The "I" in ICAPs: Examining Treatment Intensity Under the Microscope

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Background: Intensive Comprehensive Aphasia Programs (ICAPs) provide high doses of treatment over short periods. Treatment intensity in post-stroke aphasia rehabilitation and research is not well understood and is typically underspecified, including within ICAPs and modified Intensive Comprehensive Aphasia Programs (mICAPs), in which intensity is a fundamental design component. One recently developed model of treatment conceptualisation, the Multidimensional Dose Articulation Framework (MDAF), may offer a systematic, comprehensive, and granular method of characterising treatment intensity, though this framework has not yet been used to capture elements of intensity during an ICAP or mICAP.

Aims: The purpose of this paper is to examine and describe increasingly specific details of treatment intensity for both an ICAP and mICAP delivered at the University of Montana (UMT).

Methods & Procedures: Fourteen participants with aphasia attended an 84-hour ICAP (n = 8) or a 24-hour mICAP (n = 6) delivered by graduate student clinicians at UMT. Ethics approval was obtained from the UMT IRB (#13-23). We examined intensity and dose using components of the MDAF including broad temporal parameters, and episode-specific length and intensity. Descriptive statistics were used to report group-level, participant-level, and treatment-level parameters.

Outcomes & Results: In this descriptive manuscript, we use a series of vignettes to report temporal parameters from the MDAF including treatment duration, days, sessions, and session density, and episode-level characteristics including episode length and episode intensity. Vignette one examines ICAP and mICAP planned versus actual temporal parameters. Vignette two describes episode-level

detail across two evidence-based treatments administered during the ICAP. Vignette three details differences in delivery of a single treatment approach between two participants. In each vignette, we discuss the benefits and challenges of tracking treatment intensity with fine detail.

Conclusions: Comprehensive specification of dose and intensity parameters is essential to compare efficacious treatment programs and to understand variability in treatment response across individuals with aphasia. The MDAF is a promising tool, though detailed treatment intensity remains a challenging construct to measure, particularly at the level of the episode. Clinical researchers interested in dose and intensity and authors of evidence-based therapy approaches must continue to work to define and describe *active ingredients* within therapy approaches.

Keywords: aphasia, intensive comprehensive aphasia programs, intensity, dose

Introduction

Intensity as a treatment variable for aphasia rehabilitation implementation and research has gained significant attention in recent years (e.g., Bhogal et al., 2003; Brady et al., 2016; Marcotte et al., 2018; Pierce et al., 2021; RELEASE, 2021). For behavioural interventions, such as those used to treat aphasia, 'intensity' often refers to the amount of treatment provided over a given period of time. Accumulating evidence indicates that a greater number of treatment hours during the chronic stage of recovery predicts language improvement (Bhogal, Teasell, & Speechley, 2003; Brady et al., 2016; Breitenstein et al., 2017; Johnson et al., 2019). Best practice guidelines from nine international healthcare settings (Simmons-Mackie et al., 2017) recommend intensive rehabilitation over non-intensive services to maximise experience-dependent neuroplasticity. Principles of neuroplasticity theorised to influence aphasia recovery

include tenets such as *repetition matters* and *intensity matters* (Kleim & Jones, 2008) or *repetition and intensity promote learning and consolidation* (Kiran & Thompson, 2019). High quality systematic reviews and meta-analyses have underscored the role of intensity in aphasia rehabilitation (Brady et al., 2016; RELEASE, 2021), and some aphasia treatments are founded on intensive practice (e.g., Constraint-induced Language Therapy; Pulvermüller et al., 2001). Some service delivery models are foundationally designed to maximise intensity by delivering a high dose of treatment over a brief intervention duration (Rose et al., 2013). Still, clinical definitions of what constitutes intensive therapy vary, and despite recent attempts to systematically define terms related to dose and intensity (e.g., Harvey et al., 2021; Goikoetxea-Sotelo & van Hedel, 2023), concepts and terms used remain murky due to inconsistent definitions and conflicting findings in the neurorehabilitation literature base (Brogan et al., 2021; Cavanaugh et al., 2021; Cherney et al., 2012; Harvey et al., 2023; Pierce et al., 2021; Shrubsole et al., 2019).

Intensity and dose are intertwined, multidimensional constructs, which are typically underspecified in treatment studies (Baker, 2012; Harvey et al., 2023; Harvey et al., 2021; Yoder et al., 2012; Zeng et al., 2012). The terms *intensity, dose, and dosage* are sometimes used synonymously and interchangeably, while in other publications these terms are differentiated, yet inconsistently defined. In aphasia treatment studies, *intensity* may refer to the overall schedule (e.g., total hours of treatment over total number of weeks), the weekly schedule (e.g., hours or sessions per week) (Pierce et al., 2020; RELEASE, 2021), or the practice schedule within a session (e.g., massed vs. distributed trials within a session). *Dose* can be a discrete or continuous variable (Baker, 2012), and sometimes represents the total hours received (RELEASE, 2021), how much treatment is received and in what schedule (Harvey et al., 2022), the number of episodes

of activity performed in a specified treatment period (Baker, 2012; Page et al., 2012; Warren et al., 2007) or may be represented at the level of a single session (i.e., within-session dose), by using parameters occurring within the session such as frequency of practice or time within a session (Gannotti, 2017). In the absence of consensus definitions, we will use the term *dose* to refer to the amount of treatment provided or received (quantified in time and/or active ingredients for this study), and the term *intensity* to refer to how the dose was delivered over time (i.e., the schedule of delivery for this study).

Intensive Comprehensive Aphasia Programs (ICAP; Rose et al., 2013; Rose et al., 2021) are designed to maximise intensity and infuse principles of neuroplasticity while simultaneously addressing patient goals spanning the International Classification of Functioning, Disability, and Health (Babbitt et al., 2013; Babbitt et al., 2015; WHO, 2001), personal recovery (Manning et al., 2019), and the Life Participation Approach to Aphasia (Chapey et al., 2000). ICAPs deliver individualised and highly intensive treatment, while targeting multiple speech, language, cognitive, and psychosocial domains in the context of a cohort of individuals living with aphasia. By definition, ICAPs provide a minimum of 30 hours of treatment delivered at least three hours per day over two weeks (Rose et al., 2013). In the context of ICAPs, the "I" refers to a higher than typical number of treatment hours provided over a small number of weeks. Programs typically include individual sessions, group sessions, technology-based therapy, patient and family education/training, and community outings (Babbitt et al., 2015; Rose et al., 2013). ICAPs have been shown to improve cognitive-linguistic outcomes and functional communication (Babbitt et al., 2015; Griffin-Musick et al., 2020; Griffin-Musick et al., 2021; Hoover & Carney, 2014; Persad et al., 2013; Rodriguez et al., 2013; Winans-Mitrik et al., 2014). Collectively, behavioural and

neuroimaging findings indicate that the ICAP model's foundational components (i.e., high treatment intensity, comprehensive intervention, cohort-based service delivery) contribute to improved cognitive-linguistic and functional communication outcomes for stroke survivors with aphasia (Baliki et al., 2018; Dignam et al., 2015; Griffin-Musick et al., 2021; Hoover et al., 2017; Leff et al., 2021; Winans-Mitrik et al., 2014).

While evidence supports ICAP efficacy, some studies have documented the clinical challenges in implementing and sustaining ICAPs (Monnelly et al., 2023; Shrubsole et al., 2023). Pragmatic constraints may impact the ability to meet both the intensiveness and comprehensiveness parameters defined by the ICAP model. Specifically, logistics related to funding, staffing, and rigid intensity parameters (i.e., a minimum of 30 hours of treatment delivered at least three hours per day over two weeks). Modified ICAPs (mICAPs) have thus emerged as an alternative delivery model (Rose et al., 2021). A mICAP is defined as a cohort-based programme that meets all but one ICAP criterion (i.e., there may either be a modification to intensity or a single component of comprehensiveness; Rose et al., 2021). ICAPs provide a context for holistic and intensive aphasia treatment (Hoover et al., 2017) and mICAPs may provide a similarly supportive environment.

How intensive are ICAPs and mICAPs?

Figure 1 shows the total hours versus total number of therapy days reported in 14 ICAPs and seven mICAPs described in a recent international ICAP survey (Rose et al., 2021). Of the mICAPs, four were considered "modified" due to alterations in intensity rather than comprehensiveness, suggesting that this component of ICAPs is a particularly challenging one to provide across clinical settings. A wide range of schedules were reported (30-220 hours; 5-44 days) with ICAPs tending to provide more

hours of treatment over fewer days (median 25 hours per week) compared to mICAPs (15 hours per week).

Figure 1. Total provided hours versus total days for ICAPs and mICAPs as reported in Rose et al., (2021)

By design, ICAPs provide a range of therapeutic interventions (e.g., impairment-focussed treatments, group psychoeducation) and delivery modalities (e.g., individual, group, and computer-based therapy) (Kincheloe et al., 2022; Rose et al., 2021). The assertion that "each hour of therapy is not equal" (Yoder et al., 2012; Zeng et al., 2012) is of particular importance to clinical researchers striving to understand the relative importance of various interventions and delivery contexts to optimize ICAP outcomes. The content of one treatment hour to the next varies between sessions and participants. Complete specification of therapeutic activities is essential to compare efficacious treatment programs and to understand variability in treatment response across individuals with aphasia (Harvey et al., 2023). A complete understanding of ICAP intensity therefore requires careful examination of the activities performed "within the hour".

Peeling back the layers of treatment intensity

There are a number of ways to examine treatment intensity in complex service delivery models such as ICAPs. For example, the Therapeutic Intensity Ratio (TIR; Babbitt et al., 2016) has been used to characterize the intensity of ICAPs and describe treatment schedules by quantifying "weekly intensity" (Rose et al., 2021). The TIR is the percentage of time in a week spent in treatment, assuming a maximum of 40 hours

of intervention per week (e.g., 20 hours in a week equates to a TIR of 50%). The TIR compares broad temporal parameters but does not provide a mechanism through which to look more narrowly "within-the-hour" at more complex active ingredients present in an ICAP.

The Multidimensional Dose Articulation Framework (MDAF; Hayward et al., 2021) provides a way to conceptualise, measure, and report multiple dimensions of treatment intensity and dose. As outlined in Table 1, the MDAF specifies temporal parameters (i.e., the overall duration of treatment, the number and spacing of treatment days and sessions), session density (i.e., active versus inactive treatment time within a single session) and episode-level characteristics (i.e., episode length, difficulty, and intensity). According to the MDAF, episodes contain the *active ingredients* of treatment which are considered the base units of complex behavioural aphasia interventions (Turkstra et al., 2016). The active ingredients are the actions performed by either the treatment provider or recipient that are theoretically linked to the underlying mechanisms of that treatment (Van Stan et al., 2019). In addition to the concept of active ingredients specified by the MDAF, the recently developed Rehabilitation Treatment Specification System (RTSS; Hart et al., 2019) also attempts to explain how and why a treatment works (Cherney et al., 2022). The RTSS conceptualizes: (1) one target (i.e., the ability that may change as a result of treatment); (2) ingredients supplied by the clinician to support or induce the intended change (e.g., cues, activities, modalities); and (3) the treatment's hypothesized mechanism of action (i.e., the way in which active ingredients elicit change in the target). The RTSS and MDAF models may have the potential to work together to clearly define (i.e., the RTSS) and quantitatively measure (i.e., the MDAF) treatment-induced change. To date, the MDAF and the RTSS have each been applied in a small number of aphasia treatment studies (Cherney et al.,

2022; Harvey et al., 2022; Harvey et al., 2023), but both have yet to be applied to the ICAP service delivery model. For the purposes of this paper focused on measuring quantitative aspects of treatment intensity, we will focus on the MDAF, though we acknowledge the RTSS and MDAF may serve as complementary frameworks for future studies.

Table 1. MDAF Descriptors

In this paper, we will describe intensity and dose data collected during the delivery of an ICAP and mICAP by graduate student clinicians at the University of Montana (UMT). Putting intensity under the microscope, we provide vignettes that explore dose dimensions, beginning with a broad overview of program dose and intensity (vignette 1), then moving to a detailed examination of dose and intensity across two impairment-focussed treatments (vignette 2), and finishing with an exploration of variability in treatment delivery between two ICAP participants (vignette 3). The focus of this manuscript is to measure and report treatment intensity and dose dimensions within an ICAP and mICAP rather than to analyse the effect of intensity and dose on treatment.

Aims

The purpose of this paper is to explore, examine, and reflect upon ICAP intensity and dose dimensions using the MDAF as a tool to capture increasingly specific details of treatment. Our specific aims are to:

1. Examine and compare dose and intensity at the level of the session, week, and overall duration in an ICAP and mICAP;
2. Compare episode intensity for two evidence-based, impairment-focussed treatment approaches during individual ICAP sessions; and

3. Explore variability in within-episode, within-session, and across-session intensity and dose for two ICAP participants.

Materials and Methods

This manuscript reports on a Phase I pilot study that sought to prospectively investigate two clinical aphasia rehabilitation programs (a 4-week ICAP and a 2-week mICAP) that were carried out from May to July 2023 at UMT (UMT IRB #13-23). These programs were delivered by graduate student clinicians in speech-language pathology under the direct supervision of trained speech-language pathologists.

Participants

Therapists and Assessors

Graduate Student Clinicians. Sixteen speech-language pathology (SLP) graduate student clinicians (GSCs) were enrolled in the summer 2023 neurological rotation at UMT. All GSCs had completed the first year of a two-year Master of Science graduate program. GSCs underwent a rigorous two-week orientation (75 hours over two weeks) focused on the theoretical rationale and clinical procedures associated with the ICAP and mICAP service delivery models, and were trained to use the MDAF to capture intensity and dose data during individual treatment sessions. Eight GSCs were assigned to each program.

Graduate Student Researchers. Two graduate student researchers completing their Master's theses in speech-language pathology administered all pre- and post-treatment assessments for the ICAP and mICAP. Student researchers were extensively trained to administer and score each assessment (35 hours of preparation and training)

during the semester prior to the summer programming and participated in the intensive two-week orientation for graduate student clinicians.

Undergraduate Research Assistants. Four undergraduate research assistants (RAs) were hired to assist with data collection. RAs participated in relevant portions of the two-week student orientation and were trained to use the MDAF to track dose during individual treatment sessions throughout the ICAP and mICAP, either through observing treatment sessions or by watching video recordings.

Stroke Survivors with Aphasia

People with aphasia were recruited for this prospective, Phase I pilot study from the United States and Canada. Participants were self-referred or referred by a healthcare professional. Recruitment channels included email distribution lists, list serves, social media, and snowball emails that reach aphasia related healthcare professionals or researchers who regularly investigate stroke survivors with aphasia, and regional and national aphasia advocacy groups.

Inclusion criteria included persons with aphasia who were over the age of 18, medically stable, and fluent speakers of English; who demonstrated the presence of aphasia per the *Quick Aphasia Battery* (QAB; Wilson et al., 2018); who were greater than or equal to three months post-onset; and who had corrected to normal hearing and vision. See Table 2 for a summary of participant characteristics using the DESCRIBE reporting standards (Wallace et al., 2023). Fourteen people with aphasia consented to participate in either the ICAP (n = 8) or mICAP (n = 6).

Table 2. Participant Demographic and Stroke Characteristics

Procedures

Program Design and Delivery

The broad goal of programming at UMT is to provide comprehensive aphasia therapy that is individualised and salient, addresses multiple modalities, and provides clearly defined intensity parameters. We designed the four-week ICAP based on previous clinical programming at UMT, totalling 84 hours of therapy (see Griffin-Musick et al., 2020 and Off et al., 2019 for additional UMT ICAP information). As part of a larger research protocol, we also designed a novel two-week, 24-hour mICAP to include the same ICAP components and similar ICAP schedule parameters. Appendix A details UMT ICAP and mICAP guidelines for the current protocol using the template for intervention description and replication (TIDieR) checklist (Hoffmann et al., 2014). The ICAP and mICAP included 1:1 sessions (i.e., individual sessions with the participant with aphasia and their student clinician), small group sessions (e.g., conversation group, narrative group, communication partner training group), large group sessions (e.g., aphasia community group), and community engagement activities focused on skill generalisation (e.g., aphasia-friendly art museum tours). Both the ICAP and mICAP included a weekly care partner psychoeducation group, as well as interprofessional programming from physical therapists, occupational therapists, and pharmacists.

To increase consistency while still allowing for individualisation of evidence-supported treatments, GSCs, in consultation with their supervisors and ICAP directors (first and fifth authors), selected from nine evidence-based treatment approaches for aphasia and/or apraxia of speech including: Phonological Components Analysis (Leonard et al., 2008), Semantic Feature Analysis (Boyle, 2010), Phonomotor Therapy

(Kendall et al., 2015), Verb Network Strengthening Treatment (Edmonds et al., 2009), Response Elaboration Treatment (Kearns, 1985), Combined Aphasia and Apraxia of Speech Treatment (Wambaugh et al., 2014), Oral Reading for Language in Aphasia (Cherney, 2010), Copy and Recall Treatment (Beeson et al., 2003), and Intensive Auditory Comprehension Treatment for Severe Aphasia (Knollman-Porter et al., 2018). GSCs were not limited to a minimum or maximum number of treatment approaches but, rather, were instructed to individualise approaches based on participant need. All treatment stimuli were individualised and made salient for each participant.

Screening Procedures

Once participants with aphasia consented and confirmed enrolment in either the ICAP or mICAP, the program directors (first and fifth authors) scheduled one-hour video-conference calls with the participant and their family care partner(s). These initial screening meetings included administration of the *Quick Aphasia Battery* (Wilson et al., 2018), discussion of program details and logistics, and initial discussion of life-participation focused treatment goals.

Pre- and Post- Treatment Assessment

Participants with aphasia completed a comprehensive assessment battery within one week of beginning the program, and again within four days of completing the treatment phase of the ICAP or mICAP. See Appendix B for a list of assessments administered. Future publications will detail outcomes from all assessments administered across ICAP and mICAP treatment programs.

Data Collection and Analysis

Attendance and Treatment Fidelity

To track dose and intensity at the level of the session, week, and overall duration (i.e., Aim 1) participant attendance was tracked using paper-based *Treatment Fidelity Logs* (see Appendix C) completed by GSCs each day. Documenting actual attendance (rather than just scheduled treatment hours) was important, as there are known higher levels of attrition in intensive therapy programs (Brady et al., 2016), and because no ICAPs to our knowledge have reported treatment fidelity and attendance in those who do not attrite, but do not receive all treatment hours. To compare episode intensity for impairment-focussed treatments (i.e., Aim 2), GSCs and RAs collected detailed participant data for all 1:1 treatment sessions using the MDAF. Every 1:1 session was video recorded via a Clinical Observation Recording System (CORS, https://www.ipivs.com). GSCs completed a *Daily Summary Log* (see Appendix D) each day as well as *Treatment Dosage Logs* for each of the nine evidence-based treatments (see Appendices E and F). RAs completed *Treatment Dosage Logs* for every 1:1 treatment session.

All logs were organised by the first and fifth authors, and manually entered into a Microsoft Excel spreadsheet by the first author. Each log was checked for errors made during manual data entry a minimum of two times by the first author. Calculation of descriptive statistics (i.e., mean, median, range, standard deviation, interquartile range) was completed in Microsoft Excel (Version 16.76).

Results

Through a series of vignettes, we describe and illustrate intensity and dose

dimensions of the ICAP and mICAP through the lens of the Multidimensional Dose Articulation Framework (MDAF). We begin by broadly examining and comparing overall duration, weekly treatment intensity, session duration, and session density across ICAP and mICAP programs (vignette 1). We then put intensity under the microscope to examine episodes within sessions, considering dimensions including episode length and episode intensity for two evidence-based impairment-focussed treatment approaches implemented during 1:1 ICAP treatment sessions (vignette 2). Finally, we take a holistic view to consider multiple dose dimensions across two ICAP participants to explore variability in dose and intensity that occurs within episodes and sessions, and across the duration of the treatment program (vignette 3).

Figure 2. UMT ICAP Intensity Representation within the MDAF

Vignette 1: Examining Treatment Intensity with the Naked Eye

Vignette Aim: Examine and compare intensity at the level of the session, week, and overall duration in an ICAP and mICAP.

Conceptualising intensity at its broadest level, we wanted to compare and describe differences in treatment hours using both the MDAF and TIR between the ICAP and mICAP groups, and to better understand how the planned schedule compared to the actual number of hours received by each group. Table 3 details differences in planned versus actual schedule parameters, TIR, and 1:1 session density for the two programs.

Table 3. ICAP and mICAP Designed versus Delivered Intensity Parameters

The ICAP condition was designed to be delivered five to six hours per day, four days per week, for four weeks (21 hours per week), totalling 84 hours of ICAP intervention and a Therapeutic Intensity Ratio of 52.5% (TIR; Babbitt et al., 2015). The mICAP condition was designed to be delivered four hours per day, three days per week, for two weeks (12 hours per week), totalling 24 hours of mICAP intervention, and a TIR of 30%. Each ICAP and mICAP 1:1 session had a planned session density (i.e., active vs. inactive treatment time) of 1.0 (i.e., 100% of the actual individual session time spent in active treatment), though we anticipated substantial variability. We calculated session density using the number of minutes spent engaged in active impairment-focussed therapy compared to the time spent in the room. This also allowed us to examine sessions that started late or ended early, without the session density calculation being impacted. All participants completed their respective program, with only a small number of absences due to illnesses during the ICAP. At a group level, ICAP and mICAP participants attended a similar proportion of their total treatment hours (i.e., ICAP participants averaged 94% of total scheduled hours, mICAP participants averaged 90.2% of total scheduled hours). As might be anticipated during an intensive program that includes numerous transitions and breaks in a single day, no ICAP or mICAP participant attended all scheduled minutes (i.e., 84 hour dose for the ICAP or 24 hour dose for the mICAP) throughout their respective programs.

We also examined the makeup of the 24 1:1 sessions within the ICAP and the eight 1:1 sessions within the mICAP. At the group level for 1:1 treatment sessions, ICAP and mICAP participants were actively engaged in treatment for similar periods. The average session density for impairment-focused treatment for ICAP participants was 0.79 (i.e., 79% of the 1:1 session was spent in active treatment) and was 0.83 for

mICAP participants (i.e., 83% of the 1:1 session was spent in active treatment). However, there was considerable variability (ICAP session density range = 0.14 – 1.0; mICAP range = 0.15 – 1.0). The remaining time (i.e., average 21% of session for ICAP; 17% of session for mICAP) was spent either in participation-based therapy (e.g., education about aphasia) or was spent as a break, though we did not further delineate this for the current study.

Vignette 1 Reflection

To our knowledge, this analysis marks the first attempt to capture intended versus actual intensity (i.e., schedule of delivery) parameters within an ICAP. At the group level across session types, all actual hours delivered in the ICAP and mICAP were lower than what was designed. This resulted in a lower TIR (by approximately 3% for each group) than what was designed. This measurement was important, as numerous ICAPs report total hours or TIR based on the program's design, yet typically do not detail how much treatment was actually received by participants. Clear reporting of dose and intensity parameters across session types allows for greater understanding of treatment provision within the complex ICAP service delivery model.

To calculate session density, we measured the amount of time ICAP and mICAP participants were actively engaged in 1:1 impairment focussed treatments. Session density therefore does not account for time spent on aspects of aphasia management and treatment beyond the impairment-based approaches (e.g., patient education, communication partner education/training). Thus, lower session density could indicate that the participant required breaks *or* could indicate that the session focussed on communicative participation, communication partner training, psychosocial care, or education. Although 1:1 sessions often focussed on impairment-based treatments, these

sessions were also used for complementary and essential comprehensive care that systematically addressed all components of the WHO-ICF and LPAA. That is, sessions with "low" density (as defined by the amount of impairment-focussed treatment delivered) often contained high amount of counselling, education, and communication partner training, helping to balance the intensive components of the ICAP with the comprehensive care that is necessary to include in not only an ICAP, but also in best-practice aphasia management. Though beyond the scope of this paper, future manuscripts will detail intensity parameters for these comprehensive elements beyond the impairment-focussed treatments currently reported.

One interesting finding that we observed while examining these broader temporal parameters of therapy was that numerous 1:1 treatment sessions during the ICAP (47.8%) and the mICAP (58.3%) began at least three minutes after the scheduled start time (i.e., patient and clinician entered the therapy room and were seated at the table). The nature of an ICAP or mICAP includes transitions between large group, small group, and individual sessions. However, during 1:1 sessions which were often more impairment-focused, there were slow transitions between treatments and between sessions. This was not surprising, given our anecdotal experiences with treatment both within an ICAP and within a more typical usual care setting. However, should clinicians want to maximise time spent in the therapy room with each participant, one solution for the future would be to account for these transitions and intentionally schedule a five-minute buffer between every session, thus making each ICAP/mICAP treatment day slightly longer.

Key takeaways from Vignette 1:

- This initial attempt to track (but not control) actual session delivery compared to intended session delivery revealed no program attrition, but did reveal that no ICAP or mICAP participants received all designed hours.
- 1:1 sessions had a lower than anticipated session density, though tracking only impairment-focussed therapy to calculate session density was a substantial limitation of this study.

Vignette 2: Examining Treatment Intensity Under the Microscope

Vignette Aim: Compare intensity within 1:1 ICAP sessions for two evidence-based treatment approaches

In vignette 2, we compare within-session activity for two evidence-based treatment approaches frequently used during the UMT ICAP: Semantic Feature Analysis (SFA) and Verb Network Strengthening Treatment (VNeST). SFA and VNeST are lexical retrieval treatments that are widely used in clinical practice internationally (Dignam et al., 2023). SFA typically targets noun retrieval and is thought to improve lexical retrieval by activating and strengthening semantic networks (Boyle, 2004). VNeST targets retrieval of verbs and associated content words in the context of a structured sentence, and is thought to improve lexical retrieval by promoting systematic access of verbs, their thematic roles, and their patients (Edmonds et al., 2009). Both treatments involve retrieval of a target word and several non-target associated words. During the ICAP, three participants engaged in both VNeST and SFA, two engaged in VNeST only, and two engaged in SFA only.

Though no ICAP studies to date have provided detailed information on within-session dose, some previous treatment research has detailed intensity for a few within-

session delivery parameters. For example, Conlon and colleagues reported within-session treatment activity for VNeST delivered during a three-week, four hour per day, five day per week (60 hour) ICAP in the context of a randomised controlled trial (Conlon et al., 2020). The authors reported that a total of 15 verbs were targeted during the ICAP, with a minimum of three verbs targeted during daily VNeST treatment sessions. Neither the length of each 1:1 session (in minutes) nor the duration of active treatment for each target verb (in minutes) were reported. As such, it remains unclear what happens within and across each 1:1 ICAP/mICAP treatment session. More detailed within-session intensity reporting using a tool like the MDAF will allow researchers to examine how the active ingredients delivered in an ICAP/mICAP may or may not influence participant outcomes.

What is an episode? According to the MDAF, treatment sessions contain active and inactive episodes. Active episodes (Hayward et al., 2021) occur when the therapy recipient is actively involved in a treatment task (e.g., VNeST, communication partner training). Inactive episodes occur when time spent within the session is not used for treatment (e.g., breaks). For impairment-focussed lexical retrieval treatments such as VNeST and SFA, each time a target word is treated constitutes an episode of treatment (e.g., a trial or cycle of VNeST/SFA). Episodes are defined by their length (e.g., amount of time treating a particular target word), difficulty (e.g., how hard the target word is to retrieve), and intensity (e.g., how many times the target word is treated within the episode). We collected episode-level data for impairment-focused therapy only during every ICAP and mICAP 1:1 treatment session. Of note, in this study, we observed episodes but intentionally did not attempt to prescribe or manipulate episode length, difficulty, or intensity as has been done in other studies (e.g., Conlon et al., 2020;

Harvey et al., 2022). We used *Treatment Dosage Data Collection Logs* for all 1:1 treatment sessions to track episode length and intensity.

Episode length. Every episode (i.e., each time a new target word was presented) was denoted with a start and end time, with any breaks during or between targets recorded. On average, each episode of SFA took 12.28 minutes, and each episode of VNeST took 17.54 minutes. See Table 4.

Episode intensity. We calculated episode intensity for SFA based on proposed active ingredients; that is, therapeutic inputs from the clinician and opportunities for production by the participant (Cavanaugh et al., 2022; Evans et al., 2021). Therapeutic inputs included: the presentation of a picture (i.e., one salient colour photograph) and feature cues provided by the clinician (i.e., six semantic category prompts: group, use, action, association, location, and properties). For a single episode of SFA, each participant would theoretically have seven therapeutic inputs from the clinician (i.e., one picture presentation and six semantic category prompts), one opportunity to produce the target (i.e., name the picture), and six opportunities to produce the associated semantic features. We calculated the average number of opportunities to produce the target per episode and the average number of opportunities to produce non-target associated semantic features per episode. See Appendix F for SFA dosage log.

In most cases, participants received additional chances to produce the target name and features. For example, persons with aphasia may have been prompted to produce multiple object properties, or the clinician might have attempted to increase activity by asking the participant to name the target multiple times. Conversely, at times, participants had fewer opportunities to produce associated features. For example, a clinician might have established that an object's action and use logically overlapped,

and as such, they provided fewer therapeutic inputs and asked the participant to produce only one combined feature for the target.

On average, ICAP participants received an average of 9.5 (median = 7) therapeutic inputs per episode, with 1.7 (median = 1) opportunities to produce the target word, and 7.3 (median = 6) opportunities to produce associated semantic features. In total, ICAP participants averaged an episode intensity of 18.5 proposed active ingredients during each episode of SFA. See Table 4 for more details.

For VNeST, the therapeutic inputs we tracked included: (1) presentation of target verb, (2) presentation of prompts for three subjects, (3) presentation of three objects, (4) prompts for response to three wh- questions (i.e., where, when, and why), (5) prompts for three SVO/SVO+ productions, (6) presentation of 12 yes/no questions regarding syntactic plausibility, (7) verb recall (i.e., "what was the verb we just worked on?"), and (8) any additional clinician provided cues or redirects (e.g., "ok, let's consider someone you don't know personally. Who is someone who might *verb* for their job?"). Theoretically, we determined 26 therapeutic inputs for each episode of VNeST. We further measured each participant's *opportunities for production* within a single episode for generation of (1) three subjects, (2) three objects, (3) when, where, and why responses, and (4) reading of scenarios out loud (SVO/SVO+ production). We also tracked (5) responses to 12 yes/no syntactic judgement questions, and (6) one opportunity for verb recall. See Appendix E for VNeST dosage log. According to these known active ingredients, one episode of VNeST would theoretically have a total of 51 active ingredients; 26 therapeutic inputs from clinician, and 25 patient opportunities for production. Ultimately, however, we observed coding inconsistencies across both graduate student clinicians and undergraduate research assistants (RAs) when

documenting therapeutic input and clinician support. Clinician cues were not always accounted for, and although the coding system in the dosage log included a description and indication to record each clinician prompt, this was infrequently recorded. The data logs we designed did not have a mechanism to account for these inconsistencies, and as such, we do not have a clear picture of how VNeST therapeutic inputs were delivered in the ICAP. We can, however, report our findings for VNeST participant *opportunities for production*. Similar to SFA, we found that some episodes contained more opportunities for production because of repetitive practice and additional chances to expand/elaborate. Opportunities for production were also at times lower due to time constraints or skipped treatment components. Overall, participants had an average of 26.2 opportunities for production per episode during VNeST. See Table 4.

Table 4. Episode Characteristics for SFA and VNeST

Vignette 2 Reflection

Behavioural aphasia treatments are complex and multifaceted. The fundamental challenge in capturing detailed episode-level data is identifying and delineating the ingredients of treatment in real-time during treatment implementation. In this study, both GSCs and trained RAs collected data in-vivo. Despite careful attempts to design data collection tools to capture relevant episode-level variables, our data logs for VNeST did not consistently and accurately capture clinician therapeutic input due in part to a large and complex array of ingredients.

One rationale to examine episode length and intensity of VNeST and SFA was because of the numerous linguistic components in these approaches. Even though SFA has a relatively simple structure and is straightforward to administer, in-vivo data collection was difficult, and our first attempt at capturing known active ingredients may

not be completely accurate or precise. During VNeST, a more complex treatment approach, tracking episode intensity by measuring both therapeutic input and participant opportunities for production is even more challenging. This challenge may also reflect that VNeST is a rich, multimodal treatment approach; the multiple elements are uniquely complex to the language system. Ultimately, the collection of these data must not interfere with treatment delivery. For future research, alternative data collection methods including computer- or tablet-based, or automated methods should be explored.

Finally, we did not attempt to track episode difficulty because larger questions remain about whether *difficulty* should relate to perceived difficulty (i.e., from the participant), objective difficulty (e.g., word frequency, syntactic complexity, cognitive demands of the task), or something else, such as complexity of the treatment environment (Harvey et al., 2023). Exploration of episode difficulty was beyond the scope of this study.

Key takeaways from Vignette 2:

- Tracking episode-level detail was complicated, but provided insight to the complex active ingredients present in therapy approaches.
- At present, there is not an established mechanism to track episode difficulty, which limits current feasibility of the MDAF.

Vignette 3: Magnifying Intensity and Dose Dimensions across Two ICAP Participants

Vignette Aim: Explore variability in within-episode, within-session, and across-session intensity for two ICAP participants.

To better understand intensity and dose for a single participant across all individual sessions within an ICAP, as well as to understand how episode characteristics may vary for a single treatment approach (i.e., VNeST) for two similar participants, we examined differences of treatment delivery and participant activity within individual sessions. We purposefully selected two ICAP participants (represented here using pseudonyms "Jody" and "Stella") matched for age, gender, aphasia severity, and time-post onset, but who had varying personal factors including care partner support, fatigue, and psychological well-being. Previous ICAP literature has explored the role of these variables in understanding ICAP responders and non-responders (Babbitt et al., 2016). We were curious about how varying personal factors might impact treatment delivery as well as overall response to treatment.

ICAP Participant "Jody"

Jody was a 42-year-old, right-handed, bilingual (English and Patois) female who had experienced a left-hemispheric stroke 13 months prior to recruitment. She held an associate's degree, was single, and had been working full-time and living with family members prior to her stroke. Following her stroke, Jody alternated between living with her parents and her sister, who was her primary care partner and who had taken 11 months off of work prior to the ICAP to help care for her sister and aid in her recovery. Jody's sister accompanied her to each day of the ICAP and actively engaged in care

partner training and education during the program.

During pre-treatment assessment, Jody presented with mild anomic aphasia (WAB-R AQ 81.8) and did not report decreased mood or increased stress. She indicated that her quality of life and familial support remained high, despite experiencing aphasia. During the four weeks of the ICAP, Jody attended a total of 83 hours, 8 minutes out of a possible 84 hours of treatment. She attended every 1:1 session, engaging in VNeST, SFA, ORLA, PCA, and RET. Jody's average 1:1 session length was 54.5 minutes (range 44-63 minutes), and she was actively engaged in impairment-focussed therapy tasks about 80% of the time (mean session density 0.79, range 0.3-1.0).

ICAP Participant "Stella"

Stella was a 44-year-old, right-handed, monolingual (English) female who had experienced a left-hemispheric stroke 12 months prior to recruitment. She held a doctoral degree, was single, and had been working full-time and living independently prior to her stroke. Following her stroke, she lived with a friend. Stella attended the ICAP independently, navigating the local paratransit bus system to attend each day of programming. During pre-treatment assessment, Stella presented with mild anomic aphasia (WAB-R AQ 85.4), and reported experiencing significant stress, decreased mood, and low quality of life. She expressed that a number of stressors were impacting her life, including lack of cohesive rehabilitative care, family members who lived far away, and financial concerns.

Throughout ICAP sessions, Stella demonstrated considerable fatigue, and required frequent breaks within and between therapy tasks. She often became visibly

upset raising concerns about stroke-related changes in her life, including loss of employment following her stroke, and about an upcoming shift in her living situation. Her fatigue was substantial enough that the interprofessional pharmacy team associated with the ICAP was consulted regarding possible medication side effects. Upon a thorough medication review, several contraindicated medications that may have been exacerbating fatigue were identified and discussed with Stella's primary care provider.

During the four weeks of the ICAP, Stella attended a total of 79 hours and 48 minutes out of a possible 84 hours. She attended every 1:1 session, engaging in the following treatment approaches: VNeST, PMT, and ORLA. Stella's average 1:1 session length was 55.1 minutes (range 50-60 minutes), and was actively undertaking impairment-focused therapy activities 65% of the time (mean session density 0.65, range 0.08 - 0.92).

Example of Single Session Data Obtained

The following temporal information exemplifies the structure and data tracking for a single impairment-focused 1:1 treatment session for one participant. Jody's twelfth session (i.e., afternoon session during day eight of the ICAP) was scheduled for 60 minutes from 2:30 – 3:30pm. The session began at 2:35pm and ended at 3:29pm (i.e., 54 minutes). Jody was actively engaged in impairment-focused therapy for 42 of 54 minutes, with a session density of 0.77. During this session, she completed SFA for 25 minutes and VNeST for 17 minutes. She took one two-minute break, and the clinician took approximately two minutes to transition between therapy tasks. She also spent eight minutes discussing her personal goals for the next small group ICAP session with the clinician (not accounted for in our current narrow view of session density, but nonetheless important to the session). During 25 minutes of SFA, Jody completed three

episodes (i.e., three picture targets and webs), with 21 therapeutic inputs, 3 opportunities to produce the target word and 17 opportunities to produce associated semantic features. During 17 minutes of VNeST, she completed one VNeST episode (i.e., one target verb), with 30 opportunities for production.

Example of Episode-Level Data Obtained for a Single Treatment Approach Across Two Patients

In addition to examining differences in how programmatic design was carried out, we were also interested in delving into the episode-level characteristics of the MDAF in more detail for each participant. One example involving the VNeST treatment approach is described here.

Both Jody and Stella completed VNeST during the ICAP. Jody completed VNeST during 12/24 1:1 treatment sessions, totaling 266 minutes of active VNeST treatment. Her average independent accuracy (i.e., accuracy during production of three subjects, three objects, 3 SVO sentences, response to where/when/why questions, 12 syntactic judgement tasks, and one recall of the target verb) during VNeST was 77.9% (range = 53.3 - 96.7%, SD = 13.3%). Stella also completed VNeST during 12/24 1:1 treatment sessions, totaling 245 minutes of active VNeST treatment. Her average independent accuracy (i.e., accuracy during production of three subjects, three objects, 3 SVO sentences, response to where/when/why questions, 12 syntactic judgement tasks, and one recall of the target verb) during VNeST was 93.5% (range = 83.5 - 100%, SD = 0.04%). Episode length and intensity for Jody and Stella during VNeST are displayed in Table 5.

Table 5. Differences in episode delivery between two participants

Overall, Jody and Stella spent a similar amount of time engaging in VNeST (266 minutes and 245 minutes, respectively), with similar mean episode intensities (Jody: 24.6 production opportunities; Stella: 25.1 opportunities). However, episode length differed substantially between participants, on average (Jody: 19.3 minutes; Stella 7.9 minutes). Interestingly, despite significant personal factors related to fatigue and motivation for Stella, she typically engaged in more episodes per session and completed each episode more quickly than Jody. Jody's episode intensity was more variable (range 15 – 30 opportunities) than Stella's (range 24 – 26 opportunities). That is, despite similar overall time spent on VNeST treatment, Jody and Stella had a vastly different number of total opportunities for production. Across 266 minutes during 12 1:1 sessions, Jody had 336 total opportunities for production. Across 245 minutes during 12 1:1 treatment sessions, Stella had 780 total opportunities for production.

Noting these differences, the first author reviewed video recordings of three ICAP 1:1 treatment sessions at various points of the program for Jody and Stella that included VNeST. Observationally, it was noted that both clinicians administered VNeST treatment at a similar rate, but three differences were noted: (1) Jody required more time to elicit each response than Stella (i.e., due to more pronounced word-finding difficulties); (2) Jody required more redirects and task explanation each time VNeST was administered; and (3) Jody's clinician engaged in slightly more undirected side conversation than Stella's clinician. These three factors appear to explain the difference in episode length between participants. It is not clear the extent to which differing skill sets and facilitation styles between student clinicians was a factor.

Vignette 3 Reflection

Granular characterisation of individual performance during a single treatment approach (i.e., VNeST) was helpful in the larger context of patient-specific variables, demographic details, and temporal parameters. We felt it was important to understand how episode intensity and episode length might be impacted by a number of larger factors.

We found it interesting that Stella demonstrated more fatigue and had less overall active treatment time than Jody over the course of the entire ICAP (by approximately 200 minutes), but typically had a higher sum of episodes (i.e., number of episodes administered within a single session) during VNeST than Jody. We anticipated that Stella's intensity for VNeST would have been lower than Jody's, given personal factors related to fatigue and motivation, and her overall lower active treatment time. We were further surprised that Stella had substantially higher VNeST episode intensity leading to nearly three times as many total opportunities as Jody during this treatment.

One possible reason that the within-VNeST episode intensity was higher for Stella may have been because the task was more challenging for Jody than it was for Stella. As such, session activity was likely impacted as a function of "difficulty", which although designed as part of the MDAF, we did not explore. Ultimately, we believe this exemplifies why it is important to consider all pieces of intensity using a framework like the MDAF. As future research continues to examine intensity and active ingredients in more detail, we cannot only examine time spent in the session or time spent implementing the treatment, but need to also carefully examine episode difficulty within each session. On the surface, both participants received similar treatment time for VNeST, but upon more granular and microscopic examination, we observed that one participant received a substantially greater dose; far more opportunities for production

and likely more active ingredients. Thus, it is essential that as future research continues to examine intensity and active ingredients in more detail, we cannot only examine time spent in the session or time spent implementing the treatment as a mechanism of intensity, but must also carefully look within a session or within a single treatment to fully comprehend what may be occurring to stimulate change.

Key takeaway from Vignette 3:

- Individual participants show vast differences in the number of active ingredients performed/received (i.e., episode-level differences) in therapy, even when spending approximately the same amount of time performing a treatment.

Discussion

The ICAP and mICAP service delivery models have the potential to provide a viable and effective method of intervention in an intensive manner (Boyer, 2020), though implementation details regarding dose and intensity of these types of programs are not well understood. This study marks the first attempt to characterise ICAP intensity from the macro down to the micro level using the MDAF. Previous ICAP research has documented total treatment duration, number and spacing of days, number and distribution of sessions, Therapeutic Intensity Ratio, and, in some cases, timed duration of sessions (e.g., Babbitt et al., 2015; Griffin-Musick et al., 2020; Off et al., 2019; Nicholas et al., 2021). Within-session activity, such as the proportion of time spent actively engaged in therapy tasks (i.e., session density), and episode length, difficulty, and intensity have not been systematically documented or investigated. The current study captured actual versus intended total treatment dose, and allowed for better understanding of detailed *within-the-hour* 1:1 session parameters, including

temporal and episode characteristics for impairment-focussed treatments.

Having a better understanding of what happens within treatment sessions may allow clinical researchers to examine individual variability in treatment response and, ultimately in the future, help clinicians optimise treatment for individuals living with aphasia. As clinicians, we should ideally individualise intensity with the goal of optimising treatment-related aphasia recovery. However, our ability to understand how individual factors influence dose-response relationships is not yet understood.

Unlike factors such as age, stroke size and location, and time post-onset, which are irreversibly established before a person attends aphasia rehabilitation, treatment-related factors are modifiable (Varkanitsa & Kiran, 2022), especially within treatment sessions (e.g., time spent active within a session, number of opportunities to produce targets). We illustrated how two participants who were closely matched on several variables (i.e., age, time post-onset, biological sex, aphasia severity) demonstrated variability in episode intensity – the number of opportunities to practice producing targets. These differences appear to be due to personal factors including fatigue, mood, motivation, and differences in language strengths and needs. Clearly, person-level variables will ultimately impact treatment delivery in an ICAP or mICAP, both in terms of ability to participate in a more intensive program as well as the capacity to deliver high intensity episodes (Babbitt et al., 2016). If and how this variability influences aphasia recovery remains to be seen. Individual treatment in ICAPs and mICAPs typically incorporates salience into treatment, making sessions highly individualised and holistic (Monnelly et al., 2023; Rose et al., 2021). It is possible that evidence-based treatments carefully tailored to suit personal characteristics and circumstances on a case-by-case basis may elicit a dramatic improvement in individual outcomes and reduce variability in recovery profiles between people with aphasia. Though the recent

RELEASE data (2021) provides helpful information related to weekly hours of therapy for treatment domains, there is not yet further detail established for more specific episode-level parameters.

Limitations and Clinical Implications

ICAP reporting to date has typically underspecified intensity parameters. Though some temporal characteristics have been reported from programs (e.g., total duration, TIR), limited description of what ICAPs often look like within a week, a day, and a single session reduces the ability for clinical researchers to have a complete understanding of the numerous components that make up these comprehensive programs.

Within a single session, understanding episode intensity hinges on identifying and delineating the active ingredients of complex treatments for both impairment-focussed and comprehensive approaches. There is currently no consensus on what constitutes an active ingredient of aphasia treatment, although researchers have begun to shed light on this issue (e.g., Cherney et al., 2022; Gravier et al., 2018; Quique et al., 2019; Evans et al., 2021). Part of this challenge stems from the fact that the treatment approach evidence base often underspecifies details about active ingredients and how to document those active ingredients during clinical delivery. Which ingredients are important and need to be documented is currently left to the clinician and/or researcher to determine. Using shared terminology provided by models like the Rehabilitation Treatment Specification System (RTSS) to explore practical and theoretical treatment constructs may provide a useful framework for understanding the essential components, active ingredients, and underlying mechanisms of action for various treatments (Cherney et al., 2022).

Secondly, our method for collecting treatment activity data within sessions was rudimentary and labour-intensive. Despite careful planning and design of the program (e.g., RAs, intensive training for GSCs, session video-recording), we found it challenging to record active ingredients in vivo. Future work should look to leverage existing technologies to support data collection. Our goal was to investigate the process of an a priori application of the MDAF to the ICAP service delivery model. We chose to focus only on impairment-focussed treatments for the current study, which was a significant limitation and restricted our ability to report many other holistic factors essentially included in treatment. However, this focus on impairment-focussed therapy for 1:1 sessions did allow for greater ease of measurement of episode characteristics, though episode-level detail was still challenging to capture.

Future Directions

We have shown that individuals with similar demographic and aphasia profiles may receive markedly different amounts of impairment-focussed practice within an ICAP. Understanding the factors contributing to this variability, and the impact of this variability on treatment response, is essential to delivering high-quality aphasia rehabilitation services. Future investigations into treatment intensity, particularly within the context of an ICAP or mICAP, will need to investigate aphasia interventions beyond 1:1 impairment-based therapy, such as group-based treatments, and patient education and communication partner training. Within 1:1 sessions, it is recommended that future investigators document session dose beyond impairment-focussed treatment. Clinical researchers should document the amount of time spent in active impairment-focussed therapy, time spent in activity and participation-focussed therapy, and time spent not active (e.g., breaks). In the absence of established active ingredients for each therapy

approach, perhaps session dose may be best understood currently by documenting the ratio of time spent within session focused on language construct(s) (e.g., speaking and writing) and treatment modalities, rather than exploring single episodes of each treatment in depth. We attempted to put intensity under the microscope in this study, but this was challenging due to the lack of known active ingredients established for each treatment approach used during an ICAP. Though it is important to begin to understand dose parameters with greater detail than what has been reported to date, perhaps it is more practical for clinicians to begin to examine intensity at a less detailed level than under the *microscope* but instead under a *magnifying glass,* by documenting the ratio of different constructs (e.g., impairment-focussed therapy versus participation-level treatment versus psychoeducation) provided in therapy. This within-session information can provide a more holistic understanding of each session's dose and structure.

Application of a framework such as the MDAF relies on a priori specification of active ingredients of a treatment approach and clear procedures for documentation and data collection. These will need to be developed for each therapy approach. At present, it is not clear which intensity variables matter most. Ideally, development of novel treatment approaches used within ICAPs or other service delivery models will include early phase studies to find the "optimal dose" (Harvey et al., 2022) of these treatments before scaling up to larger efficacy and effectiveness studies.

Conclusions

The purpose of this study was to track intensity dimensions in increasingly specific levels of detail during an ICAP and mICAP. We captured temporal level parameters for each program, and more detailed episode characteristics for 1:1 impairment-focussed sessions within an ICAP. This was time and resource intensive.

Although clinicians can continue to work to increase provision of and reporting details for high-intensity impairment-focussed treatment, it is important to caution that more is not necessarily better (Pierce et al., 2020; Cherney et al., 2012), and treatment must remain holistic, incorporating elements of the ICF and LPAA models. However, clinicians can work to be more prescriptive. Indeed, we believe that it is essential to remember that although each hour of a treatment day in the context of an ICAP or mICAP will vary substantially, each hour nevertheless matters. To fully understand the influence of dose and intensity on response to treatment, additional research is needed to systematically manipulate broad and narrow treatment intensity parameters and then compare those parameters to a variety of patient outcomes.

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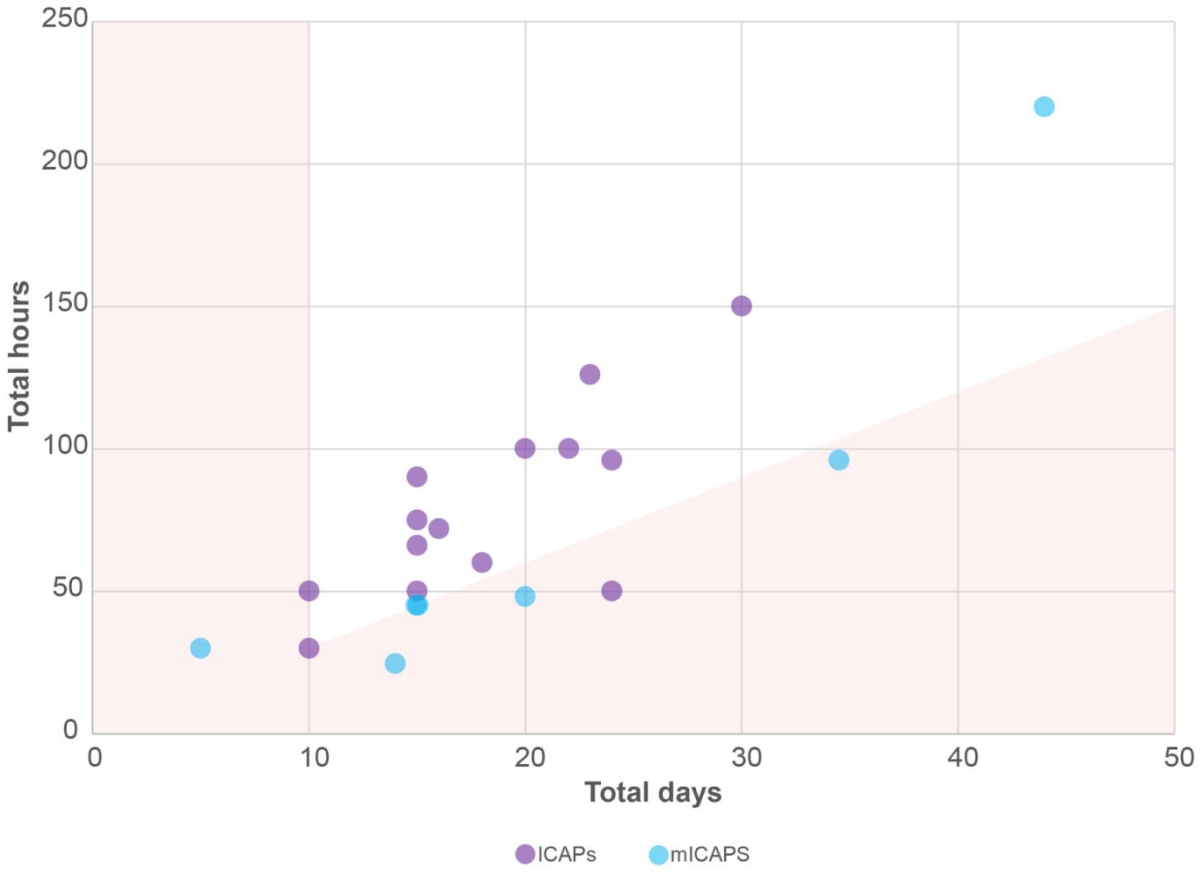
Figure 1. Total provided hours versus total days in previously surveyed ICAPs and mICAPs (Rose et al., 2021)



Note: Shaded red area indicates schedules and doses not meeting ICAP minimum criteria; either fewer than 30 hours total (vertical axis), fewer than two weeks (horizontal axis), or mean daily provision of less than three hours per day (diagonal).

Figure 2. UMT ICAP Intensity Representation within the MDAF

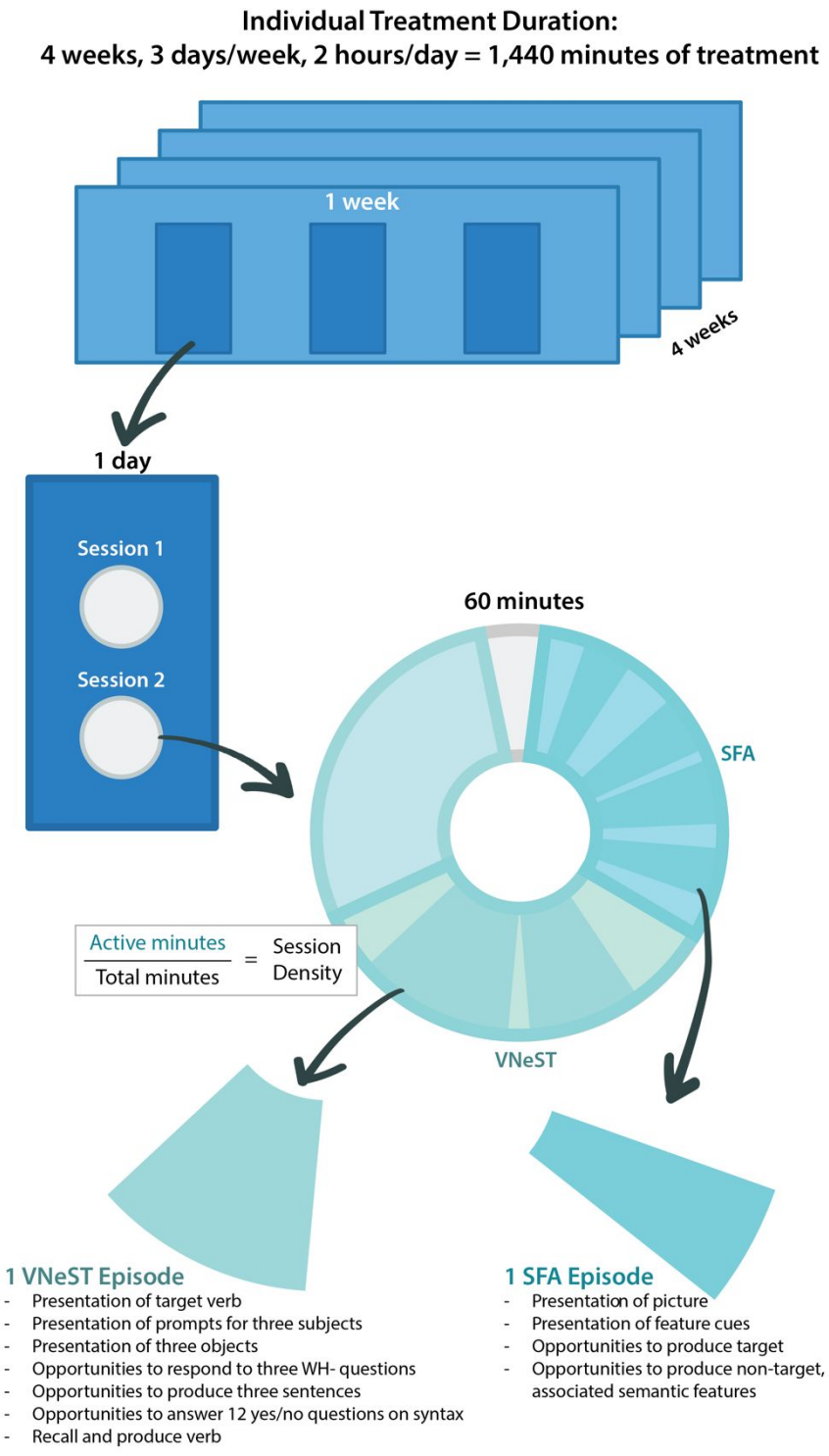


Table 1. Dose, Intensity, and MDAF (Hayward et al., 2021) Descriptors (adapted from Harvey et al., 2023)

	Term	Description
	Dose*	Amount of treatment provided or received (i.e., time or active ingredients)
	Intensity*	*How* dose is delivered over time (i.e., schedule of delivery)
Temporal Parameters	Total duration	Overall length of intervention
	Days (number and spacing)	Number and distribution of days of intervention
	Sessions (number and spacing)	Number and distribution of sessions
	Session length	Timed duration of session(s)
	Session density	Proportion of time actively engaged in therapy compared to inactive
	Episode	Basic unit of treatment which contains the *active ingredients* of a treatment
Episode-Level Characteristics	Episode length	How long task is performed for (in units of time)
	Episode difficulty	How hard the task is to perform
	Episode intensity	How much of the task is performed per episode

Note. MDAF Multidimensional dose articulation framework
*Term not defined explicitly by the MDAF, but used in this study and thus operationally defined in this paper

Table 2. Participant Demographic and Stroke Characteristics

Program Type	Participant Code	Age	Years of Education	Biological Sex	Primary Language and Language of treatment/ testing	Languages Used	History of condition(s) known to impact communication/ cognition	History of Previous Stroke	Lesion Hemisphere	Time Since Onset of Aphasia	Conditions Arising from Neurological Event	Pre-Treatment WAB-R AQ Score, Aphasia Severity & Subtype per WAB-R
ICAP	ICAP-PWA001	53	16	F	English	English	n/a	n/a	Left	9/2021; 21 months	Aphasia, Apraxia of speech, oral apraxia, right hemiparesis, right visual field cut	42/100; Severe Broca's
ICAP	ICAP-PWA002	83	14	F	English	English	n/a	n/a	Unknown; no official stroke diagnosis	Unknown	Aphasia, dysphonia, dysarthria	64.4/100; Moderate Conduction
ICAP	ICAP-PWA003	42	14	F	English	English, Patois	n/a	n/a	Left	4/2022; 13 months	Aphasia, right hemiplegia, attention processing	81.8/100; Mild Anomic
ICAP	ICAP-PWA004	52	13	M	English	English, Spanish	n/a	n/a	Left	1/2021/; 28 months	Aphasia, right hemiparesis, apraxia of speech	47.6/100; Severe Broca's
ICAP	ICAP-PWA005	44	21	F	English	English	n/a	n/a	Left	6/2022; 12 months	Aphasia, right hemiparesis	85.4/100; Mild Anomic
ICAP	ICAP-PWA006	43	12	M	English	English	n/a	n/a	Left	1/23/2022; 1/25/2023; 2/2022; 15 months	Aphasia, apraxia of speech, oral apraxia, right hemiparesis,	16.8/100; Profound Global

											seizures, right visual field cut	
ICAP	ICAP-PWA007	47	18	F	English; Hindi	English, Hindi	n/a	n/a	Left	8/2019; 45 months	Aphasia	82/100; Mild Anomic
ICAP	ICAP-PWA008	62	16	M	English	English	n/a	n/a	Left	3/2023; 3 months	Aphasia	42.4/100; Severe Wernicke's
mICAP	mICAP-PWA001	77	14	M	English	English	n/a	n/a	Left	10/2021; 19 months	Aphasia, apraxia of speech, oral apraxia	25.7/100; Severe Broca's
mICAP	mICAP-PWA002	63	16	M	English	English, French	n/a	n/a	Left	8/2017; 72 months	Aphasia	85.4/100; Mild Anomic
mICAP	mICAP-PWA003	26	16	M	English	English	n/a	n/a	Left	3/2022; 16 months	Aphasia	98.0/100; Not Aphasic per WAB-R criteria
mICAP	mICAP-PWA004	69	16	F	English	English	n/a	AVM in 2001	Left	8/2019; 47 months	Aphasia, oral apraxia, right hemiplegia	55.0/100; Moderate Broca's
mICAP	mICAP-PWA005	69	13	M	English	English	n/a	n/a	Left	9/2021; 22 months	Aphasia, right hemiparesis	71.4/100; Moderate Anomic
mICAP	mICAP-PWA006	60	16	F	English	English	n/a	n/a	Left	11/2021; 20 months	Aphasia, right visual field cut	66.5/100; Moderate Conduction

Note: Participant characteristics followed DESCRIBE reporting standards (Wallace et al., 2023) in addition to initial *Western Aphasia Battery-Revised* aphasia quotient, severity, and subtype.

Table 3. ICAP and mICAP Designed versus Delivered Intensity Parameters

	ICAP		mICAP	
	Planned	**Actual**	**Planned**	**Actual**
Duration	4 weeks		2 weeks	
Days	16 days 4 days per week		6 days 3 days per week	
Sessions	84 sessions 5-6 sessions per day		24 sessions 4-5 sessions per day	
Session length (1:1 sessions)	60 mins	Mean = 56.0 mins; SD = 4.9 mins	60 mins (3 per week) 45 mins (1 per week)	Mean = 51.8 mins; SD = 6.7 mins (60 mins sessions) Mean = 39.2 mins; SD = 7.9 mins (45 mins sessions)
Total hours	84 hours	Mean = 79.0 hours SD = 5.5 hours	24 hours	Mean = 21.7 hours SD = 0.56 hours
1:1 sessions	24 hours	Mean = 22.8 hours SD = 1.7 hours	7.5 hours	Mean = 6.5 hours SD = 0.6 hours
Small group sessions	27 hours	Mean = 25.6 hours SD = 2.1 hours	7.5 hours	Mean = 6.9 hours SD = 0.3 hours
Large group sessions	17 hours, included once weekly hosted lunch	Mean = 16.3 hours SD = 0.8 hours	5 hours	Mean = 4.5 hours SD = 0.5 hours

Interprofessional psychoeducation	10 hours	Mean = 9 hours SD = 1.3 hours	2 hours	Mean = 2 hours SD = 0.1 hours
Community engagement	6 hours	Mean = 5.4 hours SD = 0.8 hours	2 hours	Mean = 1.9 hours SD = 0.1 hours
Hours per week	21 hours per week	Mean = 19.8 hours per week	12 hours per week	Mean = 10.8 hours per week
TIR*	52.5%	49.3%	30%	27.2%
Session density of 1:1 sessions	1.0	Mean = 0.79 SD = 0.15	1.0	Mean = 0.83 SD = 0.16

Notes. Mins Minutes; *SD* Standard Deviation; *TIR* Therapeutic Intensity Ratio. * TIR is the proportion of a 40-hour week spent in treatment.

Table 4. Episode Characteristics for SFA and VNeST

MDAF dimension	SFA	VNeST
Episode Length *How much of task is performed in a given amount of time (i.e., how long it took to get through one episode of a treatment)*	Mean = 12.3 minutes; Standard deviation = 5.2 minutes	Mean = 17.7 minutes; Standard deviation = 6.8 minutes
Episode Intensity *How much of the task is performed per episode; framed in this context based on number of proposed active ingredients (i.e., therapeutic inputs from clinician and participant opportunities for production)*	Proposed Active Ingredients: (1) Therapeutic inputs; (2) Opportunities for production of target word; and (3) Opportunities for production of associated semantic features *Therapeutic Inputs* Mean = 9.5 therapeutic inputs per episode; Standard deviation = 8.1 therapeutic inputs per episode; *Target* Mean = 1.7 opportunities per episode; Standard deviation = 2.1 opportunities per episode; *Non-target associated features* Mean = 7.3 opportunities per episode; Standard deviation = 4.1 opportunities per episode *Total Proposed Active Ingredients* Mean = 18.5 active ingredients per episode; Standard deviation = 13.9 active ingredients per episode	Proposed Active Ingredients: (1) Therapeutic inputs including: (a) Presentation of target verb; (b) Presentation of prompts for three subjects; (c) Presentation of prompts for three objects; (d) Prompts for response to three wh- questions; (e) Prompts for three SVO/SVO+ productions; (f) presentation of 12 yes/no questions regarding syntactic plausibility; (g) verb recall; (h) any additional cues or redirects; (2) Opportunities for independent production during lexical retrieval components of VNeST including: (a) three subjects; (b) three objects; (c) wh- responses; (d) reading scenarios outloud (SVO/SVO+ production); (e) responses to yes/no syntactic judgement questions; (f) opportunity for verb recall *Therapeutic Inputs*

	Unable to track due to inconsistent reporting of clinician prompts/supports *Opportunities for Independent Production* Mean = 26.2 opportunities for production per episode; Standard deviation = 4.3 opportunities per episode

Note: Episode difficulty (i.e., how hard the task is to perform) was not measured

Table 5. Differences in VNeST episode length and intensity between two participants

	ICAP Participant "Jody"	**ICAP Participant "Stella"**
Episode length	Mean = 19.3 minutes per episode; Standard deviation = 6.8 minutes	Mean = 7.93 minutes per episode; Standard deviation = 1.6 minutes
Episode intensity*	Mean = 24.62 production opportunities per episode; Standard deviation = 4.82 opportunities per episode	Mean = 25.09 production opportunities per episode; Standard deviation = 0.52 opportunities per episode
Sum of Episodes	Mean = 2.5 episodes per session; Standard deviation = 1.1 episodes per session	Mean = 1.2 episodes per session; Standard deviation = 0.4 episodes per session

Note. VNeST Verb Network Strengthening Treatment. *Only participant opportunities for production were accounted for in each episode of VNeST, due to inconsistent tracking of clinician therapeutic inputs. Thus, not all active ingredients are accounted for. See Vignette 2 for more information.

Appendix A. The TIDiER guideline template for the UMT ICAP

1. Brief Name	University of Montana (UMT) ICAP; Big Sky Aphasia Program (BSAP)
2. Why	Intensive comprehensive aphasia programs (ICAPs) are an emerging service delivery model for rehabilitation of aphasia following stroke or brain injury. The number of ICAPs across the country/world is increasing due to a desire to approach aphasia rehabilitation from a holistic and biopsychosocial foundation, while also implementing intensive therapy, which has been found to yield effective therapeutic outcomes (Rose et al., 2021). The overarching goal of an ICAP is to maximise communication potential and improve life participation. ICAPs are multi-faceted and take into consideration the many aspects of communication needs faced by persons with aphasia and their family care partners. ICAPs are designed to treat stroke survivors with aphasia and their family care partners - most frequently during the post-acute phase of rehabilitation and recovery from stroke. Participants should be medically stable and able to maintain alertness and attention for the duration of the program. The mission of the Big Sky Aphasia Program (BSAP) at the University of Montana is to provide high-quality, cost-effective, research-driven speech and language therapy to individuals with aphasia and associated deficits resulting from stroke and traumatic brain injury, while serving as a clinical training facility for graduate student clinicians who attend the School of Speech, Language, Hearing, and Occupational Sciences in the Speech-Language Pathology graduate program at the University of Montana. The ICAP at the University of Montana was initially implemented during the summer of 2011 and has been refined over the years, collaborating with interprofessional colleagues including speech–language pathologists, a family counsellor, physical therapists, occupational therapists, and pharmacists. We continue to explore interprofessional experiences in an ongoing manner each year. The BSAP ICAP has clearly defined intensity parameters and is designed to treat the patient-family care partner unit. The BSAP ICAP implements comprehensive, evidence-based therapy to address multiple modalities using strategies, community engagement experiences, and recreational opportunities individualised to each patient–family care partner unit. A primary mission of the BSAP ICAP is to serve families in the Mountain West region of the United States and to serve families living rurally who do not have regular, ongoing access to post-acute aphasia services, while providing training for graduate student clinicians in speech–language pathology and other health care professions. Delivering the ICAP in the university clinic context allows us to keep program costs low to best serve

	families engaged in the rehabilitation process for the chronic condition of aphasia. Stroke survivors with aphasia who participate in the Big Sky Aphasia Program make significant and meaningful gains towards their language function (i.e., speaking, reading, writing, and understanding others) and communicative participation skills (e.g., emailing, texting, holding conversations). Outcomes data collected from our program (2015-2019) show improvements across language domains and nonverbal problem solving (Griffin-Musick, et al., 2020, 2021). Participants with aphasia and their families have also reported an improved sense of well-being, a better understanding of aphasia and stroke rehabilitation, and report that they are better able navigate daily life with aphasia. Qualitative data we have collected (Off et al., 2022) from some of our participants suggests that stroke survivors with aphasia report both challenges (e.g., communicating with people with a wide range of language ability) and successes (e.g., building friends) while working in the cohort model.
3. **What** Physical and informational materials	• Salient materials (e.g., pictures, target words/phrases/sentences, video clips) for all individual, small group, and large group sessions. • Physical stimuli to reference during small and large group sessions (e.g., fishing rods) • Technology including smartphones, tablets, and laptops, associated applications • Aphasia-friendly educational handouts (e.g., aphasia, stroke recovery, communication strategies) • Low-tech AAC (e.g., whiteboards, alphabet boards) • Lesson plans for all sessions • Data collection logs & treatment fidelity logs

4. **What** Procedures	All therapy sessions (i.e., individual, small group, large group) are designed to focus on communicative participation, evidence-based therapy, use of multiple language modalities, and communicative strategies that are individualised to each patient–family care partner unit.
	
	Treatment approaches are selected on an individual basis for each participant. A variety of impairment, activity, and participation-based evidence-based approaches are implemented across participants. For the summer 2023 programming, clinicians chose from the following evidence-based therapies for use in the individual sessions:
	
	• Semantic Feature Analysis (SFA; Boyle et al., 1995)
	• Verb Network Strengthening Treatment (VNeST; Edmonds et al., 2009)
	• Phonological Components Analysis (PCA; Leonard, Rochon, & Laird, 2008)
	• Phonomotor Therapy (PMT; Kendall et al., 2016)
	• Response Elaboration Treatment (RET; Kearns, 1985)
	• Combined Aphasia and Apraxia of Speech Treatment (CAAST, Wambaugh et al., 2014)
	• Oral Reading for Language in Aphasia (ORLA, Cherney, 2010)
	• Copy and Recall Treatment (CART, Beeson, 1999)
	• Intensive Auditory Comprehension Treatment for Severe Aphasia (IAC; Knollman-Porter et al., 2018).
	
	In addition to these evidence-based treatment approaches, individual sessions also included:
	
	• Individualised goal setting using the life participation approach (LPAA; Chapey, 2000) and Life Interest and Value (LIV) cards (Haley et al., 2010)
	• Conversation partner training and education including:
	  ○ Education about aphasia and stroke recovery
	  ○ Barrier tasks using tenets of Promoting Aphasic's Communicative Effectiveness (PACE, Davis, 2005)
	• Use of compensatory strategies (e.g., text to speech applications)
	• Training of word-finding strategies (e.g., circumlocution, self-cueing, writing)
	• AAC training and education
	  ○ Including interprofessional AAC device consultations with Assistive Technology specialists
	• Use of cueing hierarchies
	• Strategy-based reading treatments (e.g., print blocker) and supported reading comprehension using aphasia-friendly text supports (e.g., underlining key words)

	• Functional reading and writing tasks (e.g., sending text messages) • Metacognitive education and training to analyze performance and progress Materials were individualized and salient to each participant/dyad as appropriate for each treatment approach. Stimuli often include video clips, music samples, pictures, written words/phrases/sentences/paragraphs/discourse/short stories/books. Small group sessions often include conversation or narrative-based interventions that encourage multimodality communication. Care partner psychoeducation and communication partner training is often included. Includes home programming developed for the months after treatment ends, with suggestions for computer-based therapy apps (i.e., Constant Therapy) and AAC apps.

5. Who Provided	• The University of Montana ICAP Directors develop and coordinate all aspects of ICAP programming including patient enrollment. The ICAP Directors oversee the implementation of all aspects of the ICAP. ICAP Directors are nationally-certified, state-licensed speech-language pathologists with expertise in aphasia management and aphasia research. • Nationally-certified and state-licensed speech-language pathologists who are trained in ICAP aphasia management provide clinical education and supervision for all ICAP assessment and treatment sessions – directly supervising all speech-language pathology graduate student clinicians. • Interprofessional faculty (e.g., physical therapy, occupational therapy, pharmacy, counselling) who are certified and licensed in their respective disciplines collaborate with the ICAP Directors prior to the start of the ICAP to develop appropriate interprofessional content, experiences, and student supervision. They also collaborate with the ICAP clinical educators/supervisors during treatment as needed. • Graduate student clinicians enrolled in the University of Montana's speech-language pathology program are trained for two weeks prior to the ICAP. They implement all assessment and treatment under supervision in accordance with American Speech-Language Hearing Association (ASHA) standards. Graduate student clinicians in other health professions provide discipline-specific interventions under supervision by appropriate interprofessional faculty.
6. How	All in-person ICAPs are implemented face to face. • Individual therapy includes one participant with aphasia, one graduate student clinician, family care partner [when appropriate]. • Small group sessions include two to four participants with aphasia and their graduate student clinicians. • Large group sessions include six to eight participants with aphasia and their graduate student clinicians (e.g., aphasia community group, aphasia clubs, community engagement activities, opening/closing sessions).
7. Where	The University of Montana in Missoula, Montana, USA; onsite DeWit RiteCare Speech, Language, and Hearing Clinic located in the Curry Health Center.

8. When and How Much	The UMT ICAP typically runs once each year, during May and June. During the Summer of 2023 we piloted a 2-week mICAP in July. ICAP (May and June 2023): Persons with aphasia attended the ICAP for 5-6 hours per day, 4 days per week, for 4 weeks (totaling 84 hours of speech-language treatment). Family care partners were invited to attend a weekly care partner psychoeducation and communication training group, individualised communication partner training sessions, and community engagement activities. mICAP (July 2023): Persons with aphasia attended the mICAP for 4 hours per day, 3 days per week, for 2 weeks (totaling 24 hours of speech-language treatment). Family care partners were invited to attend a weekly care partner psychoeducation and communication training group, individualised communication partner training sessions, and community engagement activities.
9. Tailoring	All therapy approaches, stimuli, and communication support materials were individualised and made salient for each patient/care partner unit.
10. Modifications	Treatment delivery was modified as needed based on factors related to fatigue, motivation, collaborative goals, family care partner involvement, and strengths and weaknesses of the participant. Multimodality support was infused throughout all sessions.
11. How Well (Planned)	For the Summer 2023 ICAP and mICAP we planned to assess treatment fidelity using treatment fidelity logs, within-session data collection logs, and video recordings of all individual treatment sessions as follows: • **Treatment Fidelity Logs:** This log was designed to allow graduate student clinicians to document the total minutes of participant attendance for each session across days and weeks of treatment during the ICAP/mICAP. Clinical supervisors or ICAP Directors were instructed to sign off on this log to ensure accuracy. See Appendix C: ICAP Treatment Fidelity Log. • **Daily Summary Dosage Log:** This log was designed to allow graduate student clinicians and research assistants to document daily participation in individual (i.e., clinician, patient) treatment sessions. This log documented the following: (1) start and end time for each individual treatment session, (2) room/location of treatment, (3) treatment approaches implemented during the session, and (4) start and end time for each treatment approach that was actively implemented (i.e., active treatment time). Video recordings were captured for all individual sessions for all participants to allow for additional fidelity checks. See Appendix D: Daily Summary Log.

	• **Treatment Approach-Specific Data Collection Sheets:** Data collection sheets were created to document the following for each of the 9 evidence-based treatment approaches described above (What, Procedures): (1) start and end time for the treatment approach, (2) treatment targets used during the session, (3) start and end time of each treatment target, (4) treatment-approach specific data collection (e.g., accuracy, opportunities for production, cues). For an example, see Appendix D: VNeST Dosage Log.
12. How Well (Actual)	The ICAP and mICAP sessions were delivered as planned, although the total number of minutes of each session varied as a result of transition time, participant fatigue, and time needed to ambulate between locations.

Appendix B. Assessment Measures

Category of Assessment	Measure	Purpose
Screening Measures	Hearing screening	Determine presence/absence of normal or corrected to normal hearing
	Visual screening/cancellation task	Determine presence/absence of normal or corrected to normal vision; Determine presence/absence of visual neglect or agnosia
	Quick Aphasia Battery (QAB; Wilson et al., 2018)	Determine presence/absence of aphasia and severity of aphasia, resulting in a multidimensional profile of language function for study inclusion
	Language Experience and Proficiency Questionnaire (LEAP-Q; Marian et al., 2007)	Determine self-reported background information on bilingual and multilingual speakers; used to build participant communicative profile and inform treatment
Cognitive-Linguistic Measures	Western Aphasia Battery, Revised, Part 1 (WAB-R; Kertesz, 2006)	Determine type and severity of aphasia, including language profiles for fluency, auditory comprehension, repetition, and naming
	Boston Naming Test, Second Edition, Standard Form (BNT-2; Kaplan, Goodglass, & Weintraub, 2001)	Assess confrontational naming of concrete nouns of decreasing word frequency using a single modality language measure
	Raven's Coloured Progressive Matrices (RCPM; Kertesz, 2006)	Assess non-verbal cognitive and problem solving skills
	Scenario Test (Hilari & Dipper, 2020)	Assess how a person with aphasia conveys everyday messages in an interactive setting
	Informal Discourse Measures: Single picture description and story retell	Provide clinicians information regarding participant's spoken language for expositional narratives (i.e., picture description) and narrative discourse (i.e., story retell)

Communicative Participation Measures	Communicative Participation Item Bank (CPIB; Baylor et al., 2009)	Measure how a condition (i.e., aphasia) interferes with communication across a variety of different daily communicative participation scenarios
	Communicative Effectiveness Index (CETI; Lomas et al., 1989)	Proxy measure (i.e., completed by primary communication partner) to determine functional communication ability of the person with aphasia
Psychosocial Well-Being Measures	Stroke and Aphasia Quality of Life Scale (SAQoL-39; Hilari, Byng, Lamping, & Smith, 2003)	Measure health-related quality of life in individuals with aphasia across four domains (i.e., physical, psychosocial, communication, and energy)
	Modified Perceived Stress Scale (mPSS; Hunting Pompon et al., 2018)	Measure presence and severity of chronic stress for persons with aphasia
	General Health Questionnaire-12 (GHQ-12; Goldberg & Williams, 1988)	Screening tool to assess current mental health elements including anxiety and depression, social dysfunction, and loss of confidence
	Stroke Aphasic Depression Questionnaire-10 (SADQ-10; Sutcliffe & Lincoln, 1998)	Proxy measure (i.e., completed by family care partner or friend) used to rate the frequency at which certain observable behaviors thought to be associated with depressed mood occur

Appendix C. Treatment Fidelity Log

PWA Initials_____ PWA Code_____ Clinician Initials_____

Date	Opening Session	Individual Session #1	Small Group #1	Individual Session #2	Small Group #2	Aphasia Clubs	Aphasia Community Group	Hosted Lunch	Outing	Closing Session	Total Hours Attended	Supervisor Initial
WEEK ONE												
5/30	/30	/60	/60	/60	/60					/30		
5/31	/15					/45	/150	/60	/90			
6/1	/30	/60	/60	/60	/60					/30		
6/2	/30	/60	/60	/60	/60					/30		
WEEK TWO												
6/6	/30	/60	/60	/60	/60					/30		
6/7	/15					/45	/150	/60	/90			
6/8	/30	/60	/60	/60	/60					/30		
6/9	/30	/60	/60	/60	/60					/30		
WEEK THREE												
6/13	/30	/60	/60	/60	/60					/30		
6/14	/15					/45	/150	/60	/90			
6/15	/30	/60	/60	/60	/60					/30		
6/16	/30	/60	/60	/60	/60					/30		
WEEK FOUR												
6/20	/30	/60	/60	/60	/60					/30		
6/21	/15					/45	/150	/60	/90			
6/22	/30	/60	/60	/60	/60					/30		
6/23	/30	/60	/60	/60	/60					/30		

Clinician Signature: Date: Supervisor Signature: Date:

Appendix D. Summary of Daily Individual Sessions

Date:
Patient Initials:
Clinician Name:
Data Collector Name:

Session Start Time	Session End Time	Clinic Room	Treatment Approach	Active Treatment Approach Start Time	Active Treatment Approach End Time	Clinician Cue Types Used	# Opportunities	# Productions	Notes
Total Minutes of Individual Treatment Sessions:									
Total Minutes of Active Treatment:									

Clinician Cue Codes: Independent (I), Semantic (S), Phonemic (P), Written (W), Tactile/Gesture (T), Direct Model (DM), In Unison (U), No Response (NR)

Qualitative comments about participant's daily individual sessions:

Appendix E. VNeST Data Log

Date:
Patient Initials:
Clinician Name:
Data Collector Name:

Verb Network Strengthening Treatment (VNeST) Data Collection Sheet

Start Time	**End Time**	**Target** (i.e., verb)	**Generate 3 Subjects** (WHO) (tally x/3 +code)	**Generate 3 Objects** (WHAT) (tally x/3 +code)	**SVO/ SVO+ Production** (tally + code)	**WHERE** (tally +code)	**WHY** (tally +code)	**WHEN** (tally +code)	**Sentence Judgement** (x/12)	**Recall, Naming of Verb** (Y/N)	**# Patient Productions**	**Time Spent on Target** (min)
Number of targets treated during active treatment time:												

WHO/WHAT/WHERE/WHEN/WHY CODING: Independent (I), Prompt (P), Multiple Choice (MC)
SVO & EXPANDED SENTENCE PRODUCTION CODING: Independent (I), Reads in Unison (U), Repeats Each Word (R); Increased Grammatical Complexity (G)

VNeST Qualitative Comments (Was treatment approach or cuing strategy(s) modified, notes about treatment implementation, notes about additional clinician support):

Appendix F. SFA Dosage Log

Date:
Patient Initials:
Clinician Name:
Data Collector Name:

Semantic Feature Analysis (SFA) Data Collection Sheet

Start Time	**End Time**	**Target** (i.e., noun or verb)	**Independent Production of Target? (Y/N)**	**Group**	**Use**	**Action**	**Association**	**Location**	**Properties**	**# Pt Productions**	**Time Spent on Target** (min)
Number of targets treated during active treatment time:											

Semantic Feature (in grey) Cue Codes: Independent (I), Semantic (S), Phonemic (P), Written (W), Direct Model (DM), No Response (NR)

SFA Qualitative Comments (Was treatment approach or cuing strategy(s) modified, notes about treatment implementation):