fluency Test (%ile for # unique designs)	M	27.7	26.5	62.0
	SD	31.0	31.2	19.9
	Range	1-100	1-99	28-99

*As an inclusionary criterion, all aphasic and RBD subjects were required to be at least 6 months post-stroke onset.

Table 2. Preliminary Accuracy (% Correct) and Reaction Time (msec) Group Means, Standard Deviations, and Ranges for the Competing, Tone Discrimination Task.

			GROUP		
Data Type	Condition		Aphasic	RBD	NBD
Accuracy (%)	isolation	M	96.5	96.8	97.1
		SD	3.8	4.3	2.9
		Range	90-100	88-100	90-100
	divided attention	M	77.2	89.4	94.1
		SD	13.7	4.0	2.1
		Range	40-97	84-97	90-100
# Tones Attempted	divided attention	M	39.2	43.6	55.7
		SD	16.2	14.1	12.6
		Range	14-79	23-70	30-81
Reaction Time (ms)	isolation	M	688	666	549
		SD	164	267	125
		Range	423-967	349-1179	334-819
	divided attention	M	1988	1602	1373
		SD	547	393	283
		Range	1067-2876	852-2191	772-1877

Note. Divided Attention = 50/50% priority condition in which subjects are asked to distribute equally their attention to both the discourse and tone tasks.

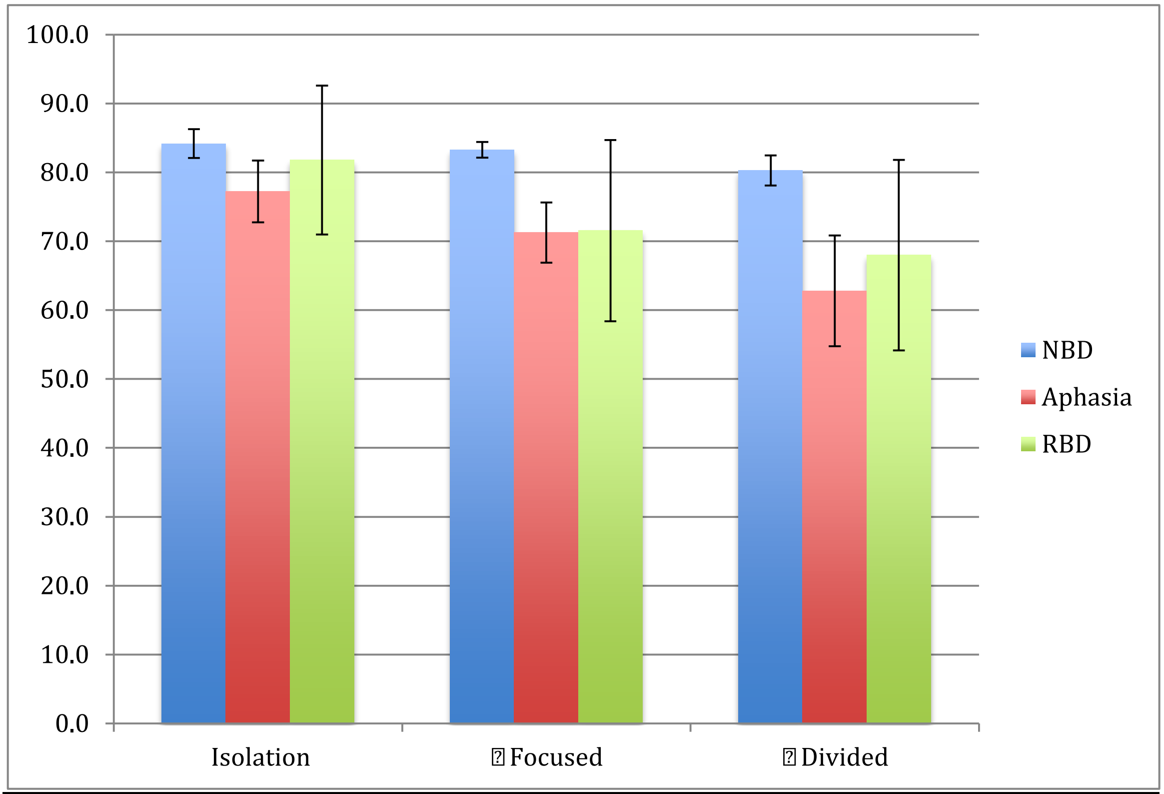

Figure 1. Mean percentage of correct information units (and 95% confidence interval bars) for each group across each speaking condition.

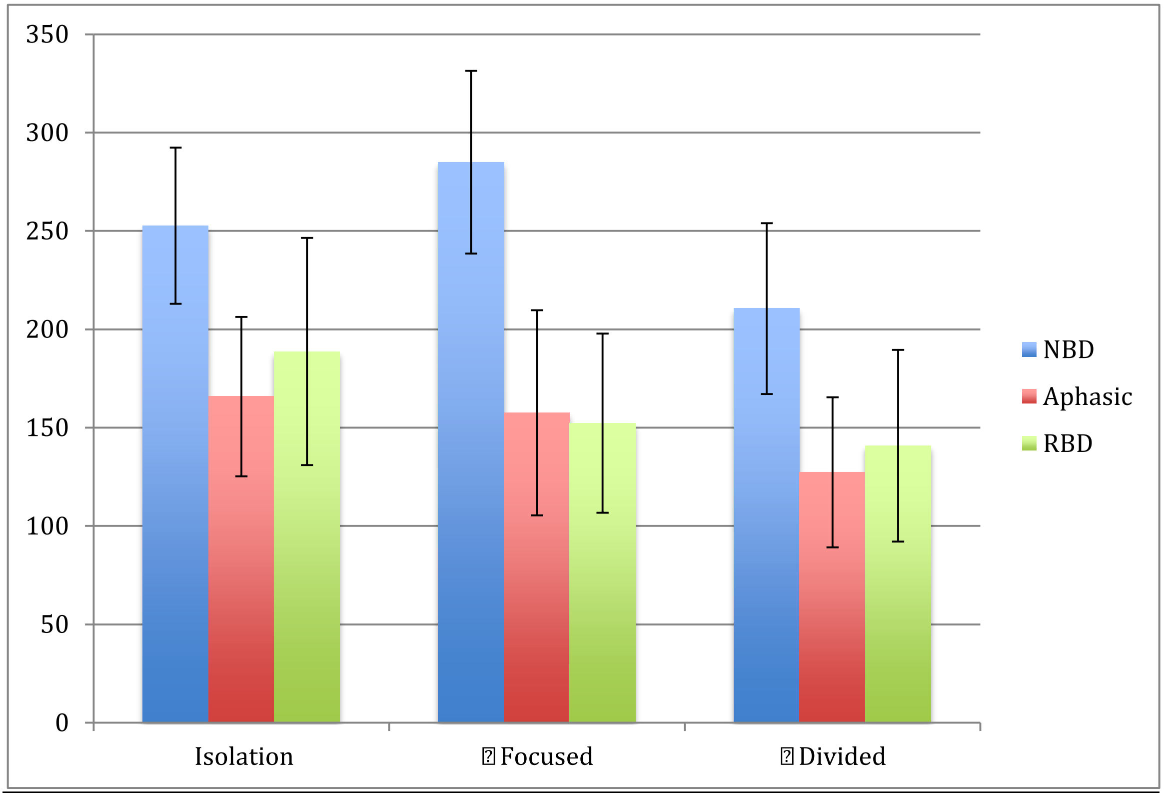

Figure 2. Mean total number of words produced (and 95% confidence interval bars) by each group across each speaking condition.