Research Article

Does Naming Therapy Make Ordering in a Restaurant Easier? Dynamics of Co-Occurring Change in Cognitive-Linguistic and Functional Communication Skills in Aphasia

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Purpose: This study was conducted to investigate the static and dynamic relationships between impairment-level cognitive-linguistic abilities and activity-level functional communication skills in persons with aphasia (PWA).

Method: In Experiment 1, a battery of standardized assessments was administered to a group of PWA ($N = 72$) to examine associations between cognitive-linguistic ability and functional communication at a single time point. In Experiment 2, impairment-based treatment was administered to a subset of PWA from Experiment 1 ($n = 39$) in order to examine associations between change in cognitive-linguistic ability and change in function and associations at a single time point.

Results: In both experiments, numerous significant associations were found between scores on tests of cognitive-linguistic ability and a test of functional communication at a single time point. In Experiment 2, significant treatment-induced gains were seen on both types of measures in participants with more severe aphasia, yet cognitive-linguistic change scores were not significantly correlated with functional communication change scores.

Conclusions: At a single time point, cognitive-linguistic and functional communication abilities are associated in PWA. However, although changes on standardized assessments reflecting improvements in both types of skills can occur following an impairment-based therapy, these changes may not be significantly associated with each other.

Aphasia is an acquired neurogenic disorder that is characterized by various deficits in *cognitive-linguistic abilities* (i.e., specific skills such as word retrieval, syntactic production, or visual scanning that may be relatively spared or impaired in persons with aphasia) that can impact an individual's *functional communication* (i.e., an individual's ability to successfully complete communicative acts such as introducing a new topic during a conversation, requesting information, or responding in an emergency) and participation in everyday activities. Most modern frameworks of health and disability indicate that, although cognitive-linguistic skills and functional communication abilities are separate, these constructs are closely linked. One such framework, the World Health

Organization's International Classification of Functioning, Disability and Health (ICF; 2001), was intended to allow for comparisons between different conditions on the basis of the impact they have on an individual in terms of body functions and structure, activity, and participation while also accounting for external factors (i.e., physical, social, or attitudinal factors) and personal factors (e.g., age, gender, and psychoemotional state). Within the ICF, cognitive-linguistic skills are classified within the body structures and functions component, and, for persons with aphasia (PWA), deficits in cognitive-linguistic abilities are considered impairment-level deficits. Functional communication abilities fall into the activity component, and deficits in these skills are considered activity-level deficits. According to the ICF, these elements are interactive and dynamic, meaning that they can influence one another bidirectionally and to varying degrees, depending on the individual.

The ICF framework also has been adapted by Kagan and colleagues into a framework for use specifically with PWA, entitled *Living With Aphasia: Framework for Outcome Measurement* (A-FROM; Kagan et al., 2008). The

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A-FROM presents cognitive-linguistic skills and functional communication—conceptualized as language and related impairments and participation in life situations, respectively—as being different from one another but closely connected in that they both contribute to the experience of living with aphasia. Kagan et al. (2008) also note that, even though the domains in the framework are presented as separate constructs, the lines between them can become easily blurred when discussing specific tasks and assessments.

Both the ICF and A-FROM frameworks, therefore, present cognitive-linguistic abilities and functional communication skills as health components that are distinct yet interconnected or overlapping. The existence of some degree of overlap between these two concepts is intuitive. It makes sense that an individual with severely impaired language would have difficulty communicating effectively in everyday situations; likewise, it seems logical that an individual with mildly impaired language would have better functional communication abilities. Although there is no consensus on the extent of this interconnectedness, studies have revealed that cognitive-linguistic and functional communication skills are related in PWA at a single point in time (e.g., Bakheit, Carrington, Griffiths, & Searle, 2005; Frattali, Thompson, Holland, Wohl, & Ferketic, 1995; Fridriksson, Nettles, Davis, Morrow, & Montgomery, 2006; Holland, 1980; Hula et al., 2015; Irwin, Wertz, & Avent, 2002; Lomas et al., 1989; Murray, 2012; Ross & Wertz, 1999).

The relationship between cognitive-linguistic and functional communication skills is not straightforward, and it is especially complex when considering these two constructs in the context of language therapy. Much of the literature on language treatment for PWA has tended to treat impairment in cognitive-linguistic skills and functional deficits in communication as being separate from one another, resulting in a perceived either–or choice between remediating one type of deficit or the other. Despite this perceived dichotomy, there exists a growing body of literature demonstrating that targeting cognitive-linguistic impairments can result in improvement in functional communication and vice versa. For example, improvement in both cognitive-linguistic and functional communication skills has been noted following a variety of impairment-based treatments, including verb and sentence production treatment (e.g., Edmonds, Mammino, & Ojeda, 2014; Links, Hurkmans, & Bastiaanse, 2010), semantic-based therapy (e.g., Doesborgh et al., 2004; Godecke, Hird, Lalor, Rai, & Phillips, 2012; Wilssens et al., 2015), phonological therapy (e.g., Doesborgh et al., 2004; Kendall, Oelke, Brookshire, & Nadeau, 2015), melodic intonation therapy (e.g., Morrow-Odom & Swann, 2013; van der Meulen, van de Sandt-Koenderman, Heijenbrok-Kal, Visch-Brink, & Ribbers, 2014), constraint-induced aphasia therapy (e.g., Berthier et al., 2009; Pulvermüller et al., 2001; Wilssens et al., 2015), naming treatment (e.g., Rubi-Fessen et al., 2015), and therapies targeting multiple language modalities (e.g., Bowen et al., 2012; Code, Torney, Gildea-Howardine, & Willmes, 2010; Martins et al., 2013). Although fewer in number, other authors (e.g., Boles, 1998; Bollinger, Musson, & Holland,

1993; Elman & Bernstein-Ellis, 1999; Hough & Johnson, 2009; Johnson, Hough, King, Vos, & Jeffs, 2008; Nykänen, Nyrkkö, Nykänen, Brunou, & Rautakoski, 2013; Worrall & Yiu, 2000) have found improvement in both types of abilities following therapy that targeted functional communication skills in group therapy contexts, in the context of training participants in the use of alternative and augmentative communication, and/or when targeting communication strategies between PWA and their conversation partners.

What these studies have not addressed is how cognitive-linguistic processing and functional communication change over time and what the relationship is between the degree of improvement (or lack thereof) in each of these areas. To our knowledge, only one study to date has been conducted to investigate whether co-occurring and related change in cognitive-linguistic skills and functional communication occurs following therapy targeting a specific ICF domain. In this study, Doesborgh et al. (2004) targeted cognitive-linguistic skills and found that change scores on the Amsterdam-Nijmegen Test of Everyday Language (ANELT; Blomert, Koster, & Kean, 1995), a measure of functional communication, were significantly associated with change scores in semantic association and nonword repetition in PWA who underwent either a semantic-based treatment or phonological therapy, respectively. A few additional studies have been conducted to explore the relationship between changes in these two constructs following combined impairment-function therapy, with mixed results. In one study (Bakheit et al., 2005), the researchers administered both the Western Aphasia Battery (WAB; Kertesz, 1982), a global measure of language impairment, and the Communicative Effectiveness Index (CETI; Lomas et al., 1989), a measure of functional communication skills, to 67 PWA several times over the course of an interdisciplinary treatment and found that scores on these two measures were correlated at each time point. This result suggests the existence of continual simultaneous improvement in these two areas; however, each time point was examined discretely, and the authors did not look for associations between degrees of change over time. Aftonomos, Steele, Appelbaum, and Harris (2001) did examine treatment-induced patterns of change on the WAB and the CETI in 50 PWA and found that mean scores on both instruments improved after a technology-based treatment. After stratifying patients by aphasia type, these authors found a moderate negative correlation between the instruments; more improvement on one instrument was associated with less improvement on the other. These results suggest some sort of relationship between the two constructs but are meaningful only in the context of understanding patterns of improvement in specific subtypes of aphasia. In their meta-analytic review of two intensive comprehensive aphasia programs, Persad, Wozniak, and Kostopoulos (2013) found that of the 71 PWA who completed the InteRACT program, 64% demonstrated clinical-level improvement in aphasia severity as captured by the revised version of the WAB (WAB-R; Kertesz, 2007) and 51% showed clinically significant

improvement in functional communication as measured by the CETI and the Communication Activities of Daily Living–Second Edition (CADL-2; Holland, Frattali, & Fromm, 1999). However, correlations between baseline WAB scores and change scores on the CADL-2 and CETI were nonsignificant.

The collective results of these studies do not resolve the complex relationship between change in cognitive-linguistic skills and change in functional communication abilities. Therefore, the goal of the current study was to investigate the complex dynamics between these constructs.

The Current Study

The current study consisted of two experiments. The aim of Experiment 1 was to replicate and further validate the findings of previous studies of the relationship between functional communication ability and cognitive-linguistic skills at a single time point by examining associations between scores on a proxy measure of functional communication and a battery of standardized measures of cognitive-linguistic abilities in PWA. We expected to find significant positive correlations, indicating that when PWA have more preserved cognitive-linguistic abilities, their functional communication skills are also better. Additionally, we predicted that correlations would be strongest between global comprehensive measures of cognitive-linguistic ability and global scales of functional communication.

The aim of Experiment 2—the primary aim of this study—was to examine the relationship between impairment treatment–induced changes in both types of measures in a subset of the same sample of PWA. First, we predicted that scores on cognitive-linguistic assessments would be significantly and positively related to scores of functional communication abilities at both testing time points (i.e., baseline and posttreatment testing). Second, because of the nature of the therapy, we predicted that changes on measures of cognitive-linguistic abilities would be greater than changes in function but that changes would be observed across all assessments. We also expected that change scores on these measures would be positively correlated, indicating a close relationship between changes in cognitive-linguistic processing and functional communication in response to treatment.

Experiment 1: Method

Participants

Experiment 1 was completed using data from a total of 72 PWA (45 men and 27 women) evaluated for participation in a variety of studies at Boston University between January 2012 and June 2015. Of the participants in this group, 71 participants had aphasia that was due to a stroke, and one had aphasia that was caused by a traumatic brain injury. Inclusion in the study was contingent upon presence of language impairment due to aphasia, self or family report of typical premorbid speech-language function, self or family

report of the absence of progressive neurological disease, premorbid fluency in English, and completion of the functional communication measure and some or all of the standardized assessments of cognitive-linguistic abilities within a 90-day period. Ages ranged from 26 to 87 years ($M = 60.90$, $SD = 12.13$), and the amount of time after onset of aphasia ranged from 0.083 to 29.92 years ($M = 4.67$, $SD = 5.21$); 5.6% of the PWA in this sample ($n = 4$) were in the subacute phase of recovery (i.e., < 6 months postonset at the time of enrollment), and the remaining 94.4% were in the chronic phase (i.e., ≥ 6 months postonset).

Instruments and Assessment Procedures

Several widely used assessments of cognitive-linguistic ability and functional communication skills were selected to measure the constructs of interest in the current study. The Boston Naming Test (BNT; Kaplan, Goodglass, Weintraub, Segal, & van Loon-Vervoorn, 2001) and the three-pictures version of the Pyramids and Palm Trees Test (PAPT; Howard & Patterson, 1992) measure the severity of anomia in PWA and nonverbal semantic associative processing, respectively. These tests were selected because our group frequently targets these skills in our intervention studies (e.g., Experiment 2). The WAB-R was selected as the primary measure of global language abilities. This test provides a quantification of aphasia severity expressed as the aphasia quotient (AQ) and two additional comprehensive summary scores: a language quotient (LQ) and a cortical quotient (CQ). The Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001) was selected as the primary measure of global cognitive abilities. This test includes a variety of tasks that collectively generate severity ratings in five domains (attention, memory, executive functions, language, and visuospatial skills) and a total composite severity rating and a clock drawing score. The American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS; Frattali et al., 1995) was selected as the measure of global functional communication because of the large number of studies validating its psychometric properties (e.g., Donovan, Rosenbek, Ketterson, & Velozo, 2006; Frattali et al., 1995; Ross & Wertz, 2003), its widespread use, the lack of added testing burden on the patients, and the breadth of functional communicative contexts that it measures. The ASHA FACS consists of two ordinal rating scales: the Communication Independence (CI) scale and the Qualitative Dimensions of Communication (QDC) scale, which cover many domains and dimensions of functional communication (see Table 1 for a listing of these domains). The following results reflect the relationship between cognitive-linguistic and functional communication skills as captured by these specific measures; the potential ramifications of using other instruments to investigate this relationship are addressed in the Discussion section of this article.

Testing sessions were conducted at Sargent College of Health and Rehabilitation Sciences at Boston University.

Table 1. Summary of standardized test scores from Experiment 1 ($n = 72$).

Parameter	<i>M</i>	<i>SD</i>	Range
ASHA FACS Communication Independence (CI)			
Social Communication (out of 7)	5.61	1.079	1.57–6.91
Communication of Basic Needs (out of 7)	6.45	0.709	4.00–7.00
Reading, Writing, Number Concepts (out of 7)	5.25	1.647	1.10–7.00
Daily Planning (out of 7)	5.02	1.838	1.00–7.00
Overall Communication Independence (out of 7)	5.59	1.116	2.29–6.98
ASHA FACS Qualitative Dimensions of Communication Scores (QDC)			
Adequacy (out of 5)	3.74	0.796	2.00–5.00
Appropriateness (out of 5)	4.25	0.810	2.00–5.00
Promptness (out of 5)	3.49	0.885	1.50–5.00
Communication Sharing (out of 5)	3.59	1.071	1.00–5.00
Overall Qualitative Dimension Score (out of 5)	3.77	0.736	2.19–4.94
WAB			
Language Quotient (LQ) (out of 100)	66.29	24.232	15.50–99.10
Cortical Quotient (CQ) (out of 100)	69.49	21.246	20.32–98.00
Aphasia Quotient (AQ) (out of 100)	65.72	26.466	11.50–99.90
CLQT			
Attention (%)	66.86	28.93	1.86–97.21
Memory (%)	59.91	22.89	14.05–94.59
Executive Functions (%)	50.85	20.62	2.50–80.00
Language (%)	50.02	28.00	0.00–86.49
Visuospatial Skills (%)	69.20	25.29	3.81–96.19
Composite Score (%)	68.03	21.92	25.00–100.00
Clock Drawing (%)	68.18	31.58	0.00–100.00
BNT (%)	48.02	36.81	0.00–98.33
PAPT (%)	86.98	12.85	21.15–98.08

Note. ASHA FACS = American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults; WAB = Western Aphasia Battery; CLQT = Cognitive-Linguistic Quick Test; BNT = Boston Naming Test; PAPT = Pyramids and Palm Trees Test.

Research speech-language pathologists (SLPs) or trained research assistants (RAs) administered and scored all standardized assessments according to test protocols. In accordance with the test manual's administration procedures, the ASHA FACS was completed by an SLP or RA who had worked with a participant on at least three occasions and who received input from a caregiver, family member, or close friend familiar with the participant's functional communication abilities. Research SLPs oversaw the administration and scoring of the assessments conducted by the RAs.

Data Analysis

Data analyses were run in R version x64 3.0.2 (R Core Team, 2014). The scores on the cognitive-linguistic assessments followed a normal distribution, but none of the ASHA FACS domain or dimension scores were normally distributed. Therefore, nonparametric Spearman correlations were used to examine the relationship between

functional communication skills as measured by mean ASHA FACS domain and dimension scores and cognitive-linguistic abilities as measured by mean scores for the other standardized assessments. To account for multiple comparisons, p values were adjusted according to Benjamini and Hochberg's (1995) false discovery rate (FDR) in which the proportion of significant results that may be false positives was set to 5%.

Experiment 1: Results

Summary descriptive statistics of group-level standardized test performance are presented in Table 1. As shown in Table 2, with the exception mainly of the Basic Needs domain, significant moderate to strong positive correlations were found between scores on standardized tests of cognitive-linguistic abilities and the ASHA FACS CI domain scores (range: $r = .351-.829$, $p < .01-.001$). Fewer and weaker correlations involving the Basic Needs domain (range: $r = .326-.518$, $p < .01-.001$) may have been due to the very simple nature of the items in that domain. Correlations between tests measuring global cognitive-linguistic abilities (e.g., WAB and CLQT Composite) and ASHA FACS domains, particularly Overall CI, were among the strongest associations found.

Similarly, significant moderate to strong positive correlations were observed between scores on standardized tests of cognitive-linguistic skills and most of the ASHA FACS QDC scores. In this case, the Adequacy dimension (range: $r = .364-.800$, $p < .01-.001$) and the Overall QDC scores (range: $r = .424-.796$, $p < .001$) were involved in stronger correlations than were the other dimensions. Once again, composite measures of cognitive-linguistic abilities and functional communication were strongly correlated (e.g., Overall QDC with WAB and CLQT Composite scores; see Table 2).

Overall, all but four of the 120 correlations between the ASHA FACS and cognitive-linguistic tests reached significance, even after correcting for multiple comparisons. All of the correlations were positive, and most of the results indicated moderate to strong relationships between these variables, suggesting that the level of cognitive-linguistic skill was largely associated with functional communication abilities in PWA.

The results of Experiment 1 confirm findings of previous studies (e.g., Frattali et al., 1995; Irwin et al., 2002; Ross & Wertz, 1999), indicating that performance on the ASHA FACS is associated with performance on a range of impairment-level assessments. Thus, it stands to reason that a measureable change in performance on measures of cognitive-linguistic impairment following language therapy would also be reflected as a change in performance on the ASHA FACS and that the nature and/or strength of such changes would be related. In Experiment 2, we examined changes in scores for the same instruments utilized in Experiment 1 with PWA who received impairment-based language and cognitive therapy in a pair of treatment studies at Boston University.

Table 2. Correlations between scores on the ASHA FACS and the other standardized tests from Experiment 1 ($N = 72$).

Test ^a	Social Communication	Basic Needs	Reading, Writing, Number Concepts	Daily Planning	Overall CI	Adequacy	Appropriateness	Promptness	Communication Sharing	Overall QDC
WAB-LQ	.789^{***}	.525^{***}	.787^{***}	.740^{***}	.829^{***}	.800^{***}	.488^{***}	.530^{***}	.700^{***}	.792^{***}
WAB-CQ	.802^{***}	.518^{***}	.773^{***}	.742^{***}	.822^{***}	.787^{***}	.501^{***}	.532^{***}	.717^{***}	.796^{***}
WAB-AQ	.782^{***}	.393 ^{**}	.688^{***}	.650^{***}	.736^{***}	.767^{***}	.438^{***}	.534^{***}	.756^{***}	.780^{***}
CLQT Attention	.351 ^{**}	.239 ($p = .054$)	.575^{***}	.612^{***}	.576^{***}	.445^{***}	.566^{***}	.429^{***}	.284⁺	.497^{***}
CLQT Memory	.743^{***}	.464^{***}	.721^{***}	.693^{***}	.780^{***}	.756^{***}	.526^{***}	.478^{***}	.688^{***}	.752^{***}
CLQT Executive Functions	.379 ^{**}	.326 ^{**}	.615^{***}	.646^{***}	.617^{***}	.484^{***}	.610^{***}	.447^{***}	.335^{**}	.543^{***}
CLQT Language	.758^{***}	.441^{***}	.722^{***}	.704^{***}	.786^{***}	.744^{***}	.449^{***}	.437^{***}	.678^{***}	.718^{***}
CLQT Visuospatial	.243 ($p = .050$)	.211 ($p = .089$)	.484^{***}	.537^{***}	.480^{***}	.364^{**}	.544^{***}	.401^{**}	.206 (n.s.)	.424^{***}
CLQT Composite	.621^{***}	.387^{**}	.782^{***}	.775^{***}	.797^{***}	.705^{***}	.614^{***}	.537^{***}	.513^{***}	.710^{***}
CLQT Clock Drawing	.560^{***}	.437^{***}	.646^{***}	.655^{***}	.692^{***}	.544^{***}	.576^{***}	.434^{***}	.451^{***}	.602^{***}
BNT	.679^{***}	.367^{**}	.651^{***}	.681^{***}	.726^{***}	.679^{***}	.412^{**}	.371^{**}	.585^{***}	.638^{***}
PAPT	.543^{***}	.415^{***}	.605^{***}	.640^{***}	.659^{***}	.565^{***}	.476^{***}	.315^{**}	.407^{***}	.546^{***}

Note. FDR correction was applied to account for multiple comparisons. Correlation strength is indicated, where bold italic = strong (.100–.700), bold = moderate (.699–.400), and italic = weak (.399–.100). ASHA FACS = American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults; CI = Communication Independence; QDC = Qualitative Dimensions of Communication; WAB = Western Aphasia Battery; LQ = Language Quotient; CQ = Cortical Quotient; AQ = Aphasia Quotient; CLQT = Cognitive-Linguistic Quick Test; n.s. = not significant; BNT = Boston Naming Test; PAPT = Pyramids and Palm Trees Test.

* $p < .05$; ** $p < .01$; *** $p < .001$.

^aQDC scores were not available for two PWA within the sample.

Experiment 2: Method

Participants

Experiment 2 included a subset of PWA from Experiment 1 ($n = 39$; 26 men and 13 women) who were evaluated before and after treatment in one of two impairment-level intervention studies (described below). Criteria for inclusion were the same as those for Experiment 1. Participants ranged in age from 49 to 87 years ($M = 63.64$, $SD = 8.59$), and time after onset of aphasia was 0.17–29.92 years ($M = 5.05$, $SD = 6.05$).

Instruments and Assessment Procedures

The same instruments utilized in Experiment 1 were administered to participants in Experiment 2 at baseline and posttreatment according to the protocols outlined in Experiment 1. Research staff (SLPs and RAs) administered the assessments and the treatments, but the assessing clinicians were not necessarily the same as the treating clinicians.

Treatment

Treatment was not administered as part of the current study. Rather, participants had previously completed one of two intervention studies. In one study, participants were seen one or two times per week and received 10 weeks of tablet-based language and/or cognitive therapy via tasks aimed at naming, auditory comprehension, reading, problem solving, and other areas (see Des Roches, Balachandran, Ascenso, Tripodis, & Kiran, 2015, for a complete description and results). In the other study, participants were seen two times per week and received up to 12 weeks of language therapy targeting anomia through semantic feature verification tasks involving auditory comprehension, reading, and naming tasks. In both studies, prior to the start of therapy, specific areas of need were identified from baseline evaluations, and for each participant different tasks targeting those areas were assigned and training was provided.

Across both interventions, PWA completed a mean of 32.11 hr of therapy ($SD = 24.67$ hr) over a mean of 11.08 weeks ($SD = 3.28$ weeks), averaging 3.04 hr of therapy per week ($SD = 2.36$ hr/week). There were no differences in treatment dosage between the two protocols, including total hours of therapy ($t[34] = -1.01$, $p = .32$; mean for protocol 1 = 30.42 hr; mean for protocol 2 = 37.00 hr), total weeks of therapy ($t[37] = 1.59$, $p = .12$; mean for protocol 1 = 10.00 weeks; mean for protocol 2 = 9.05 weeks), and mean hours of therapy per week ($t = -1.34$, $p = .09$; mean for protocol 1 = 2.75 hr; mean for protocol 2 = 3.89 hr). Therapy compliance was determined based on how many clinic hours per week participants spent on therapy tasks versus the expected number of clinic hours according to study protocols. Average group compliance was 71.88% ($SD = 19.07$); time not spent directly on therapeutic tasks was spent discussing other topics pertinent to treatment (e.g., strategy use, task performance, and scheduling).

Data from both studies were combined in the current study because both studies (a) involved impairment-level interventions and therapeutic tasks requiring multiple language and cognitive processes, (b) were similar in duration and intensity of intervention, and (c) resulted in favorable outcomes for participants. Specifically, individual slope analyses of either accuracy or response times on trained tasks indicated that 35 of the 39 PWA improved significantly in at least one targeted task.

Data Analysis

Spearman correlations were conducted between baseline scores on the ASHA FACS and baseline scores on the cognitive-linguistic measures to determine whether the pattern of results in the subsample resembled that of the results from the larger sample in Experiment 1. Spearman correlations between posttreatment scores also were conducted to characterize potential changes in the relationship between cognitive-linguistic and functional communication skills over time. An FDR correction was applied to account for multiple comparisons. Then, parametric two-tailed paired t tests were conducted to determine whether participants changed significantly from pre- to posttreatment on the WAB-R, CLQT, BNT, and PAPT. Because of the non-normal distribution of the ASHA FACS scores, two-tailed Wilcoxon rank-sum tests were conducted to determine whether participants changed significantly in functional communication due to therapy. To determine whether changes in cognitive-linguistic skills were related to co-occurring changes in functional communication, Spearman correlations were conducted between the change scores (i.e., posttreatment minus pretreatment scores) on the ASHA FACS domains and dimensions and the change scores on the other standardized assessments, with reported p values adjusted for multiple comparisons with an FDR correction.

Experiment 2: Results

Descriptive statistics regarding standardized test performance for the subset of PWA included in Experiment 2 are provided in Table 3. The same correlational analyses from Experiment 1 were conducted with the data from Experiment 2 to determine whether a similar relationship between cognitive-linguistic abilities and functional communication skills could be found for the subset of PWA who underwent therapy. At baseline, significant moderate to strong positive correlations were found between the scores on standardized cognitive-linguistic tests and each of the ASHA FACS CI scores (range: $r = .421$ – $.920$, $p < .01$ – $.001$); these correlations were even stronger than the correlations obtained for the larger sample used in Experiment 1. The correlations between the cognitive-linguistic tests and the QDC scores in this sample were comparable to those obtained with the larger sample with some minor differences in strength and significance for select correlations (see Table 4 for all results). The subset of PWA who underwent therapy were therefore considered

Table 3. Summary of standardized test scores for subset of PWA from Experiment 2 ($n = 39$).

Parameter	Pretreatment			Posttreatment		
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range
ASHA FACS Communication Independence (CI)						
Social Communication (out of 7)	5.60	1.06	3.48–6.90	5.65	0.95	3.52–6.86
Communication of Basic Needs (out of 7)	6.54	0.51	5.00–7.00	6.52	0.51	5.14–7.00
Reading, Writing, & Number Concepts (out of 7)	5.24	1.70	1.10–7.00	5.23	1.58	1.50–7.00
Daily Planning (out of 7)	4.92	1.90	1.00–7.00	5.01	1.75	1.00–7.00
Overall Communication Independence out of 7)	5.59	1.16	3.20–6.98	5.61	1.07	3.57–6.95
ASHA FACS Qualitative Dimensions of Communication Scores (QDC)						
Adequacy (out of 5)	3.81	0.89	2.00–5.00	3.81	0.71	2.50–5.00
Appropriateness (out of 5)	4.22	0.91	2.00–5.00	4.24	0.81	2.25–5.00
Promptness (out of 5)	3.43	0.88	2.00–5.00	3.36	0.83	2.00–5.00
Communication Sharing (out of 5)	3.63	1.13	1.00–5.00	3.51	0.98	1.50–5.00
Overall Qualitative Dimension Score (out of 5)	3.77	0.82	2.25–4.94	3.73	0.69	2.56–4.94
WAB						
Language Quotient (LQ) (out of 100)	62.49	26.03	15.50–99.10	63.82	25.36	11.30–99.40
Cortical Quotient (CQ) (out of 100)	66.08	22.83	20.32–98.00	67.89	22.18	15.70–98.35
Aphasia Quotient (AQ) (out of 100)	61.73	27.59	12.00–99.90	64.79	26.70	8.50–100.00
CLQT						
Attention (%)	62.89	30.85	1.86–97.21	71.53	25.24	2.79–97.21
Memory (%)	56.42	25.41	14.05–94.59	57.55	24.23	5.41–94.05
Executive Functions (%)	51.25	20.95	2.50–80.00	53.90	19.15	2.50–80.00
Language (%)	45.79	30.11	0.00–86.49	46.58	29.47	0.00–86.49
Visuospatial Skills (%)	67.96	25.88	3.81–96.19	72.58	23.33	7.62–96.19
Composite Score (%)	65.29	22.93	25.00–100.00	68.68	20.65	25.00–100.00
Clock Drawing (%)	65.16	30.73	0.00–100.00	68.10	31.24	0.00–100.00
BNT (%)	45.29	40.96	0.00–98.33	47.35	39.24	0.00–98.33
PAPT (%)	86.70	14.27	21.15–98.08	88.24	10.16	55.77–100.00

Note. ASHA FACS = American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults; WAB = Western Aphasia Battery; CLQT = Cognitive-Linguistic Quick Test; BNT = Boston Naming Test; PAPT = Pyramids and Palm Trees Test.

to be representative of the larger group on the basis of these baseline measures.

Posttreatment test scores on both scales of the ASHA FACS were also correlated with scores on the standardized cognitive-linguistic tests. As shown in online Supplemental Material S1, the number and strength of correlations differed slightly between pretreatment and posttreatment. The differences may have been influenced by the degree of change seen in each of the measures. Following treatment, PWA significantly improved in WAB-CQ ($t[32] = -2.29$, $p < .05$), WAB-AQ ($t[33] = -3.29$, $p < .01$), CLQT Attention ($t[33] = -3.15$, $p < .01$), and CLQT Visuospatial Skills ($t[33] = -2.25$, $p < .05$). Conversely, no significant changes in ASHA FACS domains or dimensions from pre- to posttreatment were observed, nor did any of these results approach significance.

Although the changes in the ASHA FACS did not reach statistical significance at a group level, it is possible that there was improvement in the ASHA FACS domain and dimension scores for certain individuals and that an association could exist between potential small improvements on the ASHA FACS and the significant improvement that was observed on several cognitive-linguistic tests. Therefore, individual change scores for each participant were calculated by subtracting the pretreatment score from the posttreatment score for each measure, and then Spearman correlations between these change scores were conducted.

After applying the FDR correction, no significant correlations between CI change scores and change scores on cognitive-linguistic measures were found. Only two significant associations were found involving QDC change scores, including moderate positive correlations between change scores on WAB-AQ and change scores on Appropriateness and Overall QDC ($r = .600$, $p < .05$; $r = .570$, $p < .05$; respectively; see Table 5). These results suggest that changes in cognitive-linguistic ability and changes in functional communication following therapy may co-occur, but significant associations are few, especially compared with the correlation results from the larger sample and the pre- and posttreatment correlations in the smaller sample.

Thus far, the results from both experiments indicate that cognitive-linguistic and functional communication skills are closely and positively related at a single time point, but a similar relationship was rarely observed in the pre- to posttreatment change scores from Experiment 2. There are several possible reasons for these disparate findings. One possibility is that although significant change was not observed in the ASHA FACS at the group level, certain PWA may have improved in their functional communicational abilities, and these individuals may have improved similarly in their impairment-level skills. Therefore, to investigate this possibility, we conducted a series of follow-up analyses using the data from Experiment 2.

Table 4. Correlations between baseline ASHA FACS and cognitive-linguistic test scores: subset of PWA from Experiment 2 ($n = 37$).

Test ^a	Social Communication	Basic Needs	Reading, Writing, Number Concepts	Daily Planning	Overall CI	Adequacy	Appropriateness	Promptness	Communication Sharing	Overall QDC
WAB-LQ	.906^{***}	.595^{***}	.871^{***}	.807^{***}	.893^{***}	.817^{***}	.529^{**}	.606^{***}	.826^{***}	.829^{***}
WAB-CQ	.920^{***}	.598^{***}	.853^{***}	.825^{***}	.891^{***}	.813^{***}	.526^{**}	.597^{***}	.838^{***}	.829^{***}
WAB-AQ	.904^{***}	.484^{***}	.799^{***}	.760^{***}	.834^{***}	.799^{***}	.487[*]	.578^{***}	.843^{***}	.817^{***}
CLQT Attention	.495^{**}	.591^{***}	.625^{***}	.630^{***}	.644^{***}	.581^{***}	.560^{***}	.444[*]	.379[*]	.570^{***}
CLQT Memory	.849^{***}	.542^{**}	.774^{***}	.754^{***}	.819^{***}	.798^{***}	.533^{**}	.473^{**}	.775^{***}	.778^{***}
CLQT Executive Functions	.558^{***}	.719^{***}	.687^{***}	.698^{***}	.727^{***}	.659^{***}	.664^{***}	.532^{***}	.519^{**}	.697^{***}
CLQT Language	.850^{***}	.502^{**}	.737^{***}	.743^{***}	.797^{***}	.722^{***}	.428[*]	.442[*]	.754^{***}	.712^{***}
CLQT Visuospatial	.421[*]	.603^{***}	.561^{***}	.585^{***}	.590^{***}	.528^{**}	.566^{***}	.394[*]	.374[*]	.538^{**}
CLQT Composite	.765^{***}	.666^{***}	.825^{***}	.811^{***}	.846^{***}	.813^{***}	.644^{***}	.559^{***}	.587^{***}	.772^{***}
CLQT Clock Drawing	.623^{***}	.604^{***}	.648^{***}	.711^{***}	.715^{***}	.544^{**}	.662^{***}	.420[*]	.494^{**}	.613^{***}
BNT	.803^{***}	.518[*]	.692^{***}	.773^{***}	.779^{***}	.668^{***}	.395[*]	.395[*]	.636^{***}	.639^{***}
PAPT	.614^{***}	.737^{***}	.664^{***}	.681^{***}	.747^{***}	.560^{***}	.484^{**}	.268 (n.s.)	.434[*]	.532^{**}

Note. FDR correction was applied to account for multiple comparisons. Correlation strength is indicated, where bold italic = strong (.100–.700), bold = moderate (.699–.400), and italic = weak (.399–.100). ASHA FACS = American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults; CI = Communication Independence; QDC = Qualitative Dimensions of Communication; WAB = Western Aphasia Battery; LQ = Language Quotient; CQ = Cortical Quotient; AQ = Aphasia Quotient; CLQT = Cognitive-Linguistic Quick Test; BNT = Boston Naming Test; PAPT = Pyramids and Palm Trees Test; n.s. = not significant.

* $p < .05$; ** $p < .01$; *** $p < .001$.

^aCI domain scores were not available for two PWA, and QDC dimension scores were not available for two additional PWA within the sample.

Table 5. Correlations between pre- to posttreatment change scores of the ASHA FACS and standardized tests ($n = 37$).

Test ^a	Social Communication	Basic Needs	Reading, Writing, Number Concepts	Daily Planning	Overall CI	Adequacy	Appropriateness	Promptness	Communication Sharing	Overall QDC
WAB-LQ	.245 (n.s.)	.063 (n.s.)	.261 (n.s.)	.027 (n.s.)	.215 (n.s.)	.086 (n.s.)	.399 (n.s.)	.403 (n.s.)	.136 (n.s.)	.475 (n.s.)
WAB-CQ	.251 (n.s.)	.132 (n.s.)	.261 (n.s.)	-.030 (n.s.)	.200 (n.s.)	.082 (n.s.)	.446 (n.s.)	.352 (n.s.)	.210 (n.s.)	.476 (n.s.)
WAB-AQ	.303 (n.s.)	.235 (n.s.)	.256 (n.s.)	.069 (n.s.)	.267 (n.s.)	.147 (n.s.)	.600*	.325 (n.s.)	.283 (n.s.)	.570*
CLQT Attention	.076 (n.s.)	.034 (n.s.)	.160 (n.s.)	-.207 (n.s.)	.008 (n.s.)	-.093 (n.s.)	.330 (n.s.)	.238 (n.s.)	.245 (n.s.)	.303 (n.s.)
CLQT Memory	.181 (n.s.)	.090 (n.s.)	.148 (n.s.)	-.015 (n.s.)	.090 (n.s.)	.141 (n.s.)	.175 (n.s.)	.128 (n.s.)	-.142 (n.s.)	.193 (n.s.)
CLQT Executive Functions	.103 (n.s.)	.131 (n.s.)	-.005 (n.s.)	-.028 (n.s.)	.077 (n.s.)	.116 (n.s.)	.313 (n.s.)	.086 (n.s.)	.087 (n.s.)	.228 (n.s.)
CLQT Language	.164 (n.s.)	-.056 (n.s.)	.181 (n.s.)	.075 (n.s.)	.154 (n.s.)	.067 (n.s.)	-.032 (n.s.)	-.043 (n.s.)	-.239 (n.s.)	-.042 (n.s.)
CLQT Visuospatial	.067 (n.s.)	.177 (n.s.)	.074 (n.s.)	-.191 (n.s.)	-.001 (n.s.)	-.025 (n.s.)	.359 (n.s.)	.165 (n.s.)	.222 (n.s.)	.282 (n.s.)
CLQT Composite	.204 (n.s.)	.188 (n.s.)	.219 (n.s.)	-.147 (n.s.)	.054 (n.s.)	.065 (n.s.)	.568 (n.s.)	.106 (n.s.)	.161 (n.s.)	.356 (n.s.)
CLQT Clock Drawing	-.218 (n.s.)	-.045 (n.s.)	-.102 (n.s.)	-.040 (n.s.)	-.170 (n.s.)	-.226 (n.s.)	.035 (n.s.)	-.313 (n.s.)	-.332 (n.s.)	-.192 (n.s.)
BNT	.293 (n.s.)	.261 (n.s.)	.280 (n.s.)	.249 (n.s.)	.337 (n.s.)	.201 (n.s.)	.246 (n.s.)	.040 (n.s.)	-.069 (n.s.)	.145 (n.s.)
PAPT	.193 (n.s.)	.061 (n.s.)	.143 (n.s.)	.143 (n.s.)	.181 (n.s.)	.325 (n.s.)	.247 (n.s.)	-.194 (n.s.)	-.009 (n.s.)	.053 (n.s.)

Note. FDR correction was applied to account for multiple comparisons. Correlation strength is indicated, where bold = moderate (.699–.400). ASHA FACS = American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults; CI = Communication Independence; QDC = Qualitative Dimensions of Communication; WAB = Western Aphasia Battery; LQ = Language Quotient; n.s. = not significant; CQ = Cortical Quotient; AQ = Aphasia Quotient; CLQT = Cognitive-Linguistic Quick Test; BNT = Boston Naming Test; PAPT = Pyramids and Palm Trees Test.

* $p < .05$.

^aChange scores in the CI domains and QDC dimensions not available for two PWA and four PWA, respectively.

Follow-Up Analyses

Individual change scores from the Experiment 2 sample were examined more closely. As a group, participants with more severe aphasia (as captured by WAB-AQ scores) appeared to improve to a greater degree than did those with milder aphasia on the measures on which they showed gains following therapy. This pattern was particularly noted on the ASHA FACS scores, and we suspected that the nonsignificant change on the ASHA FACS at the group level may have been due to the great number of mildly impaired participants in the sample. In particular, Experiment 2 included nine PWA (23.1% of the sample) whose WAB-AQ scores exceeded 93.6, which is the cutoff for mild aphasia according to the WAB manual.¹ These individuals were included in the study because they were still perceptibly aphasic and scored below the cutoff for normal limits on one or more other assessments, but we suspected they exhibited ceiling effects on the ASHA FACS. To substantiate this hypothesis, simple regression analyses were conducted in which baseline WAB-AQ was used as a categorical severity predictor of ASHA FACS domain and dimension change scores. These analyses revealed that the overall model of baseline aphasia severity predicting functional communication change approached significance for Social Communication ($F[3,35] = 2.69, p = .061$), Daily Planning ($F[3,35] = 2.78, p = .056$), and Overall CI ($F[3,35] = 2.64, p = .064$). Specifically, individuals with moderate and severe WAB-AQ scores demonstrated significantly greater change in these ASHA FACS domains compared with the group of individuals with WAB-AQ scores greater than 93.6.

Therefore, we removed these very mildly affected participants from the sample, and the analyses conducted in Experiment 2 were repeated using data from this subset of PWA (i.e., individuals with baseline WAB-AQ scores of less than 93.6, $n = 30$). As in Experiment 2, Spearman correlations were first conducted on the pretreatment and posttreatment test scores. Similar to the results of the full treatment sample, many significant correlations were found between the cognitive-linguistic tests and the ASHA FACS domains and dimensions at both time points, with some changes in strength and significance in certain bivariate relationships at posttreatment (see online Supplemental Materials S2 and S3). In this sample, significant improvement following therapy was seen for WAB-AQ ($t[26] = -3.08, p < .01$) and CLQT Attention ($t[26] = -2.57, p < .05$), whereas a trend toward significant improvement was seen for WAB-CQ ($t[25] = -1.97, p = .060$) and the BNT ($t[25] = -1.94, p = .064$). On the ASHA FACS, significant improvement in pre- to posttreatment scores of Social Communication ($V = 107.5, p < .05$) and Daily Planning ($V = 86, p < .05$)

were observed, and a trend toward significant improvement was seen for Reading, Writing, and Number Concepts ($V = 112, p = .066$), Overall CI ($V = 128, p = .054$), and Overall QDC ($V = 119, p = .056$).

As before, Spearman correlations conducted between change scores on the ASHA FACS domains and dimensions and those on the assessments of cognitive-linguistic skills revealed that only one of the two correlations observed in Experiment 2 remained significant in the follow-up analysis: change in WAB-AQ and change in ASHA FACS Appropriateness ($r = .648, p < .05$). No other significant correlations between change scores were found. However, from a theoretical perspective, one might question whether all subtests or domains would be expected to change together in this population (e.g., change on the BNT would probably not be related to change in Appropriateness on the ASHA FACS for PWA). Based on the single time point analyses (i.e., in Experiment 1 and at pre- and posttreatment in Experiment 2), the strongest relationships between cognitive-linguistic abilities and functional communication skills were often found between composite cognitive-linguistic subscales (i.e., WAB-LQ, -CQ, and -AQ and CLQT Composite) and composite ASHA FACS domains and dimensions (i.e., Overall CI and Overall QDC). Planned comparisons between just these composite scores for the more impaired group of PWA resulted in significant relationships between change in Overall QDC and change in WAB-LQ ($r = .572, p < .05$), WAB-CQ ($r = .567, p < .05$), and WAB-AQ ($r = .596, p < .05$). In other words, according to these comparisons, changes in the quality of functional communication were associated with changes in aphasia severity, yet no significant relationships included change in CLQT Composite or, more importantly, change in Overall CI (which captures the ability to execute specific functional tasks).

The results of the follow-up analyses confirm that a ceiling effect driven by the substantial proportion of mildly impaired PWA in the full treatment sample in Experiment 2 limited the extent of significant change observed on the ASHA FACS. When the least language-impaired PWA were removed from the analysis, the remaining participants improved on measures of cognitive-linguistic ability and on dimensions and domains of the ASHA FACS. However, only a few significant results—mostly on planned comparisons of change in composite cognitive-linguistic measures and change in composite ASHA FACS dimensions and domains—were found in change score correlations.

Discussion

The goal of the current study was to examine the relationship between cognitive-linguistic abilities and functional communication in PWA, both at a single time point and in terms of treatment-induced changes over time. The ASHA FACS was used as a proxy for functional communication, and a battery of measures was used to assess cognitive-linguistic skills. We began by confirming prior findings demonstrating an association between cognitive-linguistic and functional communication skills at a single

¹The cutoff for mild aphasia according to the WAB-Revised manual is an AQ score of 93.8. Two participants in the current sample had baseline AQ scores of 93.7, but these participants' scores were excluded from the follow-up analyses to stay consistent with the cutoff for mild aphasia used by Frattali et al. (1995) in the normative ASHA FACS sample.

time point and then examined whether language therapy leads to similar degrees of change in these skills.

In Experiment 1, significant moderate to strong positive correlations between the domains, dimensions, and cumulative scores of the ASHA FACS and most cognitive-linguistic tests and subtests were found in a sample of 72 PWA. These results suggest that impairment-level performance (as measured with the WAB-R, CLQT, BNT, and PAPT) and functional communication (as measured with the ASHA FACS) are closely related and that greater cognitive-linguistic impairment is associated with poorer functional communication skills and vice versa. This finding is consistent with results of previous studies, in which positive associations also were found between functional communication and various measures of language and cognition (e.g., Bakheit et al., 2005; Frattali et al., 1995; Fridriksson et al., 2006; Hula et al., 2015; Irwin et al., 2002; Lomas et al., 1989; Murray, 2012; Ross & Wertz, 1999).

In general, composite scores on each type of measure were most strongly and significantly associated with scores on other measures. For example, composite scores of cognitive-linguistic impairment (i.e., WAB-LQ, -CQ, and -AQ and the CLQT Composite) were significantly and strongly related to the majority of the ASHA FACS domains and dimensions as opposed to the BNT and the PAPT. In a similar fashion, the composite scores of functional communication—ASHA FACS Overall CI and Overall QDC—were strongly correlated with seven and six of the 12 impairment measures, respectively, whereas the domains and dimensions capturing more specific skills (e.g., Promptness, which captures the timeliness of communication) were less strongly related to impairment-level tests. The fact that various cognitive-linguistic composite scores were strongly correlated with ASHA FACS domain and dimension scores makes sense, given that these measures are derived from an array of language tasks examining fluency, expressive language, auditory comprehension, reading, writing, problem solving, and other skills that may contribute to one's performance of the type of functional activities that are part of the items on the ASHA FACS. In the same vein, the ASHA FACS composite scores represent the extent of independence and effectiveness with which PWA carry out an assortment of functional tasks, each of which rely on skills assessed by the various cognitive-linguistic instruments.

In Experiment 2, we examined the extent to which scores on assessments of cognitive-linguistic ability and functional communication changed as a result of language therapy in a subset of 39 PWA and the degree of association between changes on each type of instrument. Our three main predictions were that (a) cognitive-linguistic and functional communication skills would be significantly and positively correlated at each time point (i.e., pre- and posttreatment testing), (b) significant improvements in both cognitive-linguistic abilities and functional communication as a consequence of treatment would be observed on the standardized measures, and (c) significant positive correlations between change scores on the two types of measures would be seen. Similar to Experiment 1, the

majority of associations between cognitive-linguistic scores and functional communication subtests and domains were significant at both baseline and posttreatment assessments, confirming our first prediction.

In the full treatment sample, significant improvement on tests of cognitive-linguistic skills (i.e., WAB-CQ and -AQ, CLQT Attention, and CLQT Visuospatial Skills) but not on the ASHA FACS was noted, which we attributed to the proportion of the sample with mild aphasia. Ross and Wertz (2004) found that the ASHA FACS is capable of distinguishing functional communication skills of those with mild aphasia from functional communication skills of neurologically intact adults, yet these authors did not investigate whether the ASHA FACS was capable of detecting change over time in functional communication of persons with mild aphasia. We found that the subset of the treatment sample with WAB-AQ scores below 93.6 improved significantly both on measures of cognitive-linguistic ability and on a number of ASHA FACS domains and dimensions. Therefore, the results of the follow-up analyses confirm our second prediction, that improvements in both cognitive-linguistic skills and functional communication do occur after an impairment-based therapy and that these improvements can be captured by the standardized assessments used in the current study.

Given the number of impairment-level and functional scores that improved after treatment in the more impaired subset of PWA, our third prediction was still only partially validated. Similar to the other correlation analyses, the change score correlations initially were carried out in a somewhat exploratory fashion (by correlating each subtest of the cognitive-linguistic measures with each domain and dimension of the ASHA FACS), and only one significant relationship between these change scores was found. In contrast, planned comparisons between change scores of composite cognitive-linguistic measures (i.e., WAB-AQ, -CQ, and -LQ and CLQT Composite) and composite ASHA FACS scales (i.e., Overall CI and Overall QDC) revealed that change in the degree of aphasia (according to WAB-AQ, -CQ, and -LQ) was related to change in quality of functional communication (according to ASHA FACS Overall QDC) for these PWA. Change in cognitive-linguistic abilities was not significantly correlated with change in the successful execution of functional tasks (according to Overall CI) in these planned comparisons. As was the case in other studies (e.g., Irwin et al., 2002; Persad et al., 2013), these results suggest that cognitive-linguistic abilities and functional communication are responsive to the same treatment(s), but the extent of such response is variable enough to preclude substantial consistency in the degree and direction of change across PWA across multiple measures. These findings are consistent with the A-FROM and ICF frameworks, which depict impairment-level abilities (i.e., cognitive-linguistic skills in the current study) and functional activity-level abilities (i.e., functional communication skills in the current study) as distinct but connected constructs.

Although impairment-level and functional responses to therapy may be mostly dissociable, there are additional

potential explanations for the lack of pervasive co-occurring related change. First, there are notable differences in the way that the cognitive-linguistic tests and the ASHA FACS measure their target constructs. Specifically, the cognitive-linguistic tests are objective assessments wherein a PWA receives a score based on how well he or she completes explicit tasks (e.g., naming objects on the WAB-R or retelling a story on the CLQT). In contrast, the ASHA FACS is a subjective measure completed by proxy (e.g., an SLP with input from the PWA's significant other or loved one, as needed); it is not performance based and does not rely on the execution of discrete tasks in front of the clinician. In addition, the cognitive-linguistic tests use continuous scales, whereas the ASHA FACS utilizes 5- and 7-point ordinal rating scales, and overall, only very small improvements on the ASHA FACS domains and dimensions were observed, even in the more language-impaired treatment group. Although there is evidence that the ASHA FACS is a valid measure of the theoretical construct of functional communication (Donovan et al., 2006; Ross & Wertz, 2003), there is no empirical evidence that this measure is sensitive enough to detect meaningful changes in response to therapy. Although an extensive discussion of the properties of various instruments and their strengths and limitations is beyond the scope of this article, the fact remains that different measurement approaches may make some instruments better equipped to capture change or more responsive to a particular treatment than others (Coster, 2013; Hula, Fergadiotis, & Doyle, 2014). Performance-based measures of functional communication such as the CADL-2 or the ANELT or patient-reported outcome measures such as the Assessment for Living with Aphasia (Kagan et al., 2010) or the Aphasia Communication Outcome Measure (Hula et al., 2015) would likely yield different results and should be explored in future studies.

Second, to capture interpretable group level change associations, particular facets of cognitive-linguistic skill and functional communication would have to improve to a certain degree within one PWA, and that same pattern of improvement would have to be observed across several PWA. In the current study, therapy was tailored to each participant's needs, which meant that PWA were trained on different types of therapy tasks and improved in different types of skills. Even for individuals whose language skills improved in similar ways, it is possible that other trained therapy tasks resulted in different functional gains. For example, if two PWA both improved in lexical retrieval of food items via a semantic feature-based therapy task, the first PWA may have improved in ordering in a restaurant due to practice on other tasks of verbal expression, whereas the other PWA may have improved in writing a grocery list due to practice in selected writing exercises. Alternatively, two PWA who worked on the same cognitive-linguistic skills may have changed in different ways in their functional communication due to the inherent heterogeneity in response to therapy that is seen in PWA (Code et al., 2010; Rodriguez et al., 2013; Winans-Mitrik et al., 2014) or due to other environmental (e.g.,

family support, communication opportunities) or personal (e.g., motivation, confidence) factors that may have differed among participants. Therefore, given the number of ways participants could change, it may not be surprising that we did not see a more consistent pattern of change across all measures in a relatively small sample of PWA.

Clinical Implications

This investigation allowed us to draw some conclusions about the relationship between impairment- and function-level skills in PWA, and these conclusions have practical clinical implications. First, we found that a global assessment of cognitive-linguistic ability (such as WAB-AQ or CLQT Composite) can provide insight into the global functional communication skills of an individual with aphasia, and vice versa, a global functional communication measure such as the ASHA FACS Overall CI can provide a general idea of an individual's language deficits. The results of our study, like those of others, show that these global measures can capture improvement as a function of therapy, even when therapy targets specific impairment-level skills. However, the ASHA FACS appears to be effective at capturing change in persons with more severe aphasia but may be less well-suited to persons with mild aphasia due to ceiling effects. Because cognitive-linguistic skills and functional communication appear to be distinct (although related) constructs, we concur with Ross and Wertz (1999) that it is best to assess both areas separately to definitively capture all changes over time.

Deconstructing the Relationship Between Cognitive-Linguistic Processing and Function

A tight link between cognitive-linguistic skills and functional communication at static time points does not necessarily translate to a similarly highly related dynamic relationship between these constructs. The question then remains: what exactly is the nature of this dynamic relationship? Our view is that certain impairment-level cognitive-linguistic skills underlie the successful execution of functional communicative acts for PWA; for example, to select an item from a menu, an individual must be able to read single words, visually scan the options, remember the choices, and have good decision-making skills. In therapy, a clinician may target such specific cognitive-linguistic skills, and improvement in those skills would ideally contribute to gains in a related functional task (e.g., ordering in a restaurant). Conversely, one might address the functional level directly and find that there is improvement in both the functional task and the underlying cognitive-linguistic skills.

However, such generalization to untrained contexts is a best-case scenario. There is some evidence that working in one domain can lead to improvement in the other, but, as of this writing, we do not empirically know how

much change it takes in one domain to see measurable results in the other. Moving forward, it is necessary for researchers to empirically and systematically investigate this relationship by directly comparing different types of therapies using a range of different measures, including measures that also capture other factors (e.g., personal and environmental variables) that might influence results. To date, only a few number of studies have been conducted to directly compare impairment-level, functional-level, and integrated interventions (e.g., Barthel, Meinzer, Djundja, & Rockstroh, 2008; de Jong-Hagelstein et al., 2011; Meinzer, Djundja, Barthel, Elbert, & Rockstroh, 2005), and, although the results have been mixed, there is preliminary evidence that an integrated approach may result in the best outcomes. As such, our working hypothesis is that the most effective integrated approach would target specific skills in both domains in conjunction, thereby facilitating co-occurring and related change in both cognitive-linguistic and functional communication abilities. Future studies that measure and directly compare outcomes from such an integrated approach to outcomes from more traditional approaches (i.e., impairment- and functional-only treatments) are warranted to test this hypothesis. These investigations will allow researchers to better understand the degree of relatedness in the mechanisms of change in cognitive-linguistic and functional communication abilities and will provide better insight into how best to measure and treat deficits in both domains in PWA.

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